



# University of Central Arkansas

## Project Manual

### UCA Schichtl HVAC Upgrades

### UCA-23-040

Bid Opening Date: March 2, 2023 at 10:00 a.m.

Architect

**H + N ARCHITECTS**

1009 Main Street  
Conway, Arkansas 72032  
(501) 327-7525

Associated Architect

**WITSELL EVANS & RASCO, PA**

901 West Third Street  
Little Rock, Arkansas 72201  
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MEP / FP Engineering

**PETTIT & PETTIT CONSULTING ENGINEERS, INC.**

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UCAHNA21.01A  
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**Mandatory Pre-bid meeting: February 16, 2023 at 10:00 a.m. central time**

SECTION 00 0105  
CERTIFICATIONS PAGE

ARCHITECT

I HEREBY CERTIFY THAT THIS PROJECT MANUAL WAS PREPARED BY ME, OR UNDER MY DIRECT SUPERVISION, AND THAT I AM A DULY LICENSED ARCHITECT UNDER THE LAWS OF THE STATE OF ARKANSAS.



NAME: DAVID SARGANT, AIA DATE: 01/17/2023 REG. NO C-44

END OF SECTION

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**INVITATION TO BID**  
**Section 001116**

University of Central Arkansas 201 Donaghey Avenue, Wingo Hall 113 Conway, AR 72034 Issuing Officer: Cassandra McCuien—Smith, Director of Procurement Email: cmccuien@uca.edu Phone: 501-450-5014	Bid #UCA-23-040 Description: <b>Schichtl HVAC Upgrades</b> Construction Coordinator : Andy Anderson V Director of Energy Management Phone: 501-450-3610 Email: ganderson9@uca.edu
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1. You are invited to bid on a General Contract for all labor, methods, material and equipment necessary to provide HVAC upgrades to the Schichtl building located on the campus of the University of Central Arkansas hereinafter termed Owner. The bids shall be on a lump sum basis.
2. There will be a **Mandatory Pre-Bid Conference and site visit held on February 16, 2023 at 10:00 a.m. UCA Wingo Hall 315, Conway, AR 72035.** UCA reserves the right to schedule additional meetings.
3. Owner will receive bids until **10:00 a.m.**, local time, on **March 2<sup>nd</sup>, 2023.** Bids may be mailed or delivered to the UCA Procurement Department, 201 Donaghey Avenue, Wingo 113, Conway, AR 72035, hereinafter termed UCA. Bids received after this time will not be accepted. Bids will be publicly opened and read aloud at the time and date mentioned. Interested parties are invited to attend. Faxed bids exceeding \$20,000.00 will be rejected.
4. UCA, unless designated to another entity, supervises the bidding and awarding of all construction contracts, approves contract change orders, requests for payment and ensures that on-site observations are accomplished.
5. Obtaining contract documents through any source other than the Design Professional is not advisable due to the risks of receiving incomplete or inaccurate information. Contract documents obtained through the Design Professional or their representative(s) are considered the official version and take precedence should any discrepancies occur. Prime bidders will be furnished three (3) sets of bidding documents.
6. Bid Security in the amount of five percent (5%) of the Bid must accompany each Bid in accordance with the Instructions to Bidders.
7. Bidders are hereby notified that any bidder who desires to enter into Contract for this work must comply with disclosure requirements pursuant to Governor Executive Order 98-04. Submission to UCA of completed Disclosure (00850) form will be a condition of the Contract. UCA cannot enter into any contract nor can UCA approve any contract, which does not obligate the contractor to require the submission of Disclosure (00850) forms for subcontractors. The disclosure form will be issued to the successful bidder before the contract is awarded.<sup>90</sup>

8. **UCA reserves the rights to reject any and all bids, and to waive any formalities.** Bidders shall conform to the requirements of the Arkansas licensing laws and regulations for contractors, and shall be licensed before his bid is submitted unless the project is federally funded and therefore excepted by Ark. Code Ann. §17-25-315.
9. Pursuant to Ark. Code Ann. § 22-9-203, UCA encourages all small, minority, and women business enterprises to submit bids for capital improvements. Encouragement is also made to all general contractors that in the event they subcontract portions of their work, consideration is given to the identified groups.

**End of  
INVITATION TO BID  
001116**

## **INSTRUCTIONS TO BIDDERS**

### **Section 002113**

1. **BIDDING DOCUMENTS.** Bidders may obtain complete sets of Contract Documents from the office designated below. Complete sets of Contract Documents must be used in preparing bids; neither Owner nor Design Professional assume responsibility for errors or misinterpretations resulting from the use of incomplete sets of Contract Documents. Obtaining Contract documents through any source other than the Design Professional listed in the Invitation to Bid is not advisable due to the risks of receiving incomplete or inaccurate information, and the bidder runs the risk of basing bidder's proposal on such information. The documents obtained through the Design Professional or his representative(s) or UCA are considered the official version and take precedence if any discrepancies occur. The fact that documents used for bidding purposes are named "contract documents" does not diminish in any way the right of UCA to reject any and all bids and to waive any formality.

Southern Reprographics  
901 West 7th Street  
Little Rock, AR 72201  
(501) 372-4011

A complete set of contract documents may be examined, but not purchased, at the offices of WER Architects, 901 West Third Street, Little Rock, AR. Prime Bidders will be furnished 3 sets of bidding documents at Southern Reprographics, by depositing a check in the amount of \$100.00 per set, payable to WER Architects, the designated design professional. Deposits will be refunded to all prime bidders after the opening of the bids. Prime Bidders requiring additional sets and sub-bidders may purchase Bidding Documents through Southern Reprographics, 901 West 7th Street, Little Rock, AR 72201 (501) 372-4011.

The fact that documents used for bidding purposes are named "contract documents" does not diminish in any way the right of UCA to reject any and all bids and to waive any formality.

2. **EXAMINATION OF DRAWINGS, SPECIFICATIONS AND SITE OF WORK.** Bidder shall examine the Contract Documents and visit the project site of work. Bidder shall become familiar with all existing conditions and limitations under which the Work is to be performed, and shall base bid on items necessary to perform the Work as set forth in the Contract Documents. No allowance will be made to Bidder because of lack of such examination or knowledge. The submission of a Bid shall be construed as conclusive evidence that the Bidder has made such examination.
3. **INTERPRETATION OF CONTRACT DOCUMENTS DURING BIDDING.**
  - 3.1 All references to the Owner shall be interpreted to mean the Agency for whom the work is being contracted.
  - 3.2 If any person contemplating submitting a Bid is in doubt as to the true meaning of any part of the Contract Documents or finds discrepancies in or omissions from any part of the Contract



Documents, they may submit to the Design Professional a written request for an interpretation or correction thereof not later than five (5) calendar days before Bid opening.

3.3 Address all communications regarding the Contract Documents to Terry Jacks with Pettit & Pettit 201 E Markham St # 400, Little Rock, AR 72201 501-374-3731.

3.4 Interpretation or correction of the Contract Documents will be made only by Addendum and will be mailed, faxed or delivered to each Bidder of record by the Design Professional.

3.5 Addenda issued during the bidding period will be incorporated into the Contract Documents.

#### 4. **SUBSTITUTIONS.**

4.1 Materials, products, and equipment described in the Contract Documents establish a standard of required function and a minimum desired quality or performance level, or other minimum dimensions and capacities, to be met by any proposed substitution. Acceptability of substitutions will not be considered during bidding period.

4.2 In some cases, prior approval of material or equipment, or both shall be obtained from Owner in order to obtain the desired color, size, visual appearance, and other features specified.

#### 5. **TYPE OF BID.**

5.1 The Work under this Contract will be awarded under a stipulated sum contract to the lowest responsible base bid amount. No segregated bids or assignments will be considered.

5.2 The estimate of quantities is approximate only and shall be the basis for receiving unit price bids for each item, but shall not be considered by the Bidder as the actual quantities that may be required for the completion of the proposed work. Bidder shall state a unit price for every item of work named in the Proposal. Bidder shall include, in the unit prices, furnishing of labor, materials, tools, equipment, and apparatus of every description to construct, erect, and finish the Work. The unit price bid for the items shall be shown numerically and in the appropriate spaces provided on the Bid Form. Such figures shall be clear and distinctly legible so that no question can arise as to their intent or meaning. Unit price bids and totals shown in the Bid Form shall not include costs of engineering, advertising, printing and appraising.

6. **PREPARATION OF BID.** Bid shall be made on an unaltered Bid Form identical to the form included with the Contract Documents. Fill in all blank spaces and submit one original. Bids shall be signed with name typed below the signature. Where Bidder is a corporation, bids shall be signed with the legal name of the corporation followed by the name of the state of incorporation, contractor's license number issued by the Contractors Licensing Board, and the signature of an authorized officer of the corporation.

6.1 Bids submitted by a "Joint Venture/Joint Adventure" shall be signed by representatives of *each component part* of the Joint Venture. The licenses of *each component part* of the Joint Venture shall also be listed in the bid submittal. Therefore, joint venture bidders shall indicate at least two (2) signatures and two (2) licenses numbers on the Bid Form. Exception: Joint Ventures who have been properly licensed with the Arkansas Contractors Licensing Board as a "Joint

Venture” need only to indicate the joint venture license number on the Bid Form. Joint Venture Bidders shall indicate at least two (2) signatures on the bid form even if they are licensed as a joint venture

**7. BID GUARANTEE AND BONDS.**

- 7.1 Each bid proposal shall include a bid security in the amount of five percent of the total bid offered, if the bid is in excess of \$25,000.00. The bidder will be required to submit a bidder’s deposit, which includes enclosing a cashier’s check payable to the order of UCA drawn upon a bank or trust company doing business in Arkansas or by a corporate bid bond in an amount equal to five (5) percent of the bid. The bidder shall include in the bid the bid bond amount so that the bid represents the total cost to the Owner of all work included in the contract.
- 7.2 The bid bond shall indemnify the Owner against failure of the Contractor to execute and deliver the contract and necessary bond (Performance and Payment Bond) for faithful performance of the contract. The bid bond shall provide that the contractor or surety must pay the damage, loss, cost and expense subject to the amount of the bid security directly arising out of the Contractor’s default in failing to execute and deliver the contract and bonds.
- 7.3 Owner will have the right to retain the bid security of bidders to whom an award is being considered until the Contract has been executed and bonds if required, have been furnished, or until specified time has elapsed so that bids may be withdrawn, or all bids have been rejected.
- 7.4 Failure to execute the Contract and file an acceptable full payment and performance bond and proof of liability insurance within **10** working days after the intent to award has been issued to the bidder shall be just cause for the cancellation of the award and forfeiture of the bid bond, which shall become the property of the agency, not as a penalty but in liquidated damages sustained. Award may then be made to the next lowest responsible bidder, or the work may be rebid and constructed under contract or otherwise as the State determines. The low bidder who fails to execute the Contract and submit an acceptable payment and performance bond and proof of liability insurance will not be permitted to bid on any subsequent advertisement of that project.
8. **PERFORMANCE AND PAYMENT BOND.** Performance and Payment Bonds are not required for bids \$50,000.00 or under, except for roofing projects. For work exceeding \$50,000.00, the bidder shall furnish a Performance and Payment Bond in the amount equal to 100 percent of contract price, on a form identical to the Arkansas Statutory Performance and Payment Bond Form included with the Contract Documents as security for faithful performance of the Contract and payment of all obligations arising thereunder within ten days after receipt of the Intent to Award. The bond shall be written by a surety company qualified and authorized to do business in the State of Arkansas. The bond shall be executed by a resident or non-resident agent licensed by the State Insurance Commissioner, to represent the surety company. The bond shall be written in favor of the Owner. Bidder shall file the bond with the Circuit Clerk in the county where the Work is to be performed. Failure to deliver said bonds, as specified, shall be considered as having abandoned the Contract and the bid security will be retained as liquidated damages. The bidder shall include in the bid the Performance and Payment bond amount so that the bid represents the total cost to the Owner of all work included in the contract.

9. **SUBCONTRACTORS.** Name of principal subcontractors shall be listed where indicated on the Bid Form in accordance with Ark. Code Ann. § 22-9-204 and the contract documents. All prime contractors, as a condition to perform construction work for and in the State of Arkansas, shall use no other subcontractors when the subcontractor's portion of the project is \$50,000.00 or more, except those qualified and licensed by the Contractors Licensing Board in Mechanical (HVAC), Plumbing, Electrical and Roofing.

A bidder should request clarification from the Design Professional if the bidder determines a type of work (mechanical –indicative of HVACR; electrical – indicative of wiring and illuminating fixtures; plumbing; roofing and sheet metal work - indicative of roofing application) is a component of the project, but space has not been provided on the bid form for the listing of such or if the bid form lists a type of work that is not a component of the project. Clarification should be made in accordance with Instruction 3.2.

- 9.1 For those bids where the listed subcontract work is \$50,000.00 or more, the prime contractor must make a decision as to which subcontractor he intends to use. The prime contractor shall place the names of each subcontractor and indicate whether the amount of the listed work is \$50,000.00 or more in the space provided on the Bid Form. The prime contractor may use his own forces to do the listed work, however, if the listed work is \$50,000.00 or more, the prime contractor must be qualified and licensed by the Arkansas Contractors Licensing Board to perform the listed work. Once the prime contractor determines his own forces will be used, he shall place his name, and indicate in the space provided on the Bid Form whether the amount of the listed work is \$50,000.00 or more. Failure to complete the form correctly shall cause the bid to be declared non-responsive, and the bid will not receive consideration.
- 9.2.1 In the event the amount of the listed subcontract work is below \$50,000.00, the Prime Contractor shall place the names of the person or firm performing the work and indicate in the space provided on the Bid Form whether the listed work is under \$50,000.00. Failure to complete the form correctly shall cause the bid to be declared non-responsive, and the bid will not receive consideration.
- 9.2.2 It shall be mandatory that any subcontractors listed in (A) – (D) on the Bid Form by the Prime Contractor is awarded a contract under Ark. Code Ann. § 22-9-204. Prime Contractors who submit a bid listing unlicensed subcontractors or use unlicensed subcontractors on a state project or any subcontractor not licensed by the Contractors Licensing Board who perform work having a value of \$50,000.00 or more on a state project are subject to a civil penalty, after notice and hearing, of not less than \$250.00 nor more than \$500.00 and may be suspended from bidding on state projects. In the event that one (1) or more of the subcontractors named by the prime contractor in his successful bid thereafter refuse to perform his contract or offered contract, the prime contractor may substitute another subcontractor, after having obtained prior approval from the design professional and UCA.
- 9.3. Electrical License Requirement
- a. No person shall perform electrical work on the contract without possessing an Arkansas State Master or Journeyman License from the Arkansas State Electrical Examiners Board.

All electrical work and apprentice electricians shall be supervised by a Master or Journeyman Electrician on a one to one ratio.

- b. All electricians shall have a copy of their license with them and shall be required to show it to an appropriate inspector upon request.

9.4 Pursuant to Ark. Code Ann. § 22-9- 404, the Bidder may require listed subcontractors (mechanical, plumbing, electrical and roofing/sheet metal) whose bid to the Contractor exceeds \$50,000.00 to provide a Performance and Payment Bond to the Bidder.

10. **SUBMITTAL.** Submit bid on the Bid Form in an opaque, sealed envelope. Identify the envelope with: project name and number, name of Bidder, and Arkansas Contractors License number; only one bid shall be submitted per State Contractors license number. Submit bids in accordance with the Invitation to Bid. All blanks on the form shall be filled out in ink or be typewritten. Erroneous entries, alterations, and erasures shall be lined out, initialed by the Bidder, and the corrected entry inserted on the Bid Form.

11. **MODIFICATION AND WITHDRAWAL.** Bidder may withdraw bid at any time before bid opening and may resubmit up to the date and time designated for receipt of bids. No bid may be withdrawn or modified after time has been called for the bid opening. Oral modifications to bids will not be considered. Bidder may submit written modifications to bid in writing or by facsimile at any time prior to the expiration of the bidding time and date and shall so **state the word modification(s)** as to not reveal the amount of the original bid. Facsimile modifications shall require written confirmation of the Bidder's signature within 24 hours after bid opening. Should the modification reveal the total bid amount the entire bid will be rejected.

12. **DISQUALIFICATION OF BIDDERS.** The State shall have the right to disqualify bids (before or after opening), which includes but is not limited to, evidence of collusion with intent to defraud or other illegal practices upon the part of the Bidder, to reject a bid not accompanied by the required bid security or by other data required by the Contract Documents, or to reject a Bid which is in any way incomplete or irregular.

13. **APPLICABLE LAWS.**

13.1 Labor. Contractors employed upon the work will be required to conform to the labor laws of the State of Arkansas and the various acts amendatory and supplementary thereto, and to all the laws, regulations, and legal requirements applicable thereto.

13.2 Discrimination. Bidder shall not discriminate against any employee, applicant for employment, or subcontractor as provided by law. Bidder shall be responsible for ensuring that all subcontractors comply with federal and state laws and regulations related to discrimination. Upon a final determination by a court or administrative body having proper jurisdiction that the Bidder has violated state or federal laws or regulations, the Owner may impose a range for appropriate remedies up to and including termination of the Contract.

13.3 Taxes. Bidder shall include in the bid all state sales tax, social security taxes, state unemployment insurance, and all other items of like nature. It is the intent that the bid shall represent the total cost to the Owner of all work included in the contract. There are no

provisions for a contractor to avoid taxes by using the tax exempt number of a state agency, board, commission or institutions. Said taxes shall be included in the bid price.

13.4 State licensing laws for Contractors.

13.5 Disclosure. Potential Bidders are hereby notified that any bidder who desires to enter into a contract not exempted from the disclosure requirements, that disclosure is a condition of the Contract and that UCA cannot enter into any such contract, nor approve any such contract, for which disclosures are not made and the verbiage of paragraphs a, b, and c below will be included in the body of any contract awarded.

Potential Bidders are hereby notified that:

- a. Disclosure is required to be a condition of any present or future subcontract for which the total consideration is greater than twenty-five thousand (\$25,000)
- b. The Contractor shall require any present or future subcontractor, for which the subcontract amount is greater than \$25,000.00, to complete and sign the Contract and Disclosure and Certification. The contractor shall ensure that any agreement, current or future between the contractor and a subcontractor for which the total consideration is greater than \$25,000.00 shall contain the following:

*Failure to make any disclosure required by Governor Executive Order 98-04, or any violation of any rule, regulation or adopted pursuant to that Order, shall be material breach of the term of this subcontract. The party who fails to make the required disclosure or who violates the rule, regulation, or policy shall be subject to all legal remedies available to the contractor.*

- c. The Contractor shall transmit a copy of the subcontractor's disclosure form to the agency and a statement containing the dollar amount of the subcontract within ten (10) days upon receipt of subcontractor's disclosure.

Note: A copy of the "Contract and Grant Disclosure and Certification Form" is included at the end of this division.

13.6 Minority Participation: Pursuant to Ark. Code Ann. § 22-9-203, the State encourages all small, minority, and women business enterprises to submit bids for capital improvements. Encouragement is also made to all general contractors that in the event they subcontract portions of their work, consideration is given to the identified groups.

13.7 The bidding, award and administration of the contract shall be made pursuant to Ark. Code Ann. §14-4-1401 et seq., Ark. Code Ann. § 22-9-101 et seq., Ark. Code Ann. § 22-2-101 et seq.

14. **LIQUIDATED DAMAGES.** The amount of liquidated damages to be assessed shall be in accordance with the amount indicated in the Contract. Bidder understands and agrees that under the terms of the Contract to be awarded, if the Contractor fails to complete the work within the time limit specified in the Contract, the Contractor shall pay the Owner as Liquidated Damages, and not in the nature of a penalty the sum specified in the Bid Form for each day

completion is delayed. It is further understood and agreed by bidder that the said sum fixed as Liquidated Damages is a reasonable sum considering the damages that Owner will sustain in the event of any delay in completion of the Work, and said sum is herein agreed upon and fixed as Liquidated Damages because of difficulty in ascertaining the exact amount of damages that may be sustained by such delay.

15. **PREBID CONFERENCE.** There will be a **Mandatory Pre-Bid Conference meeting held on February 16, 2023 at 10:00 a.m. central time, UCA, 201 Donaghey Avenue, Wingo Room 315, Conway, AR 72035.** All prospective bidders are encouraged to attend. UCA reserves the right to reschedule the Pre-Bid Conference or to schedule additional conferences.
16. **OPENING.** Bids will be opened as identified in the Invitation to Bid.
17. **EVALUATION AND CONSIDERATION OF BIDS.** It is the intent of UCA to award a Contract to the lowest responsive qualified Bidder provided the bid has been submitted in accordance with the requirements of the Contract Documents and does not exceed the funds certified for the project by more than 25%. UCA shall have the right to waive any formalities in a bid received and to accept the bid which, in UCA's judgment, is in its best interests and upon approval of UCA. UCA shall have the right to accept any or all bids for a period not to exceed 30 days.
  - 17.1 Tie Bids. If two or more sealed bids are equal in amount, meet Bidding Document requirements, and are the lowest received by the time of the bid opening, then the apparent low bidder will be determined by lot (placing the name of the tie bidders into a container and drawing one name). The drawing will be conducted by UCA personnel and another person so designated by UCA in the presence of a witness and the tie bidders or representatives. The witness shall be an employee of the State of Arkansas. Documentation of the drawing shall be included on the bid tabulation and be signed by those present. Nothing in the above and foregoing will diminish UCA's reserved right to reject any and all bids and to waive any formalities.
18. **EXECUTION OF CONTRACT.**
  - 18.1 The apparent low Bidder shall be prepared, if so required by the Owner, to present evidence of experience, qualifications, and financial ability to carry out the terms of the Contract.
  - 18.2 The successful Bidder will be required to execute an Agreement with the Owner on a form identical to the Agreement Form included with the Contract Documents and the Performance and Payment Bond and Certification of Insurance within ten days after receipt of the Intent to Award. Failure of the Bidder to do so may result in the Bidder being rejected and could result in disqualification and forfeiture of bid bond.
  - 18.3 The successful Bidder will be required to furnish Owner with proof of insurance, as prescribed by the General and Supplementary Conditions.

**End of  
INSTRUCTIONS TO BIDDERS  
002113**

**SECTION 00 3100  
AVAILABLE PROJECT INFORMATION**

**PART 1 GENERAL**

**1.01 EXISTING CONDITIONS (NOT USED)**

- A. Certain information relating to existing surface and subsurface conditions and structures is available to bidders but will not be part of Contract Documents, as follows:
- B. UCA Schichtl Hall Equipment Procurement Package:
  - 1. UCA has purchased and secured the HVAC equipment to be installed in the HVAC Upgrades Package. Reference Package for items to be owner provided.
- C. UCA Schichtl Hall Renovation Bid set:
  - 1. The UCA Schichtl Hall HVAC Upgrades Package is intended to be completed in tandem with the UCA Schichtl Hall Renovations Package. While the scopes of work are separate, the GC will need to coordinate the schedule with the renovations package.

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION**

**3.01 OBTAINMENT OF PERMITS**

- A. Contractor to obtain the following required permits, at no cost to Owner:
  - 1. Building Permit for all trades.
- B. Building Permit Procedures: When required to obtain this permit:
  - 1. Complete and file permit application(s) with appropriate agency.
    - a. Submit application within five days of the Notice to Proceed.
  - 2. Pay required fees.
  - 3. Advise Architect if submission of modified documents is necessary to have the authorities having jurisdiction complete the plan review and approval process. Submit modified documents expeditiously.
  - 4. Do not commence execution of any item of work for which a permit has not been obtained.

**END OF SECTION**

**BID FORM**  
**Section 004113**

**Bid Time: 10:00 a.m.**  
**Bid Date: March 2, 2023**  
**Bid Opening Location: UCA**  
**Wingo Hall Room 315**

BID FROM:

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

BID TO: University of Central Arkansas

PROJECT: UCA-23-040 Schichtl HVAC Upgrades

Gentlemen:

1. Having carefully examined the Contract Documents for this project, as well as the premises and all conditions affecting the proposed construction, the undersigned proposes to provide all labor, materials, services, and equipment necessary for, or incidental to, the construction of the project in accordance with the Contract Documents within the time set forth, for the lump sum base bid of:

\$ \_\_\_\_\_

Dollar Amount Is To Be Shown Numerically

2. Ark. Code Ann. §22-9-212 requires the contractor to indicate on this bid form the cost of Trenching Safety Systems. **FAILURE TO SHOW THIS COST IF APPLICABLE WILL INVALIDATE THE BID.** (NOTE THIS COST SHALL BE INCLUDED IN THE ABOVE BASE BID)

\$ \_\_\_\_\_

Dollar Amount Is To Be Shown Numerically.

3. Completion Date: BIDDER AGREES THAT THE WORK WILL BE SUBSTANTIALLY COMPLETE AND READY FOR FINAL PAYMENT IN ACCORDANCE WITH THE CONTRACT DOCUMENTS BY **300 CALENDAR DAYS** FROM NOTICE TO PROCEED (RECEIPT OF PURCHASE ORDER WILL SERVE AS THE NOTICE TO PROCEED.).
4. The undersigned, in compliance with the Contract Documents for the construction of the above named project, does hereby declare:
  - a. That the undersigned understands that UCA reserves the right to reject any and all bids and to waive any formality.
  - b. That if awarded the Contract, the undersigned will enter into an Agreement, on a form identical to the form included in the Contract Documents and execute required performance and payment bonds within ten (10) days after receipt of the Intent to Award, will commence work after the purchase order has been issued and the notice to proceed has been given by the Construction Coordinator, and will complete the Contract fully by Completion Date indicated.



Should the undersigned fail to fully complete the work within the above stated time, he shall pay the Owner as fixed, agreed and liquidated damages and not as a penalty, the sum of five hundred dollars (\$500) for each **calendar** day of delay until the work is completed or accepted.

- c. The undersigned further agrees that the bid security payable to Owner and accompanying this proposal shall become the property of the Owner as liquidated damages if the undersigned fails to execute the Contract or to deliver the required bonds to the Owner within three (3) days from receipt of the Intent to Award as these acts constitute a breach of the Contractor's duties.
  - d. That this bid may not be withdrawn for a period of thirty (30) days after the bid opening.
  - e. The undersigned understands that the Owner's intent is to construct all facilities proposed within the limits established by the funds appropriated for the project.
  - f. The names of subcontractors and the nature of the work to be performed by each one have been included on the Bid Form.
  - g. Bids submitted by a "Joint Venture/Joint Adventure" shall be signed by representatives of *each component part* of the Joint Venture. The licenses of *each component part* of the Joint Venture shall also be listed in the bid submittal. Therefore, joint venture bidders shall indicate at least two (2) signatures and two (2) licenses numbers on the Bid Form. Exception: Joint Ventures who have been properly licensed with the Arkansas Contractors Licensing Board as a "Joint Venture" need only to indicate the joint venture license number on the Bid Form. Joint Venture Bidders shall indicate at least two (2) signatures on the bid form even if they are licensed as a joint venture
6. The following documents are attached to and made a condition of this Bid.
    - a. Bid security.
    - b. Listing of Mechanical, indicative of heating, air conditioning, ventilation, and refrigeration, Plumbing, Electrical, indicative of wiring and illuminating fixtures and Roofing and sheet metal work, indicative of roofing application Subcontractors, if required.
  7. The undersigned acknowledges receipt of and inclusion as a part of the Contract Documents the following addenda:

No. \_\_\_\_\_ Dated \_\_\_\_\_

No. \_\_\_\_\_ Dated \_\_\_\_\_

No. \_\_\_\_\_ Dated \_\_\_\_\_

No. \_\_\_\_\_ Dated \_\_\_\_\_

## **8. LISTING OF MECHANICAL, PLUMBING, ELECTRICAL, ROOFING, SHEETMETAL AND OTHER SUBCONTRACTORS**

**ALL MECHANICAL, PLUMBING, ELECTRICAL, ROOFING AND SHEETMETAL, TRENCHING, ETC. SUBCONTRACTORS SHALL BE LISTED REGARDLESS OF QUALIFICATIONS, LICENSURES OR WORK AMOUNT. BIDDERS SHOULD CONSULT THE PROJECT MANUAL ON HOW TO FILL OUT THIS FORM.**

**IF APPLICABLE, FAILURE TO LIST THE NAME OF THE SUBCONTRACTOR IN THE SPACE PROVIDED SHALL CAUSE THE BID TO BE DECLARED NON-RESPONSIVE AND THE BID WILL NOT RECEIVE CONSIDERATION. Refer to Section 002113, Instruction to Bidders.**

**PROJECTS NOT REQUIRING THE STATED WORK CAN BE NOTED AS NONAPPLICABLE (N/A).**

**IF THE PRIMARY CONTRACTOR IS PERFORMING THE WORK THEY MUST LIST THEIR NAME IN THE BLANKS BELOW.**

Indicate the Name(s), of each entity performing the listed work:

MECHANICAL (Indicative of HVACR): **License #:**

\_\_\_\_\_  
Is the amount of work \$50,000.00 or over: Yes\_\_\_ No \_\_\_

PLUMBING: **License #:**

\_\_\_\_\_  
Is the amount of work \$50,000.00 or over: Yes\_\_\_ No \_\_\_

ELECTRICAL: (Indicative of wiring and illuminating fixtures) **License #:**

\_\_\_\_\_  
Is the amount of work \$50,000.00 or over: Yes\_\_\_ No \_\_\_

ROOFING AND SHEETMETAL (Indicative of roofing applications) **License #:**

\_\_\_\_\_  
Is the amount of work \$50,000.00 or over: Yes\_\_\_ No\_\_\_

TRENCHING (Indicative of trenching applications) **License #:**

\_\_\_\_\_  
Is the amount of work \$50,000.00 or over: Yes\_\_\_ No\_\_\_

OTHER (Indicative of other applications) **License #:**

**Contractor Only:**

Is the amount of work \$50,000.00 or over: Yes\_\_\_ No\_\_\_

Respectfully Submitted:

Name of Bidder (Typed or Printed):\_\_\_\_\_

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

BY: (Signature and Title):\_\_\_\_\_

Contractor's License Number or Contractor's (Joint Venture) License Number(s):

\_\_\_\_\_

Telephone Number: \_\_\_\_\_

Fax Number: \_\_\_\_\_

Federal ID or SSN: \_\_\_\_\_

Date of Bid: \_\_\_\_\_

**End of  
BID FORM  
004113**

**AGREEMENT FORM**  
**Section 005213**

THIS AGREEMENT entered into this \_\_\_\_\_ day of \_\_\_\_\_, 2023 by and between \_\_\_\_\_, hereinafter referred to as the Contractor, and the University of Central Arkansas, hereinafter referred to as Owner, in accordance with Ark. Code Ann. § 22-2-101 et seq.,

WITNESSETH:

1. That for and in consideration of the payment by the owner in the amount of \$\_\_\_\_\_ to be made as set forth in the Contract Documents, the Contractor hereby agrees to furnish all tools, labor, equipment, and materials, and to build and construct that certain project in **Faulkner County**, designated as:

Project #: **UCA-23-040**

Project Name: **Schichtl HVAC Upgrades** consisting of construction, more specifically described in the Contract Documents attached hereto and incorporated herein by reference. Contract Documents include the following: the Agreement Form (this instrument); the Invitation to Bid; Instruction to Bidders; Bid Form; all Addenda; Performance and Payment Bond (**MUST BE FILED IN FAULKNER COUNTY**); General and Supplementary Conditions; Drawings and Specifications. All construction shall be in exact accord with the Contract Documents filed with the UCA Procurement Department, located at 201 Donaghey Avenue, Wingo 113 in Conway, AR. UCA Procurement Department shall have direct contract supervision. Said construction shall be to the satisfaction of the UCA Procurement Department, and in accordance with the laws of the State of Arkansas, and the work shall be subject to inspection and approval at all times by the appropriate state and federal agencies.

2. Owner may at any time during the progress of the work alter, change, subtract from, or add to said Contract Documents without violating this Agreement or the terms thereof. Said changes, alterations, subtractions, or additions shall be set forth in writing in a document referred to as a "Change Order." Said document shall not be effective unless approved by the UCA Procurement Office. Once effective, the Change Order shall be attached hereto and incorporated herein by reference and shall be made a condition or term of the Contract Documents.

3. The Contractor agrees, for the consideration set forth in the Bid Form, to begin work after the receipt a purchase order and verbal notice to proceed from the construction coordinator has been issued. If the Contractor fails to complete the work within the 300 day time limit specified, he shall pay to the Owner, as liquidated damages and not in the nature of a penalty, the sum specified in the Bid Form of for each calendar day delayed, it being understood and agreed between the parties hereto that the said sum fixed as liquidated damages is a reasonable sum, considering the damages that Owner will sustain in the event of any such delay, and said amount is herein agreed upon and fixed as liquidated damages because of difficulty of ascertaining the exact amount of damages that may be sustained by such delay. The said sum shall be deducted from the final amount of estimate due the Contractor.

4. Should Contractor be delayed in the execution or completion of the work by the act, neglect or default of UCA, or by any damage by fire, weather conditions or other casualty or event for which the contractor is not responsible, or by general strikes or lockouts caused by acts of employees, then any extended period shall be determined and fixed by the Owner with approval given by UCA Procurement Department. Said extended period shall be the time for a period equivalent to the time lost by reason of any or all of the causes aforesaid, but no such allowance shall be made unless a claim therefore is presented in writing to the Owner within seven calendar days of the occurrence of the event causing the delay.

5. It is mutually agreed between the parties that in the performance of this contract, Contractor is acting independently and in no sense as Agent of the State. Contractor shall not let, assign, or transfer this contract or any interest therein, without the written consent of the Owner.

6. It is agreed and understood between the parties hereto that the Contractor shall accept and the Owner will pay for the work, at the prices stipulated in the Contract Documents, such payment to be in the form of legal tender, and the payment shall be made at the time and in the manner set forth in the Contract Documents.

7. Any laborer or mechanic employed by the Contractor or any Subcontractors for this project, directly on site for the work covered by the Contract Documents, shall be paid a rate of wages required by the Contract Documents. If the Owner discovers that wages less than the rate of wages specified by the Contract Documents have been or are being paid, then the Owner, after giving written notice to the Contractor, will terminate the Contractor's right to proceed with the project work or such part of the work as to which there has been a failure to pay the required wages and to prosecute the work to completion by contract or otherwise, and the Contractor and his sureties shall be liable to the Owner for any excess costs occasioned thereby.

8. Contractor shall promptly repair, at his own expense and to the satisfaction of the UCA Procurement Department, damage done by him or his employees or agents at the work site, or to the public property or buildings, or both, and will save UCA harmless from all claims of any person for injury to person or to property occasioned by his act, or the acts of his employees or agents, while in the execution of the work specified.

9. The Owner, or both may terminate this agreement to the extent Owner's funds are no longer available for expenditures under this agreement.

10. Failure to make any disclosure required by Governor's Executive order 98-04, or any violation of any rule, regulation, or policy adopted pursuant to that Order, shall be a material breach of terms of this contract. Any contractor, whether an individual or entity, who fails to make the required disclosure or who violates any rule, regulation, or policy shall be subject to all legal remedies available to the Agency.

a) The contractor shall prior to entering any agreement with any subcontractor, for which the total consideration is greater than \$25,000.00, require the subcontractor to complete a Contract and Grant Disclosure and Certification Form. The contractor shall ensure that any agreement, current or future between the contractor and a subcontractor for which the total consideration is greater than \$25,000.00 shall contain the following:

Failure to make any disclosure required by Governor Executive Order 98-04, or any violation of any rule, regulation or adopted pursuant to that Order, shall be a material breach of the term of this subcontract. The party who fails to make the required disclosure or who violates the rule, regulation, or policy shall be subject to all legal remedies available to the contractor.

(b) The Contractor shall, within ten days of entering into any agreement with a subcontractor, transmit to UCA Procurement Department; a copy of the Contract and Grant Disclosure and Certification Form (00850) completed and signed by the subcontractor and a statement containing the dollar amount of the subcontractor.

(c) The terms and conditions regarding the failure to disclose and conditions which constitutes material breach of contract and rights of termination and remedies under the Executive Order 98-04 are hereby incorporated within.

11. Nothing in this Contract shall be construed to waive the sovereign immunity of the STATE OF ARKANSAS or any entities thereof.

Executed by the parties who individually represent that each have the authority to enter into this Contract.

CONTRACTOR:

By: \_\_\_\_\_  
(Signature)

\_\_\_\_\_  
(Print Name)

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

Firm: \_\_\_\_\_

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

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

APPROVED: **UNIVERSITY OF CENTRAL ARKANSAS**

By: \_\_\_\_\_  
(Signature)

\_\_\_\_\_  
(Print Name)

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

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

**End of  
AGREEMENT FORM  
005213**

**PERFORMANCE BOND AND PAYMENT BOND  
SECTION 006113**

We \_\_\_\_\_, hereinafter referred to as Principal, and \_\_\_\_\_, hereinafter referred to as Surety, are held and firmly bound unto \_\_\_\_\_, as obligee, hereinafter referred to as Owner, in the initial Contract amount of \$ \_\_\_\_\_, said amount to be deemed a performance bond payable to Owner under the terms of this Performance and Payment Bond Agreement. The Principal and Surety state that the Surety is a solvent corporate surety company authorized to do business in the State of Arkansas.

Principal has by written agreement dated \_\_\_\_\_ entered into a capital improvement contract (Contract) with the Owner for: \_\_\_\_\_

---

The above referenced Contract is incorporated herein by reference.

Under this Performance and Payment Bond Agreement, the Principal and Surety shall be responsible for the following:

a. The Principal shall faithfully perform the above referenced Contract, which is incorporated herein by reference and shall pay all indebtedness for labor and materials furnished or performed under the Contract.

b. In the event that the Principal fails to perform the Contract, the Principal and the Surety, jointly and severally, shall indemnify and save harmless the Owner from all cost and damage which the Owner may suffer by reason of Principal's failure to perform the Contract. Said indemnification shall include, but not be limited to, full reimbursement and repayment to the Owner for all outlays and expenses which the Owner may incur in making good any such default or failure to perform the Contract by the Principal.

c. Principal shall pay all persons all indebtedness for labor or material furnished or performed under the Contract and in doing so this obligation shall be null and void. In the event that Principal fails to pay for such indebtedness, such persons shall have a direct right of action against the Principal and Surety, jointly and severally, under this obligation, subject to the Owner's priority.

**SECTION 00 6325  
SUBSTITUTION REQUEST FORM**

**V.20 SEND TO:**

**H+N ARCHITECTS            ATTN: JOANNA NABHOLZ  
1109 MAIN STREET  
CONWAY, AR 72032  
PHONE: 501-327-7525**

**SECTION:\_\_\_\_\_ PARAGRAPH:\_\_\_\_\_ SPECIFIED ITEM:\_\_\_\_\_**

**PROPOSED SUBSTITUTE:\_\_\_\_\_**

**ATTACH, COMPLETE DESCRIPTION, DESIGNATION, CATALOG OR MODEL NUMBER, SPEC DATA SHEET, AND OTHER TECHNICAL DATA, INCLUDING LABORATORY TESTS IF APPLICABLE.**

**ANSWER THE FOLLOWING QUESTIONS:**

**WILL SUBSTITUTION AFFECT DIMENSIONS INDICATED ON DRAWINGS? IS THE SIZE DIFFERENT PHYSICAL SIZE?**

\_\_\_\_\_  
**WILL SUBSTITUTION AFFECT WIRING, PIPING, DUCTWORK, ETC. INDICATED ON DRAWINGS? THIS INCLUDES LOWER OR HIGHER ELECTRICAL LOAD AND/OR VOLTAGE; DIFFERENT BTU HEAT LOAD AND/OR OR VENTING; REQUIRED CLEARANCES, ETC.**

\_\_\_\_\_  
**WHAT AFFECT WILL SUBSTITUTION HAVE ON OTHER TRADES?**

\_\_\_\_\_  
**LIST ANY DIFFERENCES BETWEEN PROPOSED SUBSTITUTION AND SPECIFIED ITEM:**

\_\_\_\_\_  
**IF NECESSARY, WILL THE UNDERSIGNED PAY FOR ARCHITECTS/ENGINEER'S COSTS, REQUIRED TO REVISE WORKING DRAWINGS, THAT ARE CAUSED BY SUBSTITUTION?**

\_\_\_\_\_  
**MANUFACTURER'S WARRANTY OF PROPOSED ITEMS ARE ☐ SAME    ☐ DIFFERENT  
PROPOSED COST SAVINGS USING SUBSTITUTION PRODUCT:\_\_\_\_\_**

**REVIEW COMMENTS:**

**☐ APPROVED**

**☐ APPROVED AS NOTED (SEE ATTACHED EXPLAINATION)**

**☐ NOT APPROVED / REJECTED**

**☐ REJECTED / RECEIVED TOO LATE / NOT REVIEWED**

**REMARKS: \_\_\_\_\_ REVIEWED BY: \_\_\_\_\_**

**SUBMITTED BY:**

**FIRM: \_\_\_\_\_**

**ADDRESS: \_\_\_\_\_**

**SIGNATURE: \_\_\_\_\_**

**DATE: \_\_\_\_\_**

**PHONE/EMAIL: \_\_\_\_\_**

**END OF SECTION**



**RELEASE OF CLAIMS**  
**Section 006519.16**

Comes the undersigned, who does hereby swear and affirm that:

1. My name is \_\_\_\_\_, and my  
(printed or typed)  
address is \_\_\_\_\_, doing business  
as \_\_\_\_\_.

2. Pursuant to Contract Number \_\_\_\_\_  
(project description)  
and Contract Date \_\_\_\_\_ excepted as listed below in Paragraph 4, I have paid  
otherwise satisfied all obligations for all materials and equipment furnished, for all work, labor, and  
services performed, and for all known claims against the Contractor arising in any manner in  
connection with the performance of the contract referenced above for which the Owner or his property  
might in any way be held responsible.

3. To the best of my knowledge, information and belief, excepted as listed below in  
Paragraph 4, the Releases or Waivers of Claim, attached hereto and incorporated herein, include the  
Contract, all subcontractors, all suppliers of materials and equipment, and all performers of work, labor  
or services who have or may have claims against any property of the Owner arising in any manner out  
of the performance of the Contract referenced above.

4. The Exceptions are: (if none, indicate "none." If required by the Owner, the Contractor  
shall furnish bond satisfactory to the Owner for each exception.)

\_\_\_\_\_  
AFFIANT

\_\_\_\_\_  
DATE

VERIFICATION

STATE OF ARKANSAS            )  
  )  
COUNTY OF                    )

SUBSCRIBED AND SWORN TO before me this \_\_\_\_ of \_\_\_\_\_ 20\_\_\_\_.

\_\_\_\_\_  
NOTARY PUBLIC

MY COMMISSION EXPIRES: \_\_\_\_\_

**CONSENT OF SURETY  
Section 006519.19**

Comes the undersigned, who does hereby swear and affirm that:

1. My name is \_\_\_\_\_ and I am an authorized representative of \_\_\_\_\_ a surety company.

2. With regards to the Project \_\_\_\_\_ Contractor; and \_\_\_\_\_ Owner; I hereby approve the final payment to the contractor. I agree that the final payment to the contractor shall not relieve the Surety Company of any of its obligations as set forth in the contract with the State of Arkansas and this contractor.

\_\_\_\_\_  
AFFIANT

\_\_\_\_\_  
DATE

VERIFICATION

STATE OF ARKANSAS                    )  
  )  
COUNTY OF \_\_\_\_\_)

SUBSCRIBED AND SWORN TO before me this \_\_\_\_\_ of \_\_\_\_\_, 2023.

\_\_\_\_\_  
NOTARY PUBLIC

MY COMMISSION EXPIRES:

**End of  
CONSENT OF SURETY FORM  
006519.19**

**GENERAL CONDITIONS**  
**Section 007213**

**ARTICLE 1 -- GENERAL PROVISIONS**

**1.1 DEFINITIONS**

- 1.1.1 Contract Documents: Contract Documents consist of Agreement; Invitation to Bid; Instruction to Bidders; the Bid Form; the Bid and the Performance and Payment bonds; General and Supplementary Conditions; Specifications; Drawings; Addenda issued prior to execution of the Contract; all UCA approved Change Orders; other documents listed or referred to in the Agreement; and modifications issued after execution of the Contract and signed by Contractor and Owner, and approved by UCA.
- 1.1.2 Contract: The Contract Documents form the Contract for construction. The Contract Documents will not be construed to create a contractual relationship between the Design Professional and Contractor, between the Owner and a subcontractor, between the Owner and Design Professional, or between entities other than the Owner and Contractor; however, a contractual relationship does exist between the Contractor and the agency referred to as Owner for approval purposes.
- 1.1.3 Work: Construction and services required by the Contract Documents whether completed or partially completed, include tools, labor, equipment, supplies, transportation, handling, and incidentals provided by the Contractor.
- 1.1.4 Project: The total capital improvement project described in the Contract Documents.
- 1.1.5 Drawings: Graphic and textual portions of the Contract Documents showing the design, location, and dimensions and size of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.
- 1.1.6 Specifications: Written requirements for materials, equipment, systems, standards, and workmanship for the Work, and performance of related services.
- 1.1.7 Project Manual: Volume, which may include the bidding requirements, forms, contracting requirements, and the Specifications.
- 1.1.8 Owner: The person or entity identified as such in the Contract Agreement, referred to throughout the Contract Documents as singular in number. The term Owner means the Owner and the Owner-authorized representative.
- 1.1.9 Contractor: The person or entity identified as such in the Contract Agreement, referred to throughout the Contract Documents as singular in number. The term Contractor means the Contractor or the Contractor-authorized representative.

1.1.10 Design Professional (Architect/Engineer/Consultant): The person or entity identified as such in the Agreement, lawfully licensed to practice architecture or engineering or another field of expertise and under contract to Owner to provide design service, advice, and consultation, referred to throughout the Contract Documents as if singular in number. The term Design Professional means the Architect/Engineer/ Consultant or the authorized representative.

1.1.11 Subcontractor: Any person, firm, or corporation with a direct contract with the Contractor who acts for or in behalf of the Contractor in executing a portion of the Work. The term subcontractor is referred to as singular in number and means the subcontractor or the subcontractor-authorized representative.

1.1.12 Inspector: A duly authorized representative of UCA and Design Professional, designated for detailed inspection of materials, construction, workmanship, and methods of construction.

1.1.13 Site: The particular location of that part of the project being considered.

1.1.14 State: The Owner.

## **1.2 INTENT**

1.2.1 The intent of the Contract Documents is to set forth the standards of construction, the quality of materials and equipment, the guarantees that are to be met, and to include items necessary for proper execution and completion of the Work. The Contract Documents are complementary and what is required by one will be as binding as if required by all. Performance by the Contractor shall be required to the extent consistent with the Contract Documents and reasonably inferable as necessary to produce indicated results.

1.2.2 Organization of the Specifications into divisions, sections, and articles, and arrangement of Drawings will 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 which have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

## **1.3 CAPITALIZATION**

1.3.1 Terms capitalized in the Contract Documents include those which are specifically defined, the titles to numbered sections and articles, identified references to paragraphs, and the titles of other published documents.

## **1.4 INTERPRETATION**

1.4.1 Whenever in these Contract Documents the words "as ordered", "as directed", "as required", "as permitted", "as allowed", or words or phrases of like import are used, it shall be understood that

the order, direction, requirement, permission, or allowance of the Owner and Design Professional is intended.

- 1.4.2 Whenever in these Contract Documents the word "product" is used, it shall be understood that the materials, systems, and equipment will be included.
- 1.4.3 Whenever in these Contract Documents the word "provide" is used, it shall be understood that it means to "furnish and install".
- 1.4.4 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.

## **ARTICLE 2 -- OWNER**

### **2.1 LAND**

- 2.1.1 The Owner will provide the lands shown on the Drawings upon which the Work shall be performed. The Owner will provide a right-of-way for access to the project site.
- 2.1.2 The Owner will provide base lines for the location of the principle component parts of the Work with a suitable number of bench marks adjacent to the Work.

### **2.2 RIGHT OF ENTRY BY OWNER**

- 2.2.1 The Owner and his authorized representative will have the right to enter the property or location on which the Work shall be constructed. The Owner further reserves the right to construct or have his authorized agents construct such work as the Owner will desire, so long as these operations do not interfere with or delay the work being constructed under this Contract.

### **2.3 OWNER'S RIGHT TO CARRY OUT THE WORK**

- 2.3.1 If the Contractor defaults or neglects to perform the Work in accordance with the Contract Documents, including the requirements with respect to the schedule of completion, and fails after ten days written notice from the Owner to correct the deficiencies, the Owner may deduct the cost thereof from the payment then or thereafter due the Contractor.

## **ARTICLE 3 -- CONTRACTOR**

### **3.1 GENERAL**

- 3.1.1 The Contractor shall perform the Work in accordance with the Contract Documents.

- 3.1.2 The Contractor shall furnish labor, materials, equipment, and transportation necessary for the proper execution of the work unless specifically noted otherwise. The Contractor shall do all the work shown on Drawings and described in Specifications and all incidental work considered necessary to complete the project in a substantial and acceptable manner, and to fully complete the work or improvement, ready for use, occupancy and operation by the Owner. Drawings and Specifications shall be interpreted by the Design Professional or the Owner if no Design Professional exists for the project.
- 3.1.3 The Contractor shall cooperate with the Owner, Design Professional, inspectors, and with other contractors on the Project. Contractor shall allow inspectors acting in an official capacity, to have access to the project site.
- 3.1.4 The Contractor shall determine that the final and completed work on the project is in accordance with the Contract Documents. The failure of the Design Professional to find or correct errors or omissions in the use of materials or work methods during the progress of the work shall not relieve the Contractor from his responsibility to correct all the defects in the project.
- 3.1.5 The Contractor shall assist in making final inspections and shall furnish such labor and equipment as may be required for the final tests of equipment, piping, and structures.

### **3.2 REVIEW OF FIELD CONDITIONS**

- 3.2.1 Before ordering material or doing Work, the Contractor shall verify all measurements involved and shall be responsible for the correctness of same. No extra charge or compensation will be allowed on account of difference between actual dimensions and the measurements indicated on Drawings; differences which may be found, shall be submitted to Design Professional for consideration before proceeding with the Work.
- 3.2.2 Drawings may show the location or existence of certain exposed and buried utilities as well as existing surface and subsurface structures. The Owner assumes no responsibility for failure to show any or all such utilities and structures on the Drawings or to show such in the exact location. It is mutually agreed such failure will not be considered sufficient basis for claims for extra work or for increasing the pay quantities in any manner unless the obstruction encountered necessitates substantial changes in the lines or grades or requires the building of a special structure.

### **3.3 REVIEW OF CONTRACT DOCUMENTS**

- 3.3.1 The Contractor shall study and compare Drawings, Specifications, and other instructions and shall report to the Design Professional at once any error, inconsistency, or omission discovered.
- 3.3.2 In the event of conflict among the Contract Documents, interpretations will be based on the following order of precedence, stated highest to lowest:
  - a. The Agreement

- b. This Division Zero (0) shall control in the event of conflict between this Division Zero (0) and other Divisions 1 through 28.
- c. Addenda to Drawings and Specifications with those of later date having precedence.
- d. Drawings and Specifications

3.3.3 Since the Contract Documents are complementary, the Contractor shall take no advantage of any apparent error or omission in the Drawings and Specifications. The Owner or Design Professional shall furnish interpretations as deemed necessary for the fulfillment of the intent of the Drawings and Specifications.

3.3.4 Discrepancies found between the Drawings and Specifications and actual site conditions or any errors or omissions in the Drawings or Specifications shall be immediately reported to the Design Professional or in the case where a Design Professional is not on the Project, the Owner shall be notified, who shall address such error or omission in writing. Work done by the Contractor after discovery of such discrepancies, errors, or omissions shall be at the Contractor's risk and expense.

#### 3.4 **REQUEST FOR SUPPLEMENTARY INFORMATION**

3.4.1 The Contractor shall make timely requests of the Owner or Design Professional for additional information required for the planning and production of the Work. Such requests shall be submitted as required, but shall be filed in ample time to permit appropriate action to be taken by all parties involved so as to avoid delay. Contractor understands and agrees that it is Contractor's duty to determine the need for, and to request said additional information in writing from the Design Professional by such date as allows Design Professional to provide the information to the Contractor by a date that will not adversely affect Contractor's ability to complete the Work by the date specified in the Contract.

3.4.2 Additional instructions may be issued by the Design Professional during the progress of the Work to clarify the Drawings and Specifications or as may be necessary to explain or illustrate changes in the Work.

#### 3.5 **SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES**

3.5.1 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.

3.5.2 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.

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

- 3.5.4 The Contractor shall provide shop drawings and other submittals, settings, schedules, and other drawings as may be necessary for the prosecution of the Work in the shop and in the field as required by the Drawings, Specifications, or Design Professional instructions.

### **3.6 LABOR AND MATERIALS**

- 3.6.1 Except as otherwise specifically stated in the Contract, the Contractor shall provide, but not be limited to, all materials, labor, tools, equipment, water, light, heating and cooling, power, transportation, superintendence, temporary construction of every nature, taxes legally collectible because of the work, and all other services and facilities of every nature whatsoever necessary to complete the Work in accordance with the Contract Documents in an orderly and efficient manner. The sequence of construction operations shall follow the schedule of construction as approved by the Design Professional. The Work shall not be discontinued by the Contractor without approval of the Design Professional. Should prosecution of the Work be discontinued for any reason, the Contractor shall notify the Design Professional at least twenty-four hours in advance of resuming the Work.
- 3.6.2 Materials and equipment furnished under this Contract will be subject to inspection by the Owner's authorized representative or by independent laboratories. Defective material, equipment, or workmanship may be rejected at any time before the acceptance of the Work even though the defective material, equipment, or workmanship may have been previously overlooked and estimated for payment. The Contractor shall replace defective equipment and material in accordance with the Contract Documents at no additional cost to the Owner.
- 3.6.3 The Contractor shall provide materials and supplies not subject to conditional sales agreements, or other agreement reserving unto the seller any right, title, or interest therein. All materials and supplies shall become the property of the Owner upon final acceptance of this Contract by the Owner.
- 3.6.4 If shop tests are to be conducted, the Contractor shall notify the Owner of such tests so a representative may witness tests, if desired.
- 3.6.5 The Contractor may make substitutions only with the consent of the Owner, after evaluation by the Design Professional, and in accordance with a Change Order.

### **3.7 UNAUTHORIZED WORK**

- 3.7.1 Work done without lines and grades having been given or work done beyond the lines or not in conformity with the grades shown on the Drawings or as provided by the Owner, except as provided herein, and work completed without proper inspection and supervision or any extra or unclassified work completed without written authority and prior agreement shall be at the Contractor's risk. Such unauthorized work, at the option of the Design Professional, may not be measured and paid for and may be ordered removed at the Contractor's expense.



### **3.8 SUPERINTENDENCE**

- 3.8.1 The Contractor shall supervise and direct the Work. The Contractor shall be solely responsible for construction means, methods, techniques, sequences, and procedures and for coordinating portions of the Work under the Contract.
- 3.8.2 The Contractor shall employ a qualified superintendent during the duration of the Project who is acceptable to the Owner and the Design Professional. The superintendent shall be maintained on the Project site and shall be present on the site at all times work is in progress. The superintendent shall be capable of reading and understanding the Drawings and Specifications and shall have full authority to act in behalf of the Contractor. All directions and instructions given to the Superintendent shall be considered as given to the Contractor and shall be as binding as if given to the Contractor.
- 3.8.3 Workmanship shall be performed by workmen experienced in their trade and skilled and experienced for the class of work to which assigned. Any person, including supervisory personnel, who does not show and exhibit skill and proficiency in said work shall be removed by the Contractor and replaced by a competent and experienced workman.
- 3.8.4 The Contractor shall, at all times, be responsible for the conduct and discipline of his employees and all Subcontractors and their employees. Disorderly, incompetent or intemperate persons, or persons who commit any crimes or trespass on public or private property in the vicinity of the Work must not be allowed to continue working upon the project which the Contractor has with the State. Any superintendent, foreman or workman employed by the Contractor or a Subcontractor who unreasonably refuses or neglects to comply with the instructions of the Owner, Design Professional, or inspector, shall, at the written request of the Owner or Design Professional, be removed from the work site and shall not be allowed to work further on any portion of the work or another State Project without the approval of the Owner.
- 3.8.5 The Contractor shall coordinate Work by the various trades to provide uniform and symmetrical layout and spacing of the exposed components which will affect the finished design and appearance. Where spacing and related locations are not specifically shown on Drawings or where in doubt, the Contractor shall consult the Design Professional prior to installation of that part of the Work.

### **3.9 PERMITS, FEES, AND NOTICES**

- 3.9.1 The Contractor shall purchase and secure all applicable permits and licenses and give all notices necessary and incidental to the prosecution of the Work. However, in accordance with Ark. Code Ann. §22-9-213, public works construction projects conducted by UCA or other state agencies are exempt from permit fees or inspection requirements of county or municipal ordinances.
- 3.9.2 When new construction under the Contract crosses highways, railroads, streets or utilities under the jurisdiction of the state, county, city, or other public agency, public utility, or private entity, the Contractor shall secure written permission from the proper authority before executing such

new construction. A copy of this written permission shall be filed with the Owner before any work is completed. The Contractor shall furnish a release from the proper authority before final acceptance of the Work. Any bonds required for this Work shall be secured and paid for by the Contractor.

### **3.10 SAMPLES AND TESTS**

3.10.1 The Contractor shall provide samples, materials, and equipment necessary or required for testing as outlined in the various sections of the Specifications or as directed by the Owner. The Contractor shall pay all costs for testing. Should materials, methods, or systems fail to meet specified standards, the Contractor shall pay all costs for additional testing as required by the Owner.

3.10.2 All tests shall be made by a laboratory approved by the Owner.

### **3.11 LOCATION, GRADIENT, AND ALIGNMENT**

3.11.1 Based upon the site information provided by the Owner, the Contractor shall develop and make detailed surveys necessary for construction including slope stakes, batter boards, and other working points, lines and elevations.

3.11.2 The Contractor shall report any errors, inconsistencies, or omissions to the Design Professional as a request for information.

3.11.3 The Contractor shall preserve benchmarks, reference points and stakes, and in the case of destruction thereof by the Contractor, shall be responsible for damage or mistakes resulting from unnecessary loss or disturbance.

### **3.12 LAND**

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

3.12.2 The Contractor shall not enter upon private property for any purpose without first obtaining permission.

3.12.3 The Contractor shall be responsible for the preservation of and prevent damage or injury to all trees, monuments, and other public property along and adjacent to the street and right-of-way. The Contractor shall prevent damage to pipes, conduits and other underground structures, and shall protect from disturbance or damage all monuments and property marks until an authorized agent has witnessed or otherwise referenced their location, and shall not remove monuments or property marks until directed.

### **3.13 LIMITS OF WORK**

3.13.1 The Contractor shall conduct Work and operations so as to cause a minimum of inconvenience to the public. At any time when, in the opinion of the Owner or Design Professional, the Contractor is obstructing a larger portion of a road, street, or other public right-of-way than is necessary for the proper execution of the Work, the Design Professional may require the Contractor to finish the sections on which work is in progress before work is commenced on any new sections.

### **3.14 WARRANTY**

3.14.1 The Contractor shall warrant that all Work, materials, and equipment furnished will be free from defects in design, materials, and workmanship and will give successful service under the conditions required. The warranty period for Work, materials, and equipment furnished by the Contractor shall be one year from the date of the written acceptance of the Work as stated in the Substantial Completion Form approved by the Contractor, Owner and Design Professional or the date that UCA approves the final payment request, unless a longer period is agreed upon.

### **3.15 PATENTS AND ROYALTIES**

3.15.1 If the Contractor is required or desires to use any design, device, material or process covered by letters, patent, or copyright, he shall provide for such use by suitable legal agreement with the patents or Owner. It is mutually understood and agreed that without exception the Contract Sum shall include all royalties or costs arising from patents, trademarks, and copyrights in any way involved in the Work. The Contractor and the surety shall defend, indemnify, and save harmless the Owner and all its officers, agents and employees from all suits, actions, or claims of any character, name and description brought for or on account of infringement or alleged infringement by reason of the use of any such patented design, device, material or process of any trademark or copyright used in connection with the Work agreed to be performed under this Contract, and shall indemnify the Owner for any cost, expense, or damage which it may be obliged to pay by reason of any action or actions, suit or suits which may be commenced against the Owner for any such infringement or alleged infringement at any time during the prosecution or after the completion of the Work contracted for herein. It is mutually agreed that the Owner may give written notice of any such suit to the Contractor, and thereafter, the Contractor shall attend to the defense of the same and save and keep harmless the Owner from all expense, counsel fees, cost liabilities, disbursements, recoveries, judgments, and executions in any manner growing out of, pertaining to, or connected therewith.

### **3.16 CLEANING UP**

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

3.16.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the cost thereof shall be charged to the Contractor.

## **ARTICLE 4 -- ADMINISTRATION OF CONTRACT**

### **4.1 DESIGN PROFESSIONAL AUTHORITY**

- 4.1.1 The Design Professional will interpret the requirements of the Contract Documents and decide matters concerning performance there under on request of the Owner or Contractor.
- 4.1.2 The Design Professional will provide administration of the Contract as described in the Contract Documents and will be the Owner's representative. The Design Professional will decide any and all questions as to the acceptability of materials or equipment furnished, work performed, interpretation of the Drawings and Specifications, rate of progress of the Work, acceptability of the quality of workmanship provided, and other questions as to the fulfillment of the Contract by the Contractor.
- 4.1.3 The Design Professional will prepare all change orders on the form specified by UCA. The Design Professional may authorize minor changes in the Work not involving adjustment in Contract Sum or extension of Contract Time and not inconsistent with the intent of the Contract Documents.
- 4.1.4 The Design Professional and his authorized representatives, UCA will have the right to enter the property or location on which the Work shall be constructed.

### **4.2 CLAIMS**

- 4.2.1 Definition: A claim is a demand or assertion by one of the parties seeking adjustment, or interpretation of Contract terms, payment of money, extension of time, or other relief with respect to the terms of the Contract. The term includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. Claims will be initiated by written notice. The responsibility to substantiate claims shall rest with the party making the claim.
- 4.2.2 Claims of the Contractor or the Owner: Claims regarding the Work of the Contract shall be referred initially to the Design Professional for a decision. The Design Professional will review claims, and 1) reject in whole or in part; 2) approve the claim; 3) suggest a compromise; 4) advise the parties that the Design Professional is unable to resolve the claim.
- 4.2.3 Claims for Concealed or Unknown Conditions: If new and unforeseen items of work are discovered, which cannot be covered by any item or combination of items for which there is a Contract Sum, then the Contractor shall notify the Design Professional as quickly as reasonably possible and shall not continue working on the discovered new or unforeseen items without express written permission from the Design Professional. The Contractor shall complete such work and furnish such materials as may be required for the proper completion or construction of

the work contemplated upon written Change Order from the Design Professional as approved by the Owner. Work shall be performed in accordance with the Contract Documents.

- 4.2.4 Claims for Extensions of Time: The Contractor shall provide written notice to Design Professional within ten days stating the cause of the delay and request an extension of Contract Time. The Design Professional will act on the request in writing. The extension of time shall be for a period equivalent to the time lost by reasons indicated. No extension of time shall be effective until included in a Change Order approved by the Design Professional and UCA.
- 4.2.5 Claims for Changes in the Work: The Contractor shall provide written notice to Design Professional within ten calendar days after the receipt of instructions from the Owner, as approved by the Design Professional, to proceed with changes in the Work and before such Work is commenced. Changes in the Work shall not be commenced before the claim for payment has been approved, except in emergencies endangering life or property. The Contractor's itemized estimate sheets showing labor and material shall be submitted to the Design Professional. The Owner's order (Change Order) for changes in the Work shall specify any extension of the Contract Time and one of the following methods of payment:
- a. Unit prices or combinations of unit prices, which formed the basis of the original Contract.
  - b. A lump sum fee based on the Contractor's estimate, approved by the Design Professional and accepted by the Owner.
  - c. The actual cost of the Work plus an allowance of 12 percent and 5 percent for the General Contractor and Subcontractor, respectively.
- 4.2.6 Claims for Additional Costs: In case of an emergency which threatens loss or injury of property or safety of life, the Contractor shall be allowed to act, without previous instructions from the Design Professional, in a diligent manner. The Contractor shall notify the Design Professional immediately thereafter. Any claim for compensation by the Contractor due to such extra work shall be promptly submitted, but in no case more than 7 calendar days following the event causing the emergency, to the Design Professional for consideration. The amount of reimbursement claimed by the Contractor on account of any emergency action shall be determined in the manner provided under these General Conditions. No agreement to pay costs for additional work shall be effective until included in a Change Order approved by the Contractor, the Design Professional and UCA.

## **ARTICLE 5 -- SUBCONTRACTORS**

### **5.1 ASSIGNMENT OF CONTRACT**

- 5.1.1 Neither the Owner nor the Contractor shall have the right to sublet, sell, transfer, assign, or otherwise dispose of the "Contract" or any portion thereof without written consent of the other party. No assignment, transfer, or subletting, even with the proper consent, shall relieve the Contractor of his liabilities under this Contract. Should any Assignee or Subcontractor fail to

perform the work undertaken by him in a satisfactory manner, with UCA approval, has the right to annul and terminate the Assignee's or Subcontractor's contract on the project.

## **5.2 SUBCONTRACTS**

- 5.2.1 The subcontracting of the whole or any part of the Work to be done under this Contract will not relieve the Contractor of his responsibility and obligations. All transactions of the Owner or Design Professional shall be with the Contractor. Subcontractors will be considered only in the capacity of employees or workmen and shall be subject to the same requirements as to character and competency.
- 5.2.2 The Contractor shall discharge or otherwise remove from the project any Subcontractor that the Owner or the Design Professional has reasonably determined as incompetent or unfit.
- 5.2.3 The Contractor may not change those Subcontractors listed on the proposal without the written approval of the Owner, Design Professional. The Contractor shall submit written evidence, which includes but is not limited to, that the substituted contractor is costing the same amount of money or less and if costing less, that the saving will be deducted from the total contract of the prime contractor and rebated to the Owner prior to any approval. The Contractor shall submit his request to the design professional who then shall review the request, if approved, the request and approval shall be forwarded to the Owner. The Owner shall then review the request and accompanying paperwork and if approved, shall forward the approval and the accompanying documents to UCA. UCA shall review all of the documents. UCA shall provide written notification to the Contractor and the Design Professional as its determination. The Contractor shall not be relieved of any liabilities under this Contract, but shall be fully responsible for any Subcontractor or work by said Subcontractor where Subcontractor is employed by the Contractor to perform work under this Contract. Nothing contained in the Contract Documents shall create contractual relations between any Subcontractor and the State.
- 5.2.4 No officer, agent, or employee of the Owner, including the Design Professional, shall have any power or authority to bind the Owner or incur any obligation in his behalf to any Subcontractor, material supplier or other person in any manner whatsoever.

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

### **6.1 OTHER CONTRACTS**

- 6.1.1 The Owner reserves the right to award other contracts in connection with the Project. The Contractor shall cooperate with the other contractors with regard to the storage of materials and equipment, access to the site, and execution of their work. It shall be the Contractor's responsibility to inspect the work of other contractors which will affect the work of this Contract and to report to the Owner irregularities which will not permit him to complete his work in a satisfactory manner or in the time allotted. Failure to so report shall constitute an acceptance of the work of other contractors.

## **6.2 DEPENDENCE ON OTHERS**

- 6.2.1 If any part of the Contractor's work depends for proper execution or results upon the work of the Owner or any separate contractor, the Contractor shall, prior to proceeding with the work, promptly report to the Design Professional any apparent discrepancies or defects in such other work that render it suitable for such proper execution and results. Failure of the Contractor to so report shall constitute an acceptance of the work.

## **ARTICLE 7 -- CHANGES IN THE WORK**

### **7.1 GENERAL**

- 7.1.1 The Owner may, as the need arises, without invalidating the Contract, order changes in the work in the form of additions, deletions, or modifications. Compensation to the Contractor for additional work or to the Owner for deductions in the work and adjustments for the time of completion shall be adjusted at the time of ordering such change.
- 7.1.2 Additional work shall be done as ordered in writing by the Owner. The order shall state the location, character, and amount of extra work. All such work shall be executed under the conditions of the Contract, subject to the same inspections and tests.
- 7.1.3 The Design Professional and the Owner reserve and shall have the right to make changes in the Contract Documents and the character or quantity of the work as may be considered necessary or desirable to complete fully and acceptably the proposed construction in a satisfactory manner.

### **7.2 CHANGE ORDERS**

- 7.2.1 A Change Order is a written instrument, prepared by the Design Professional and approved by UCA stating their agreement upon the following, separately or in any combination thereof:
- a. Description and details of the work.
  - b. Amount of the adjustment in the Contract Sum.
  - c. Extent of the adjustment in the Contract Time.
  - d. Terms and conditions of the Contract Documents.
- 7.2.2.1 Change Order requests by the Contractor shall be submitted in a complete itemized breakdown, acceptable to the Design Professional and UCA.
- 7.2.2.2 Where unit prices are stated in the Contract, Contractor should submit an itemized breakdown showing each unit price and quantities of any changes in the Contract Amount.

The value of all such additions and deductions shall then be computed as set forth in Paragraph 7.2.2.3.

7.2.2.2 The Contractor shall present an itemized accounting together with appropriate supporting data for the purposes of considering additions or deductions to the Contract Amount. Supporting data shall include but is not limited to the following:

- a. Costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and worker or workmen's compensation insurance;
- b. Cost of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;
- c. Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
- d. Costs of premiums for all bonds and insurance, permit fees, and sales, use of similar taxes related to the Work; and
- e. Additional costs of supervision and field office personnel directly attributable to the change.

The burden of proof of cost rests upon the Contractor. Contractor agrees that UCA's Representative shall have the right, at reasonable times, to inspect and audit the books and records of Contractor to verify the propriety and granting of such cost.

7.2.2.3 Compute requests for changes be they additions or deductions as follows:

- a. For work performed by the Contract:

Net Cost of Materials	a. _____
State Sales Tax	b. _____
Net Placing Cost	c. _____
W.C. Insurance Premium and FICA Tax	d. _____
Subtotal of a+b+c+d	_____
Overhead and Profit, 12% x (a+b+c+d)	e. _____
Allowable Bond Premium	f. _____
<b>TOTAL COST</b>	a+b+c+d+e+f _____

- b. Credit for work deleted shall be computed as outlined in 7.2.2.3 a. through e., except the Contractor's share of overhead and profit percentage is seven percent.
- c. For added work performed by Subcontractors: Subcontractors shall compute their work as outlined in 7.2.2.3 a. through e. To the cost of that portion of the work (Change) that is performed by the Subcontractor, the Contractor shall add an Overhead and Profit Change of five percent plus the Allowable Bond Premium.



- d. For work deleted by a Subcontractor: Subcontractors shall compute their work as outlined in 7.2.2.3 a through e, except that the overhead and profit shall be seven percent and the Contractor's overhead and profit shall be five percent.

### **7.3 PAYMENT FOR CHANGES IN THE WORK**

- 7.3.1 All changes in the Work will be paid for in the manner indicated in Article 4, Paragraph 4.2, and the compensation thus provided shall be accepted by the Contractor as payment in full for the use of small tools, superintendent's services, premium on bond, and all other overhead expenses incurred in the prosecution of such work.
- 7.3.2 The Owner shall not be deemed to have agreed to any costs for additional work, to have agreed to additional time for completion, or to have agreed to any other change in the terms and conditions of the Contract Documents until Owner, Design Professional and Contractor have executed a Change Order to this Contract, and the Change Order is approved by UCA.

## **ARTICLE 8 -- TIME**

### **8.1 DEFINITIONS**

- 8.1.1 Contract Time is the period of time identified in the Contract Documents for Substantial Completion of the Work, including authorized adjustments made as part of Change Orders agreed to by the Contractor Design Professional and UCA.
- 8.1.2 Date for commencement of the Work is the fifth calendar day following the date of mailing, by regular mail, of the Notice to Proceed, unless otherwise stated in the Contract.
- 8.1.3 Date of Substantial Completion is the date certified by the Design Professional and UCA.

### **8.2 PROGRESS**

- 8.2.1 Time limits identified in the Contract Documents are of the essence of the Contract. The Contractor confirms that the Contract Time is a reasonable period of time for performing the Work.

### **8.3 HOLIDAYS**

- 8.3.1 New Year's Day, Robert E. Lee/Dr. Martin Luther King's Birthday, President's Birthday, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day and the day thereafter, Christmas Eve and Christmas Day will be considered as being legal holidays; no other days will be considered unless declared by the Governor of the State of Arkansas through an Executive Order or Proclamation. No Design Professional clarifications, observations, or State inspections will be provided on legal holidays.

### **8.4 DELAYS**

- 8.4.1 Delays beyond the Contractor's control occasioned by an act or omission on the part of the Owner, strikes, fires, additions to the work, delays by any separate contractor employed by the Owner, extremely abnormal weather conditions, or other delays beyond the Contractor's control may, if agreed to by Change Order by the Contractor, the Design Professional and entitle the Contractor to an extension of time in which to complete the work. While such delays may be just cause for an extension of the Contract Time, the Contractor shall not have a claim for damages for any such cause or delay.

## 8.5 INCLEMENT WEATHER

- 8.5.1 Include in construction time stated in Contract documents an allowance for calendar days per month which, according to the following inclement weather table may not be available for construction out-of-doors (normal inclement weather).

January (7)	April (7)	July (6)	October (3)
February (5)	May (8)	August (4)	November (6)
March (7)	June (6)	September (6)	December (4)

- 8.5.2 Contract time will not be extended due to normal inclement weather unless the Contractor can substantiate, to satisfaction of Architect, that greater-than-normal inclement weather occurred, considering the full term of contract Time, using a 5-year average of accumulated record mean values from climatological data compiled by the U.S. Department of commerce National Oceanic and Atmospheric Administration for the project local, and that alleged greater-than-normal inclement weather actually delayed work or portions of work. All inclement weather day extension submittals must be submitted to the Architect for review and approval by the 15<sup>th</sup> of the following month.

The measure of extreme weather shall be the number of days in excess of those stated for each month, in precipitation exceeded 0.10 inch, from area weather station for same period of time, which is source of data used to determine normal weather losses.

If total accumulated number of calendar days lost to weather exceeds total accumulated number expected for same period from inclement weather table, time for completion will be extended by number of calendar days needed to include excess number of calendar days lost.

## **RTICLE 9 -- PAYMENTS AND COMPLETION**

### **9.1 CONTRACT SUM**

- 9.1.1 The Contractor shall accept the compensation, as herein provided, in full payment for furnishing all materials, equipment, labor, tools, and incidentals necessary to complete the Work and for performing all Work contemplated and embraced under the Contract; also for loss or damage arising from the nature of the Work, from the action of the elements or from any unforeseen difficulties which may be encountered during the prosecution of the Work until the final acceptance by the Design Professional and Owner and for all risks of every description connected with the prosecution of the Work, for all expenses incurred in consequence of the suspension or discontinuance of the Work as specified, for any infringement of patent, trademark, or copyright, and for completing the Work according to the Contract Documents. Neither the payment of any estimate nor of any retained percentage shall relieve the Contractor of any obligation to make good any defective work or material.
- 9.1.2 No moneys payable under Contract or any part thereof, except the estimate for the first month or period, shall become due and payable if the Owner so elects until the Contractor shall satisfy the said Owner that he has fully settled or paid for all materials and equipment used in or on the Work and labor done in connection therewith, and the Owner, if he so elects, may pay any or all such bills wholly or in part and deduct the amount or amounts so paid from any monthly or final estimate excepting the first estimate.
- 9.1.3 In the event the surety on any contract or payment bond given by the Contractor becomes insolvent, or is placed in the hands of a receiver, or has the right to do business in a state revoked as provided by law, the Owner may at its election withhold payment of any estimate filed or approved by the Design Professional until the Contractor shall give a good and sufficient bond in lieu of the bond so executed by such surety. Any and all subsequent bonds shall be filed with the Circuit Clerk of the County in which the Work is being performed.

### **9.2 SCHEDULE OF VALUES**

- 9.2.1 The Contractor shall submit to the Design Professional a schedule of values for each part of the Work. The schedule shall be a complete breakdown of labor and materials for the various parts of the Work including an allowance for profit and overhead. The total of these amounts shall equal the Contract Sum. The approved schedule of values shall be used as a basis for the monthly payments to the Contractor. In applying for the monthly payment, the Contractor shall show a detailed account of work accomplished in conformity with the schedule.

### **9.3 MEASUREMENT OF QUANTITIES**

- 9.3.1 The Contractor shall be paid for all Work performed under the Contract based on Design Professional computations of as-built quantities and the Contractor's Contract Sum. This payment shall be full compensation for furnishing all supplies, materials, tools, equipment, transportation, and labor required to do the Work; for all loss or damage, because of the nature of the Work, from the action of the elements or from any unforeseen obstruction or difficulty which may be encountered in the prosecution of the Work and for which payment is not specifically provided for all or any part of the Work; and for well and faithfully completing the

Work in accordance with the Contract Documents. The method of computation and payment for each item shall be as set forth in the Specifications or the General and Supplementary Conditions.

#### **9.4 REQUESTS FOR PAYMENT**

- 9.4.1 The Contractor may submit periodically, but not more often than once each month, a Request for Payment for work completed. When unit prices are specified in the Contract Documents, the Request for Payment shall be based on the quantities completed.
- 9.4.2 Unless otherwise provided in the Contract Documents, payments will be made on account of materials or equipment not incorporated in the Work but delivered and suitably stored at the site, and if approved in advance by the Owner, payments may similarly be made for materials or equipment suitably stored at some other location agreed upon in writing. Payments for materials or equipment stored on or off the site shall be conditioned upon submission by the Contractor of bills of sale or such other procedures satisfactory to the Owner and the Design Professional to establish the Owner's title to such materials or equipment or otherwise protect the Owner's interest including applicable insurance and transportation to the site for those materials and equipment stored off the site.
- 9.4.3 The Contractor shall furnish the Design Professional all reasonable facilities and job tickets required for obtaining the necessary information relative to the progress and execution of the Work and the measurement of quantities. Each Request for Payment shall be computed from the work completed on all items listed in the approved schedule of values less 10 percent of the first 50 percent of the adjusted Contract Sum and less previous payments to the Contractor on the Contract.

#### **9.5 PERIODIC ESTIMATES FOR PAYMENT**

- 9.5.1 Unless otherwise stated in the Specifications or General and Supplementary Conditions, the Owner shall cause the Design Professional to prepare an Estimate for Payment to the Contractor each month. The Design Professional will make the estimate for the materials complete in place and the amount of work performed in accordance with the Contract between the twenty-fifth day of the month and the fifth day of the succeeding month.
- 9.5.2 From the total of the amount estimated to be paid, an amount equal to 10 percent of the total completed shall be retained until the Contract is 50 percent complete after which no further retainage will be withheld from the monthly estimates. All sums withheld by the Owner and requested in a Final Pay Request prepared by the Owner or Contractor will be paid to the Contractor within 30 days after the Contract has been completed and the work approved by UCA. No retainage will be withheld on that amount of the progress payment pertaining to the cost of materials stored at the site or within a bonded warehouse.

## **9.6 PAYMENT FOR INCREASED OR DECREASED QUANTITIES**

9.6.1 When alterations in the quantities of work not requiring Contract modifications are ordered and performed, the Contractor shall accept payment in full at the Contract Sum, for the actual quantities of work accomplished. No allowance will be made for anticipated profits. Increased or decreased work involving Contract modifications shall be paid for as stipulated in such Contract modifications

## **9.7 DESIGN PROFESSIONAL'S ACTION ON A REQUEST FOR PAYMENT (See 9.9)**

9.7.1 The Owner shall cause the Design Professional to, within five working days plus time required for transmittal from one party to another, act on a Request for Payment by the Contractor in one of the following:

- a. Approve the Request for Payment as submitted by the Contractor, and transmit same to the Owner.
- b. Approve an adjusted amount, as the Design Professional will decide is due the Contractor informing the Contractor in writing of the reason for the adjusted amount, and transmit same to the Owner.
- c. Withhold the Request for Payment submitted by the Contractor informing the Contractor, and UCA in writing of the reason for withholding the request.

## **9.8 OWNER'S ACTION ON A REQUEST FOR PAYMENT AND FINAL PAYMENT (See 9.9)**

9.8.1 The Owner will, within five working days plus transmittal time between the various state agencies involved, act on a Request for Payment (not Final) after approval by the Design Professional by one of the following:

- a. Approve the Request for Payment as approved by the Design Professional, process the payment.
- b. Approve payment of an adjusted amount as the Owner will decide is due the Contractor, informing the Contractor and, the Design Professional in writing of the reason for the adjusted amount of payment.
- c. Withhold the Request for Payment informing the Contractor, and the Design Professional in writing of the reason for withholding the payment.

## **9.8 ARKANSAS STATE AGENCIES ACTION ON A REQUEST FOR PAYMENT**

9.8.1 The State shall process payments in accordance with Ark. Code Ann. §19-4-1411, which establishes the time limits for the Design Professional, the Owner, and the Department of Finance and Administration. It also authorizes the Chief Fiscal Officer of the State to investigate

any complaints of late payments and assess penalties for late payment. Complaints shall be addresses to "Chief Fiscal Officer of the State: Department of Finance and Administration; 1509 West Seventh Street, Suite 401; Post Office Box 3278; Little Rock, AR 72203-3278.

## **9.9 WITHHOLDING PAYMENT**

9.9.1 The Design Professional or the State may withhold payment for contested issues, including but not limited to, defective work on the project; evidence indicating the probable filing of claims by other parties against the Contractor related to the project; damage caused to another contractor; reasonable evidence that Work cannot be completed for the unpaid balance of the Contract Sum or within Contract Time or failure of the Contractor to make payments on materials, equipment or labor to subcontractors. It is the responsibility of the contesting party to notify the Contractor in writing that payment has been contested and the reasons why. The notification must be done within the timeframe specified for processing of payment under Ark. Code Ann. §19-4-1411.

## **9.10 PAYMENT FOR UNCORRECTED WORK**

9.10.1 Should the Design Professional direct the Contractor not to correct work that has been damaged or that was not performed in accordance with the Contract Documents, an equitable deduction from the Contract Sum shall be made to compensate the Owner for the uncorrected work. The Design Professional shall determine the amount of the equitable deduction.

## **9.11 PAYMENT FOR REJECTED MATERIALS AND WORK**

9.11.1 The removal of rejected Work and materials and the re-execution of acceptable work by the Contractor shall be at the expense of the Contractor. The Contractor shall pay the cost of replacing the work of other contractors destroyed or damaged by the removal of the rejected work or materials and the subsequent replacement with acceptable work.

## **9.12 DATE OF SUBSTANTIAL COMPLETION**

9.12.1 A Certificate of Substantial Completion, which shall establish the Date of Substantial Completion, shall state the responsibilities of the Owner and the Contractor for security, maintenance, heat, utilities, damage to work, and insurance and shall fix the time within which the Contractor shall complete the items listed therein. Warranties required by the Contract Documents shall commence on the Date of Substantial Completion, unless another timeframe is stated in the Certificate of Substantial Completion. The Certificate of Substantial Completion shall not become effective until approved by UCA.

## **9.13 FINAL COMPLETION AND PAYMENT BY OWNER**

9.13.1 The Contractor shall furnish a letter from the Design Professional attached to the Contractor's final estimate, which shall include all retainage withheld, certifying that the Design Professional has received and approved all guarantees, bonds, maintenance and operation manuals, air balance data, shop drawings, catalog data, and record documents specified in the Contract Documents.

9.13.2 Before final payment, the Contractor shall furnish to the Design Professional executed copies of the Release of Claims and Consent of the Performance and Payment Bond Surety for Final Payment. Items listed in this Section Nine (9) shall be submitted with and at the same time as the final estimate to the Design Professional and shall be promptly delivered by the Design Professional to the Owner. No final payment or release of retained amounts shall be made without complete compliance with this Section Nine (9), and approval by UCA of the Final Pay Request, which shall include payment of all retained amounts,

9.14.3 Any claim by the Contractor to the Owner for interest on a delinquent final payment shall only be made pursuant to Ark. Code Ann. § 22-9-205.

#### **9.14 PARTIAL OCCUPANCY OR USE**

9.14.1 The Owner may occupy or use any completed or partially completed portion of the Work provided such use or occupancy is consented to by the insurer and authorized. The Contractor will prepare a list of items to be completed or corrected before partial acceptance. Upon receipt of the Contractor's list, the Design Professional will make an inspection to determine whether the Work or portion thereof is substantially complete. No portion of the work shall be considered substantially complete unless described in a Certificate of Substantial Completion Form approved by the Contractor, Owner, and Design Professional.

9.14.2 The Design Professional will prepare a Certificate of Substantial Completion which shall establish the date of Substantial Completion, shall state the responsibilities of the Owner and the Contractor for security, maintenance, heat, utilities, damage to Work and insurance, identify work items to be corrected or completed by the contractor and shall fix the time within which the Contractor shall complete the items listed therein. Warranties required by the Contract Documents shall commence on the Date of Substantial Completion, unless another timeframe is stated in the Certificate of Substantial Completion. No retained amounts shall be paid until the Contractor, Design Professional and the Owner approve a Certificate of Substantial Completion for all of the Work unless specifically provided for by this contract, and all other conditions for final acceptance of this Work are met to the satisfaction of the Owner.

9.15.3 Instances where some of the Work is "sectioned" out and substantially completed, the retained amounts shall not be paid until the final Certificate of Substantial Completion of the entire Work is approved by the Contractor, Design Professional and the Owner and all other conditions of this Section Nine (9) are met by the Contractor.

#### **9.15 FINAL INSPECTION**

9.15.1 Tests, inspections, and approvals of portions of the Work required by the Contract Documents, laws, ordinances, or any public authority having jurisdiction shall be made at the appropriate time. The Contractor shall give the Design Professional timely notice of when and where tests and inspections shall be made so that the Design Professional may be present. The Contractor shall make arrangements for the testing and inspection with an independent testing laboratory.

9.15.2 The Contractor shall ensure that the final completed work is in accordance with the Contract Documents. Required certificates of testing and inspection shall be secured by the Contractor and delivered to the Design Professional, unless otherwise required by the Contract Documents.

## **9.16 ASSIGNMENT OF WARRANTIES**

9.16.1 All warranties of materials and workmanship running in favor of the Contractor shall be transferred and assigned to the Owner on completion of the Work and at such time as the Contractor receives final payment.

9.16.2 In case of warranties covering work performed by subcontractors, such warranties shall be addressed to and in favor of the Owner. The Contractor shall be responsible for delivery of such warranties to the Owner prior to final acceptance of the work.

9.16.3 Delivery of guarantees or warranties shall not relieve the Contractor from any obligation assumed under any provision of the Contract. All warranties shall be for one year from the date of Substantial Completion of the Project, unless extended otherwise

## **9.17 ACCEPTANCE AND FINAL PAYMENT**

9.17.1 Upon receipt of written notice that the Work is ready for final inspection, the Design Professional together with UCA will conduct such inspection and when the Design Professional determines the work is acceptable to the Design Professional, UCA and the Design Professional shall certify his acceptance to the Owner. Final Payment shall be the Contract Sum plus approved Change Order additions less approved Change Order deductions and less previous payments made. The Contractor shall furnish evidence that he has fully paid all debts for labor, materials, and equipment incurred in connection with the Work. The Owner, upon approval by the Design Professional of all documentation to be provided by the contractor in accordance with this Section 9, and approval by the Design Professional, Contractor and Owner of the Certificate of Substantial Completion will accept the Work and release the Contractor, except as to the conditions of the Performance and Payment Bond, any legal rights of the Owner, required guarantees and correction of faulty work after Final Payment, and shall authorize payment of the Contractor's final Request for Payment. The Contractor must allow sufficient time between the time of completion of the work and approval of the final Request for Payment for the Design Professional to assemble and check the necessary data.

9.17.2 Acceptance of final payment by the Contractor shall constitute waiver of all claims by the Contractor except those previously made in writing and identified by the Contractor as unsettled at the time of the final Request for Payment. Any claims for interest on delinquent payments shall be made pursuant to Ark. Code Ann. § 22-9-205.

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

### **10.1 GENERAL**



- 10.1.1 The Contractor shall at all times exercise precaution for the safety of employees on the Project and of the public, and shall comply with all applicable provisions of federal, state and municipal safety laws and applicable building and construction codes. The Contractor shall provide and maintain passageways, guard fences, lights, and other facilities for protection required by all applicable laws. All machinery, equipment, and other physical hazards shall be guarded in accordance with all federal, state or municipal laws or regulations.
- 10.1.2 The Work, from commencement to completion, and until written acceptance by the Design Professional, and the Owner or to such earlier date or dates when the Owner may take possession and control in accordance with Section Nine (9) of these General Conditions, shall be under the charge and control of the Contractor and during such period of control by the Contractor, all risks in connection therewith shall be borne by the Contractor. The Contractor shall make good and fully repair all damages to the Project by reason of the Contractor's negligence, and make good on all injuries to persons caused by any casualty or cause by reason of the Contractor's negligence. The Contractor shall adequately protect adjacent Property as provided by law and the Contract Documents. The Contractor shall hold the Owner harmless from any and all claims for injuries to persons or for damage to property during the control by the Contractor of the project or any part thereof.
- 10.1.3 The Contractor shall at all times so conduct the Work as to ensure the least possible obstruction to traffic, to the general public, and the residents in the vicinity of the Work, and to ensure the protection of persons and property. No road, street, or highway shall be closed to the public except with the permission of the Owner and proper governmental authority. Fire hydrants on or adjacent to the Work shall be kept accessible to firefighting equipment at all times. The local fire department shall be notified of the temporary closing of any street.

## **ARTICLE 11 -- INSURANCE AND BONDS**

### **11.1 CONTRACTOR'S LIABILITY INSURANCE**

- 11.1.1 The Contractor shall secure and maintain in force during this Contract such insurance as is specified within the Contract Documents, from an insurance company authorized to write the prescribed insurance in the jurisdiction where the Project is located as will protect the Contractor, his subcontractors, and the Owner from claims for bodily injury, death, or property damage which may arise from operations under this Contract. The Contractor shall not commence work under this Contract until he has obtained all the insurance required, has filed the Certificate of Insurance with the Owner, and the certificate has been approved by the Owner. Each insurance policy shall contain a clause providing that it shall not be canceled by the insurance company without written notice to the Owner of intention to cancel.
- 11.1.2 Workman's Compensation and Employer's Liability Insurance in statutory limits shall be secured and maintained as required by the laws of the State of Arkansas. This insurance shall cover all employees who have performed any of the obligations assumed by the Contractor under these Contract Documents including Employer's Liability Insurance. This insurance shall protect the

Contractor against any and all claims resulting from injuries, sickness, disease, or death to employees engaged in work under this Contract.

11.1.3 Comprehensive General Liability Insurance, including automobile and truck liability. Prior to blasting, the Contractor shall furnish Certificate of Insurance, which shall certify that damage caused by blasting is within the coverage of his Comprehensive General Liability Insurance to the full limits thereof. Hired and non-owned automobile insurance for automobiles and trucks shall include hired and non-owned automobile coverage.

11.1.4 Contractor's Protective Liability Insurance: The Contractor shall indemnify and save harmless the Owner from and against all losses and all suits, claims, demands, judgments, actions, and payments of every description and nature brought or recovered against him by reason of any omission or act of the Contractor, his agents, or employees in the execution of the Work or in the guarding of it. The Contractor shall secure and maintain protective liability insurance in the name of the Owner and the Contractor covering them from contingent liability under this Contract.

11.1.5 Builder's Risk and Fire Insurance: The Contractor shall procure and maintain during the life of this Contract Builder's Risk Insurance fire, lightning, extended coverage, vandalism, and property theft on the insurable portion of the Project on a 100 percent completed value basis against damage to the equipment, structures, or material. The Owner and the Contractor, as their interests may appear, shall be named as the Insured.

11.1.6 Proof of Insurance: The Contractor shall maintain the insurance coverage's required by this contract (see Section 00825 Insurance requirements) throughout the term of this contract, and shall furnish the Owner with certificates showing the type, amount, class of operations covered, effective dates and dates of expiration of policies. Such certificates shall also contain substantially the following statement: "The insurance covered by this certificate will not be canceled, or materially altered except after 15 days prior written notice has been received by the Owner."

## **11.2 BONDS**

11.2.1 Performance and Payment Bond: The Contractor shall, at the time of execution of the Contract, furnish bonds covering faithful performance of the Contract and the payment of obligations. Performance and Payment bonds, and any amendments thereto, shall be filed with the circuit clerk office in the County Courthouse of the county where the work shall be performed.

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

### **12.1 EXAMINATION OF COMPLETED WORK**

12.1.1 If any portion of the work should be covered contrary to the request of the Owner, Design Professional, or Inspector or to requirements specifically expressed in the Contract Documents, it must, if required in writing by the Owner, Design Professional, or Inspector, be uncovered for his observation and replaced at the Contractor's expense.

## **12.2 DEFECTIVE WORK**

12.2.1 Defective work, whether through the use of defective materials, the result of poor workmanship, or any other cause, shall be removed within ten days after notice is given by the Owner or Design Professional. The Work and affected materials and equipment shall be removed and replaced as necessary to comply with the Contract Documents without additional cost to the Owner. The fact that the defective work may have been previously overlooked by the Design Professional shall not constitute acceptance.

## **12.3 REJECTED MATERIALS**

12.3.1 Materials which do not conform to the requirements of the Contract Documents, are not equal to samples approved by the Design Professional, or are in any way unsuited or unsatisfactory for the purpose for which intended, shall be rejected. Defective materials shall be removed within ten days after notice by the Design Professional. The materials shall be replaced with new materials as necessary to comply with the Contract Documents at no additional cost to the Owner. The fact that the defective material may have been previously overlooked by the Design Professional shall not constitute acceptance.

12.3.2 Should the Contractor fail to remove and replace rejected material within the specified ten days after written notice to do so, the Owner may remove and replace the material and deduct the cost from the Contract Sum.

## **12.4 CORRECTION OF FAULTY WORK AFTER FINAL PAYMENT**

12.4.1 The approval of the final Request for Payment by the Design Professional and the making of the final payment by the Owner to the Contractor shall not relieve the Contractor of responsibility to correct faulty materials or workmanship promptly after receipt of written notice from the Owner. The Owner shall give such notice of faulty materials or workmanship promptly, after discovery of the condition. If the Contractor fails to correct the defects, promptly, after receipt of written notice from Owner, the Owner may have the work corrected at the Contractor's expense.

# **ARTICLE 13 -- MISCELLANEOUS PROVISIONS**

## **13.1 GOVERNING LAW**

13.1.1 The Contract shall be governed by the laws and regulations of the STATE OF ARKANSAS. Venue for any administrative action or judicial proceedings shall be Pulaski County, Arkansas. Nothing in these General Conditions shall be construed to waive the sovereign immunity of the STATE OF ARKANSAS or any entities thereof.

13.1.2 The Contractor shall give all notices and comply with all federal, state, and local laws, ordinances, and regulations in any manner affecting the conduct of the Work. The Contractor shall indemnify and save harmless the Owner against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order, or decree whether by himself or his employees.

13.1.3 The Contractor shall comply with the laws of the local, state, and federal government regarding wages and hours of labor.

## **13.2 WRITTEN NOTICE**

13.2.1 Consider as served when delivered in person or sent by certified or registered mail to the individual, firm, or corporation or to the last business address of such known to him who serves the notice.

13.2.2 The written Notice to Proceed with the Work shall be issued by the Design Professional after the execution of the Contract by the Owner. The Contractor shall begin and prosecute the Work and uninterruptedly in a manner that will complete the Work within the time limits stated in the Contract.

## **13.3 TESTS AND INSPECTIONS**

13.3.1 All materials and each and every part of the Work shall be subject at all times to inspection by the Owner, Design Professional, or the Inspector. The Contractor shall be held to the intent of the Contract Documents in regard to quality of materials, equipment, and workmanship, and the diligent execution of the Contract. The inspection may extend to and include plant, shop, or factory inspection of material furnished. The Contractor agrees to allow Federal or State inspectors, acting in an official capacity, to have access to the job site.

13.3.2 The Owner, Design Professional and the Inspector shall be allowed access to all parts of the Work and shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection for ascertaining if the Work as performed is in accordance with the requirements and the Contract Documents.

13.3.3 Inspectors shall only have authority to suspend any work in a life-threatening situation, which is being improperly done, subject to the final decision of the Owner or Design Professional. Inspectors shall have no authority to permit deviations, or to relax provisions of the Contract Documents without the written permission or instruction of the Owner or Design Professional, or delay the Contractor by failing to work with reasonable promptness.

## **13.4 VERBAL AGREEMENTS**

13.4.1 No verbal objection, order, claim, or notice by any of the parties involved to the other parties shall affect or modify any of the terms or obligations contained in the Contract Documents. None of the terms or provisions of the Contract Documents shall be considered waived or modified unless the waiver or modification thereof is in writing, and agreed upon by the parties

in the form of a Change Order approved by the Design Professional, Contractor and UCA, and no evidence shall be introduced in any proceeding of any other waiver or modification.

## **ARTICLE 14 -- TERMINATION OR SUSPENSION OF THE CONTRACT**

### **14.1 SUSPENSION OF WORK**

14.1.1 The work or any portion thereof may be suspended at any time by the Owner provided that the Owner gives the Contractor written notice of the suspension. The notice shall set forth the date on which the work is to be suspended and the date on which the work is to be resumed. The Contractor shall resume the work upon written notice from the Owner within ten days after the date set forth in the notice of suspension.

14.1.2 The Owner will have the authority to suspend the work, wholly or in part, for such period of time as deemed necessary. The suspension may be due to unsuitable weather, or such other conditions as are considered unfavorable for the proper prosecution of the work, or the failure on the part of the Contractor to fulfill the provisions of the Contract. Failure to supply material, equipment, or workmanship meeting the requirements of the Contract Documents shall be just cause for suspension of the Work. The Contractor shall not have the right to suspend operations without the Design Professional or Owner's permission.

### **14.2 TERMINATION BY OWNER FOR CAUSE**

14.2.1 The Owner will have the right to terminate the Contract upon giving ten days written notice of the termination to the Contractor and the Contractor's surety, in the event of any default by the Contractor and upon written notice from the Design Professional to the Owner that sufficient cause exists to justify such action. In the event of termination of the Contract, the Owner may take possession of the Work and of all materials, tools, and equipment and construction equipment and machinery thereon and may finish the work by whatever method he may select. If the Owner does not elect to use his own forces, the surety shall furnish a competent licensed contractor within 10 working days from the written notice to the surety.

14.2.2 It shall be considered a default by the Contractor whenever he shall become insolvent; declare bankruptcy assigns assets for the benefit of his creditors; fails to provide qualified superintendence, proper materials, competent subcontractors, competent workmen; fails to make prompt payments for labor, materials, or equipment; disregards or violates provisions of the Contract Documents; disregards the Owner's, or the Design Professional's instructions; fails to prosecute the Work according to the approved schedule of completion, including extensions thereof as provided for by approved Change Orders; and fails to start the Work on the date established in the Notice to Proceed.

### **14.3 TERMINATION BY OWNER FOR CONVENIENCE**

The Owner will have the right to terminate the Contract for Convenience and without cause upon giving ten days written notice of the termination to the Contractor and Contractor's surety and UCA. Once notice is received, the Contractor shall: cease all operations as indicated by the written notice and take necessary actions or at the Owner's direction as indicated by the written notice, for the protection and preservation of the work; and terminate existing subcontractors and purchase orders upon the effective termination date as indicated in the notice and not enter into any contracts involving subcontractors or purchase orders.

If the contract is terminated upon the convenience of the Owner, the Contractor is entitled to receive payment for the work executed and accepted by the Owner, and the overhead and profit credit amount of 7% of the work that was left to be performed in the contract.

## **ARTICLE 15 – ALTERNATIVE DISPUTE RESOLUTION**

### **15.1 MEDIATION**

15.1.1 In the event of any dispute regarding the Contractor, Architect, Engineer, and/or Owner (hereinafter referred to as party/parties for this section only) under this Agreement, the party shall notify the appropriate UCA Administrator (UCA Procurement Director) in writing. The UCA Administrator or his designee will then attempt to negotiate a settlement of the dispute between the parties.

15.1.2 If the UCA Administrator, or designee, determines he is unable to negotiate a settlement between the parties, the parties may participate in mediation. A request for mediation must be made in writing to the Owner and the parties shall agree upon the location of the mediation. A Mediator mutually agreed upon by the parties shall conduct the mediation process. Mediation shall be voluntary, non-binding and all proceedings in connection with such shall be subject to this Agreement and applicable provisions of Arkansas law. Any mediation fees shall be borne equally between the parties. The parties shall coordinate mediation and the Owner shall notify of any mediation prior to it taking place. UCA Administrator or his designee may view any and all mediation proceedings. Any settlements arising out of the mediation process must be approved by UCA.

15.1.3 Notwithstanding anything to the contrary contained herein, if any dispute arises between the Parties, whether or not it requires at any time the use of dispute resolution procedures described above, in no event, nor for any reason, shall the Contractor, Architect, or Engineer interrupt the provision of services/performance to the Owner, or perform any other action that prevents, slows down, or reduces, in any way, the provisions of the Agreement unless: (a) authority to do so is granted by UCA and approved by UCA or (b) the Agreement has been terminated by the UCA. Nothing in these contract documents, including the use of mediation, shall be construed to waive the sovereign immunity of the State of Arkansas or any entities thereof.

### **15.2. ARBITRATION**

15.2.1 In the event of any dispute regarding the Contractor, Architect, Engineer, and/or Owner (hereinafter referred to as party/parties for this section only) under this Agreement, the party shall

notify the appropriate UCA Administrator (Procurement Director) in writing. The UCA Administrator or his designee will then attempt to negotiate a settlement of the dispute between the parties.

15.2.2 Claims, disputes and other matters in question between the parties may be decided by arbitration if the UCA Administrator, or designee, determines he is unable to negotiate a settlement (due to time or other reasons) between the parties, and/or the parties are unwilling to have UCA negotiate and/or the parties are unable to settle the dispute, and these issues were not resolved by mediation. Requests for arbitration must be made in writing to the Owner. The parties shall agree upon the Arbitrator, process and procedures and the location of arbitration. Arbitration while voluntary shall be binding and all proceedings in connection with such shall be subject to this Agreement and applicable provisions of Arkansas law. Any arbitration fees shall be borne equally between the parties. The parties shall coordinate arbitration and the Owner shall notify of any arbitration prior to it taking place. UCA Administrator or his designee may view any and all arbitration proceedings.

15.2.3 Notwithstanding anything to the contrary contained herein, if any dispute arises between the Parties, whether or not it requires at any time the use of dispute resolution procedures described above, in no event, nor for any reason, shall the Contractor, Architect, or Engineer interrupt the provision of services/performance to the Owner, or perform any other action that prevents, slows down, or reduces, in any way, the provisions of the Agreement unless: (a) authority to do so is granted by UCA and approved by UCA or (b) the Agreement has been terminated by UCA. Any award rendered by the arbitrator shall be final. Nothing in these contract documents, including the use of arbitration, shall be construed to waive the sovereign immunity of the State of Arkansas or any entities thereof.

**End of  
GENERAL CONDITIONS  
007213**

## **CONTRACTOR'S INSURANCE REQUIREMENTS**

### **Section 007316**

(1) Commercial General Liability: The Contractor shall obtain, at Contractor's expense, and keep in effect during the term of the contract, Commercial General Liability insurance covering bodily injury and property damage containing minimum limits of one million dollars (\$1,000,000) written on a per occurrence form with a two million dollars (\$2,000,000) aggregate limit. This insurance shall include personal injury coverage with employment exclusion deleted, and contractual liability. Such coverage shall include products and completed operations and shall not be excluded under the commercial general liability insurance. Nothing shall prohibit the University from requiring increased amounts than stated herein.

(2) Umbrella Liability: The Contractor shall be required to furnish umbrella liability coverage, and keep in effect during the term of the contract which provides excess limits over the primary coverages. Agencies must refer to the recommendation of the Risk Management division of the Arkansas Insurance Department on the minimum amount of coverage.

(3) Automobile Liability: The Contractor shall obtain, at Contractor's expense and keep in effect during the term of the contract, automobile liability insurance including hired and non-owned coverage in minimum amounts of one million dollars (1,000,000) per occurrence.

(4) Workers' Compensation and Employers' Liability: The Contractor, its subcontractors, if any and all employee providing work, labor or materials used in connection with this work.

(5) Contractor's Equipment:

(a) The Contractor shall be responsible for any loss, damage or destruction of its own property or that of any subcontractor's equipment and materials used in connection with this work.

(b) Contractor will purchase at Contractor's own sole cost and expense such policy to cover contractor's owned property.

(c) Contractor will provide waiver of subrogation to Owner.

(d) Pollution Liability: If requested by Owner at any time, Contractor shall, at Contractor's expense, obtain and maintain in force and effect for the term of the contract Pollution Liability Insurance covering losses caused by pollution conditions that result from the performance of the Contract. This requirement also applies to any consultant or contractor engaged by Contractor or performing construction, geotechnical, well drilling, abatement activities or contractor services.

(e) Pollution Liability Insurance shall cover Owner costs and liabilities attributable to bodily injury; property damage, including loss of use of damaged property or of property that has not been physically injured; clean-up cost; and defenses, including costs and expenses (including attorney's fees) incurred in the investigation, defense or settlement of claims. Contractor shall maintain such insurance in an amount of at least two million dollars (2,000,000) per loss with annual aggregate of at least five million dollars (\$5,000,000). Nothing shall prohibit the University from increasing the amounts stated herein.

(f) If coverage is written on a claims-made basis, Contractor represents that any retroactive dates applicable to coverage under the policy precedes the effective date of the letter; and that continuous coverage will be maintained or an extended discovery period will be exercised for a period of three



(3) years or as required by law beginning from the time that services under the contract are completed.

(g) If the scope of work as defined in this Contract includes the disposal of any hazardous or non-hazardous materials from the Projects site, the Contractor must furnish to the owner evidence of pollution liability insurance maintained by the disposal site operator for losses arising from the insured facility accepting waste under this Contract. Such coverage must be maintained in amounts conforming to applicable laws, rules and regulations.

(h) Remediation: Remediation Contractor shall provide liability insurance for the removal or remediation of asbestos including the transportation and disposals of asbestos waste materials from the Project site. Limits of insurance shall be not less than those required under the Commercial General Liability policy. Depending on the nature and amount of asbestos to be removed/abate, Owner may request higher limits than those required by the Commercial General Liability policy.

(i) Additional Requirements: All policies shall be provided by insurers qualified to write the respective insurance in the State of Arkansas, be in such form and include such provision as are generally considered standard provisions for the type of insurance involved.

## SECTION 01 1000 SUMMARY

### PART 1 GENERAL V.20

#### 1.01 PROJECT

- A. Project Name: UCA Schichtl HVAC Upgrades
- B. Owner's Name: University of Central Arkansas.
- C. Architect's Name: H+N Architects.
- D. The Project consists of a New HVAC System and Ceilings. The UCA Schichtl Hall HVAC Upgrades Package is intended to be completed in tandem with the UCA Schichtl Hall Renovations Package.

#### 1.02 CONTRACT DESCRIPTION

- A. The work of each separate contract is identified in this section.

#### 1.03 DESCRIPTION OF ALTERATIONS WORK

#### 1.04 WORK BY OWNER

- A. The Owner, without sacrificing their right to do so, does not plan to undertake significant work with their own forces within the construction site prior to Substantial Completion. Refer to the responsibility matrix following this section for components being performed by Owner.
- B. Owner will supply the following for installation by Contractor:
  - 1. HVAC Equipment as listed in the Referenced Equipment Procurement Package.
- C. Cooperate fully with the Owner's own forces or separate contractors, if any, so work on those contracts may be carried out smoothly, without interfering with or delaying work under this contract.

#### 1.05 OWNER OCCUPANCY

- A. Owner intends to occupy the Project upon Substantial Completion.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.

#### 1.06 CONTRACTOR USE OF SITE AND PREMISES

- A. Construction Operations: Limited to areas noted on Drawings.
  - 1. Locate and conduct construction activities in ways that will limit disturbance to site.
- B. Arrange use of site and premises to allow:
  - 1. Owner occupancy.
  - 2. Work by Others.
  - 3. Work by Owner.
- C. Do not unreasonably encumber site with materials or equipment. Confine stockpiling of materials to areas authorized by Owner.
- D. Provide access to and from site as required by law and by Owner:
  - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
  - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- E. Workers on the jobsite are to be reminded that adjunct areas are occupied and in use on the campus. **Workers will maintain a respectful attitude toward all people for the duration of the construction project. Abusive language or gestures will result in immediate dismissal from the project.**
- F. Existing building spaces may not be used for storage.
- G. Time Restrictions:
  - 1. Limit conduct of especially noisy exterior work to the hours of 7:00 am through 4:00 pm..

H. Utility Outages and Shutdown:

1. Limit disruption of utility services to hours the building is unoccupied.
2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
3. Prevent accidental disruption of utility services to other facilities.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

**SECTION 01 2000  
PRICE AND PAYMENT PROCEDURES**

**PART 1 GENERAL V.20**

**1.01 SECTION INCLUDES**

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Documentation of changes in Contract Sum and Contract Time.
- C. Change procedures.
- D. Correlation of Contractor submittals based on changes.
- E. Procedures for preparation and submittal of application for final payment.

**1.02 SCHEDULE OF VALUES**

- A. Use Schedule of Values Form: AIA G-702 Application and Certificate for Payment.
- B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
- C. Forms filled out by hand will not be accepted.
- D. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.
- E. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization.
- F. Include in each line item, the amount of Allowances specified in this section. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.
- G. Revise schedule to list approved Change Orders, with each Application For Payment.

**1.03 APPLICATIONS FOR PROGRESS PAYMENTS**

- A. Payment Period: Submit at intervals stipulated in the Agreement.
- B. Use Form AIA G702 and Form AIA G703, edition stipulated in the Agreement.
- C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
- D. Forms filled out by hand will not be accepted.
- E. For each item, provide a column for listing each of the following:
  - 1. Item Number.
  - 2. Description of work.
  - 3. Scheduled Values.
  - 4. Previous Applications.
  - 5. Work in Place and Stored Materials under this Application.
  - 6. Authorized Change Orders.
  - 7. Total Completed and Stored to Date of Application.
  - 8. Percentage of Completion.
  - 9. Balance to Finish.
  - 10. Retainage.
- F. Execute certification by signature of authorized officer.
- G. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
- H. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.
- I. Submit one electronic and three hard-copies of each Application for Payment.

**1.04 MODIFICATION PROCEDURES**

- A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.
- B. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
  - 1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
  - 2. Promptly execute the change.
- C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 15 days.
- D. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
  - 1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
- E. Substantiation of Costs: Provide full information required for evaluation.
  - 1. Provide the following data:
    - a. Quantities of products, labor, and equipment.
    - b. Taxes, insurance, and bonds.
    - c. Overhead and profit.
    - d. Justification for any change in Contract Time.
    - e. Credit for deletions from Contract, similarly documented.
- F. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.
- G. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Price.
- H. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
- I. Promptly enter changes in Project Record Documents.

#### **1.05 APPLICATION FOR FINAL PAYMENT**

- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- B. Application for Final Payment will not be considered until the following have been accomplished:
  - 1. All closeout procedures specified in Section 01 7000.

#### **PART 2 PRODUCTS - NOT USED**

#### **PART 3 EXECUTION - NOT USED**

**END OF SECTION**

## **SECTION 01 2500 SUBSTITUTION PROCEDURES**

### **PART 1 GENERAL V.20**

#### **1.01 SECTION INCLUDES**

- A. Procedural requirements for proposed substitutions.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 00 6325 - Substitution Request Form: Required form for substitution requests made after award of contract (During construction).
- B. Section 01 6000 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

#### **1.03 DEFINITIONS**

- A. General Clarification: Where a definite material is specified it is not the intent to discriminate against any equal product from another manufacturer. It is the intent to set a definite standard. Open competition is expected, but in all cases, complete data must be submitted for comparison and test when requested by Architect. No substitution shall be made unless authorized in writing by the Architect. If the Contractor proposes to substitute an equal product, he shall make this fact known, in writing, to the Architect as soon as possible after the award of the contract.
- B. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
  - 1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
    - a. Unavailability.
    - b. Regulatory changes.
  - 2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
    - a. Substitution requests offering advantages solely to the Contractor will not be considered.

### **PART 2 PRODUCTS - NOT USED**

### **PART 3 EXECUTION**

#### **3.01 GENERAL REQUIREMENTS**

- A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
  - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system including aesthetics of physical properties such as available colors, patterns and textures.
  - 2. Agrees to provide the same warranty for the substitution as for the specified product.
  - 3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
  - 4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
  - 5. Waives claims for additional costs or time extension that may subsequently become apparent.
  - 6. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.
- B. A Substitution Request for specified installer constitutes a representation that the submitter:
  - 1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.
- C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.

1. Note explicitly any non-compliant characteristics.
- D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
  1. Forms included in the Project Manual are adequate for this purpose, and must be used.
- E. Limit each request to a single proposed substitution item.
  1. Submit an electronic document, combining the request form with supporting data into single document.

### **3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT**

- A. Instructions to Bidders specifies time restrictions for submitting requests for substitutions during the bidding period, and the documents required.
- B. Submittal Form (before award of contract):
  1. Submit substitution requests by completing the form in Section 006325; see this section for additional information and instructions. Use only this form; other forms of submission are unacceptable.
  2. Lighting Fixture Substitution- Lighting Fixtures not specifically listed in the Lighting Fixture Schedule by manufacturer indicated as approved to bid must be submitted 7 days prior to bid. Provide cut sheets labeled with the mark shown in the Lighting Fixture Schedule on E0.02. Provide lighting level calculations for review. Typical lighting levels for classrooms are acceptable. Architect will review for conformance with the Design Intent. Engineer will review for conformance with technical requirements.
  3. Plumbing Fixture Substitution- Plumbing Fixtures not specifically listed in the Plumbing Fixture Schedule by manufacturers indicated as approved to bid must be submitted 7 days prior to bid. Provide cut sheets labeled with the mark shown in the Plumbing Fixture Schedule.
  4. Mechanical Equipment Substitution- Mechanical Equipment not specifically listed in the Mechanical Equipment Schedules and specifically noted in the drawings by manufacturers indicated as approved to bid must be submitted 7 days prior to bid. Provide cut sheets labeled with the mark shown in the Mechanical Equipment Schedules. Architect will review for conformance with the Design Intent. Engineer will review for conformance with technical requirements.

### **3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION**

- A. Submittal Form (after award of contract):
  1. Submit substitution requests by completing the form in Section 00 6325; see this section for additional information and instructions. Use only this form; other forms of submission are unacceptable.
- B. Architect will consider requests for substitutions only within 30 days after date of Agreement.
- C.
- D. Substitutions will not be considered under one or more of the following circumstances:
  1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
  2. Without a separate written request.
  3. When acceptance will require revisions to Contract Documents.

### **3.04 RESOLUTION**

- A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.
- B. Architect will notify Contractor in writing of decision to accept or reject request.
  1. Architect's decision following review of proposed substitution will be noted on the submitted form.

### **3.05 ACCEPTANCE**

- A. Accepted substitutions change the work of the Project. They will be recorded into submittal and any required changes to the Construction Documents will be incorporated into the work by

issuance of Change Order, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

### **3.06 CLOSEOUT ACTIVITIES**

- A. See Section 01 7800 - CLOSEOUT SUBMITTALS , for closeout submittals.
- B. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected Requests.

**END OF SECTION**



**SECTION 01 3000  
ADMINISTRATIVE REQUIREMENTS**

**PART 1 GENERAL V.20**

**1.01 SECTION INCLUDES**

- A. Electronic document submittals.
- B. Preconstruction meeting.
- C. Site mobilization meeting.
- D. Progress meetings.
- E. Construction progress schedule.
- F. Change Order requirements.
- G. Contractor Liability requirements.
- H. Coordination drawings.
- I. Submittals for review, information, and project closeout.
- J. Number of copies of submittals.
- K. Submittal procedures.

**1.02 RELATED REQUIREMENTS**

- A. Document 00 7200 - General Conditions: Dates for applications for payment.
- B. Document 00 7300 - Supplementary Conditions: Duties of the Construction Manager.
- C. Section 01 3216 - Construction Progress Schedule: Form, content, and administration of schedules.
- D. Section 01 7000 - Execution and Closeout Requirements: Additional coordination requirements.
- E. Section 01 7800 - Closeout Submittals: Project record documents.

**1.03 PROJECT COORDINATION**

- A. Cooperate with the Project Coordinator in allocation of mobilization areas of site; for field offices and sheds, for construction & delivery access, traffic, and parking facilities.
- B. During construction, coordinate use of site and facilities through the Project Coordinator.
- C. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
- D. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities.
- E. Coordinate field engineering and layout work under instructions of the Project Coordinator.
- F. Make the following types of submittals to Architect:
  - 1. Requests for interpretation.
  - 2. Requests for substitution.
  - 3. Shop drawings, product data, and samples.
  - 4. Test and inspection reports.
  - 5. Manufacturer's instructions and field reports.
  - 6. Applications for payment and change order requests.
  - 7. Progress schedules.
  - 8. Coordination drawings.
  - 9. Closeout submittals.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

### **3.01 ELECTRONIC DOCUMENT SUBMITTALS**

- A. Any documents transmitted for purposes of administration of the contract will be in electronic (PDF) format and transmitted via an Internet-based e-mail service.
  - 1. In addition to submittals for review, information, and closeout, this procedure will apply to requests for information (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, proposal requests, change orders), applications for payment, field reports and meeting minutes, and any other document the Contractor or Architect wish to make part of the project electronic record.
  - 2. Contractor and Architect will use conventional e-mail for this service, subject to the limitations of the service provider (file size).
  - 3. It is the Contractor's responsibility to submit documents in PDF format via file attachment to e-mail directed to H+N Architects. Addressee will be determined at the pre-construction conference. Documents shall be reviewed and stamped by the contractor prior to submission. PDF documents without contractors stamp, signature and/or initials, & date will not be reviewed. Each scan or PDF copy, especially large format documents or drawings, shall be individually stamped, if transmitted as individual files. Assembled documents in a single file need only be stamped once.
  - 4. Subcontractors, suppliers, and Architect's consultants are required to use the e-mail transmission of review documents, and provide copies directed to the Architect and Contractor.
  - 5. Users of the electronic document submission process shall provide an email address and Internet access. PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, [www.adobe.com](http://www.adobe.com), or Bluebeam PDF Revu, [www.bluebeam.com](http://www.bluebeam.com)), is encouraged, unless scan to PDF file capability is provided by the document generator / provider.
  - 6. Paper documents & transmittals of electronic submissions will not be reviewed; emailed PDF documents without transmittal letters / forms from the contractor will not be reviewed.
  - 7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to physical samples or color selection charts.
- B. Cost: The cost of the electronic document submittal(s) is to be paid by Contractor; include the cost of the submittals in the contract sum.
- C. Project Closeout: Architect will determine which project electronic document files shall be archived for the Owner. The contractor shall provide these documents electronically and physical components as part of the close out document submission.

### **3.02 PRECONSTRUCTION MEETING**

- A. Architect will schedule a meeting after Notice of Award.
- B. Attendance Required:
  - 1. Owner.
  - 2. Architect.
  - 3. Contractor.
- C. Agenda:
  - 1. Distribution of Contract Documents.
  - 2. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule.
  - 3. Designation of personnel representing the parties to Contract, the Owner and <1|A/E|>.
  - 4. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
  - 5. Scheduling.
- D. Record minutes and distribute copies within two days after meeting to participants, with electronic copies to Architect, Owner, participants, and those affected by decisions made.

### **3.03 SITE MOBILIZATION MEETING**

- A. Architect will schedule a meeting at the Project site prior to Contractor occupancy.
- B. Attendance Required:
  - 1. Contractor.
  - 2. Owner.
  - 3. Architect.
  - 4. Contractor's Superintendent.
  - 5. Major Subcontractors.
- C. Agenda:
  - 1. Use of premises by Owner and Contractor.
  - 2. Owner's requirements .
  - 3. Construction facilities and controls provided by Owner.
  - 4. Temporary utilities provided by Owner.
  - 5. Security and housekeeping procedures.
  - 6. Schedules.
  - 7. Application for payment procedures.
  - 8. Procedures for testing.
  - 9. Procedures for maintaining record documents.
  - 10. Requirements for start-up of equipment.
  - 11. Inspection and acceptance of equipment put into service during construction period.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

#### **3.04 PROGRESS MEETINGS**

- A. Schedule and administer meetings throughout progress of the Work at maximum monthly intervals.
- B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner, Architect, as appropriate to agenda topics for each meeting.
- D. Agenda:
  - 1. Review minutes of previous meetings.
  - 2. Review of Work progress.
  - 3. Field observations, problems, and decisions.
  - 4. Identification of problems that impede, or will impede, planned progress.
  - 5. Review of submittals schedule and status of submittals.
  - 6. Maintenance of progress schedule.
  - 7. Corrective measures to regain projected schedules.
  - 8. Planned progress during succeeding work period.
  - 9. Maintenance of quality and work standards.
  - 10. Effect of proposed changes on progress schedule and coordination.
  - 11. Other business relating to Work.
- E. Record minutes and distribute copies within two days after meeting to participants, with electronic copies to Architect, Owner, participants, and those affected by decisions made.

#### **3.05 CONSTRUCTION PROGRESS SCHEDULE - SEE SECTION 01 3216**

- A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
  - 1. Include written certification that major contractors have reviewed and accepted proposed schedule.

- D. Within 10 days after joint review, submit complete schedule.
- E. Submit updated schedule with each Application for Payment.

### **3.06 COORDINATION DRAWINGS**

- A. Provide information required by Project Coordinator for preparation of coordination drawings.
- B. Review drawings prior to submission to Architect.

### **3.07 DIGITAL DOCUMENT FILES AND RELEASES**

- A. BIM Models: Projects are created by Architect using Building Information Modelling software and not all projects will have these files available for Contractor's use. Contact Architect for specific availability and cost.
- B. AutoCAD files: Do not exist for architectural plans. Architect has capability to generate AutoCAD files that resemble the sheets as seen in the Construction Documents as well as generate entire floor plans of the building. This service can be provided at a cost to the Contractor per sheet/floor plan desired. See end of section for Digital Release form.
- C. Portable Digital Format (PDF): PDF of issued drawings can be provided to Contractor at no cost. Contact Architect for availability.
- D. Other documents: Contractor will have to directly contact consultants for trade specific files, such as AutoCAD files for topographical layout, etc.

### **3.08 REQUESTS FOR CHANGE ORDERS**

- A. In order to facilitate checking of quotations for extras or credits, all proposals, except for those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs including labor, materials and subcontracts. Labor and materials shall be itemized in manner prescribed above. Where major cost items are subcontracts, they shall be itemized also.

### **3.09 CONTRACTOR LIABILITY REQUIREMENTS**

- A. The Contractor shall cause the commercial liability coverage required by the Contract Documents to include (1) the Owner, the Architect Engineer and the Architect Engineer's consultants as additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's completed operations. The Architect / Engineer, Engineer, and their respective Consultants are responsible for their own Professional Liability coverage.

### **3.10 SUBMITTALS FOR REVIEW**

- A. When the following are specified in individual sections, submit them for review:
  - 1. Product data.
  - 2. Shop drawings.
  - 3. Samples for selection.
  - 4. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
- C. Samples will be reviewed only for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 - CLOSEOUT SUBMITTALS.

### **3.11 SUBMITTALS FOR INFORMATION**

- A. When the following are specified in individual sections, submit them for information:
  - 1. Design data.
  - 2. Certificates.
  - 3. Test reports.
  - 4. Inspection reports.

5. Manufacturer's instructions.
  6. Manufacturer's field reports.
  7. Other types indicated.
- B. Submit for Architect's knowledge as contract administrator or for Owner. No action will be taken.

### **3.12 SUBMITTALS FOR PROJECT CLOSEOUT**

- A. When the following are specified in individual sections, submit them at project closeout:
1. Project record documents.
  2. Operation and maintenance data.
  3. Warranties.
  4. Bonds.
  5. Other types as indicated.
- B. Submit for Owner's benefit during and after project completion.

### **3.13 NUMBER OF COPIES OF SUBMITTALS**

- A. Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
- B. Documents for Information: Submit one electronic copy.
- C. Documents for Project Closeout: Make electronic reproductions of submittal files originally reviewed. Include electronic files of any submittals for information. All hard copies of Operational Manuals included with products and equipment should be collected and retained for close out documentation.
- D. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
1. After review, produce duplicates required for jobsite use & verification.
  2. Retained samples will not be returned to Contractor unless specifically so stated. Digital documentation of approved samples will be provided.

### **3.14 SUBMITTAL PROCEDURES**

- A. Transmit each submittal with approved form and Contractors transmittal form. Transmittal shall be numbered sequentially and revised submittals should include original number and a sequential alphabetic suffix. Transmittal shall include list of each specification section or sections that are included in the submittal contents. Send transmitted submittal as one complete PDF; multiple files will not be reviewed and will need to be reassembled by Contractor.
- B. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number.
- C. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.
- D. Deliver physical submittals to Architect at business address. In some instances, larger physical samples can be coordinated to be delivered to the construction site, typically for use in a mock-up.
- E. Schedule submittals to expedite the Project, and coordinate submission of related items. Transmit higher priority submittals first and provide date for anticipated return of submittal.
- F. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor. When large quantities of submittals are transmitted in a short time frame, review time may take longer. Mark high priority submittals on transmittal to notify / assist in an expedited review.
- G. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work. Any proposed change or deviation from Contract Document plans or specifications must be clearly noted and easily identifiable on the submittal. Any change must be identified and specifically requesting approval of proposed deviation by Architect or Engineer of Record. Failure to follow this

requirement results in submitted deviation bearing the complete responsibility of the contractor.

- H. Provide space for Contractor and Architect review stamps. Submittals must be reviewed and stamped by Contractor, unstamped submittals will not be reviewed and will be returned.
- I. Submittals to be as complete, comprehensive and accurate as possible. Include all components requested to be reviewed in Submittal section 1.03 of the specifications. Do not split up a single specification section into multiple submittals (ie product data, samples, shop drawings, etc.). Avoid grouping unrelated specifications sections together in a submittal.
- J. Each submittals will only be reviewed two times; once for original review and then a second time for a potential revised submittal. Any further additional reviews must include General Contractor's explanation for their inability to conform with requirements. Additional reviews beyond aforementioned may have costs associated to complete additional reviews.
- K. When revised for resubmission, identify all changes made since previous submission. Cloud all changes and revised details / notes. Address all comments and/or questions posed in previous submission; lack of addressing all previous review comments are grounds for rejections of submittal. Include previous reviewed submittal pages after the last page of the new submittal information.
- L. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.
- M. Submittals not requested will not be recognized or processed.

### 3.15 AUTOCAD RELEASE FORM

- A. At your request, H+N Architects will provide electronic files for your convenience and use in the preparation of a bid or shop drawings related to Project: \_\_\_\_\_ subject to the following terms and conditions.
- B. H+N Architects electronic files are compatible with AutoCad as a dwg. file. H+N Architects makes no representation as to the compatibility of these files with your hardware or your software beyond the specified release of the referenced specifications.
- C. Data contained on these electronic files is part of H+N Architects instruments of service and shall not be used by you or anyone else receiving this data through or from you for any purpose other than as a convenience in the preparation of bids or shop drawings for the referenced project. Any other use or reuse by you or by others, will be at your sole risk and without liability or legal exposure to H+N Architects. You agree to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against H+N Architects, its officers, directors, employees, agents or sub-consultants which may arise out of or in connection with your use of the electronic files.
- D. Furthermore, you shall, to the fullest extent permitted by law, indemnify and hold harmless H+N Architects from all claims, damages, losses and expenses, including attorney's fees arising out of or resulting from your use of these electronic files.
- E. **These electronic files are not contract documents.** Differences may exist between these electronic files and corresponding hard copy contract documents due to addenda, change orders or other revisions. H+N Architects makes no presentation regarding the accuracy or completeness of the electronic files you receive. In the event that a conflict arises between the signed contract documents prepared by H+N Architects and electronic files, the signed contract documents shall govern. You are responsible for determining if any conflict exists. By your use of these electronic files, you are not relieved of your duty to fully comply with the contract documents, including and without limitations, the need to check, confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate your work with that of other contractors for the project.
- F. Because of the potential that the information presented on the electronic files can be modified, unintentionally or otherwise, H+N Architects reserves the right to remove all indications of its ownership and/or involvement from each electronic display.
- G. H+N Architects will furnish you electronic files at a cost of **\$150.00** per building floor or sheet, for the following:
1. \_\_\_\_\_
  2. \_\_\_\_\_
  3. \_\_\_\_\_
- A service fee of \$ ( \_\_\_\_\_ ) shall be remitted to H+N Architects prior to delivery of the electronic files.
- H. Under no circumstances shall delivery of the electronic files for use by you be deemed a sale by H+N Architects and H+N Architects makes no warranties, either express or implied, of merchantability and fitness for any particular purpose. In no event shall H+N Architects be liable for any loss of profit or any consequential damages.

**SIGNED:**

\_\_\_\_\_  
**H+N ARCHITECTS**

\_\_\_\_\_  
**CONTRACTOR NAME / TITLE**

\_\_\_\_\_  
**DATE:**

\_\_\_\_\_  
**ADDRESS / PHONE NUMBER**

**END OF SECTION**

**SECTION 01 3216  
CONSTRUCTION PROGRESS SCHEDULE**

**PART 1 GENERAL V.20**

**1.01 SECTION INCLUDES**

- A. Preliminary schedule.
- B. Construction progress schedule, bar chart type.

**1.02 SUBMITTALS**

- A. Within 10 days after date of Agreement, submit preliminary schedule.
- B. Within 10 days after joint review, submit complete schedule.

**1.03 QUALITY ASSURANCE**

- A. Scheduler: Contractor's personnel or specialist Consultant specializing in CPM scheduling with one years minimum experience in scheduling construction work of a complexity comparable to this Project, and having use of computer facilities capable of delivering a detailed graphic printout within 48 hours of request.

**1.04 SCHEDULE FORMAT**

- A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.
- B. Diagram Sheet Size: Maximum 22 x 17 inches. Provide electronic file(s) in PDF format.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 PRELIMINARY SCHEDULE**

- A. Prepare preliminary schedule in the form of a horizontal bar chart.

**3.02 CONTENT**

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify each item by specification section number.
- C. Provide sub-schedules to define critical portions of the entire schedule.
- D. Include conferences and meetings in schedule.
- E. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- F. Provide separate schedule of submittal dates for shop drawings, product data, and samples, owner-furnished products, products identified under Allowances, and dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes.
- G. Indicate delivery dates for owner-furnished products.
- H. Provide legend for symbols and abbreviations used.

**3.03 BAR CHARTS**

- A. Include a separate bar for each major portion of Work or operation.
- B. Identify the first work day of each week.

**3.04 REVIEW AND EVALUATION OF SCHEDULE**

- A. Participate in joint review and evaluation of schedule with Architect at each submittal.
- B. Evaluate project status to determine work behind schedule and work ahead of schedule.
- C. After review, revise as necessary as result of review, and resubmit within 10 days.

**3.05 UPDATING SCHEDULE**



- A. Maintain schedules to record actual start and finish dates of completed activities. Revised schedules should show original baseline start and finish dates for activities in comparison with actual work started and completed.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity.
- C. Annotate diagrams to graphically depict current status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Submit reports required to support recommended changes.
- G. Provide narrative report to define problem areas, anticipated delays, and impact on the schedule. Report corrective action taken or proposed and its effect.

### **3.06 DISTRIBUTION OF SCHEDULE**

- A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Architect, Owner, and other concerned parties.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

**END OF SECTION**

**SECTION 01 5000  
TEMPORARY FACILITIES AND CONTROLS**

**PART 1 GENERAL V.20**

**1.01 SECTION INCLUDES**

- A. Temporary utilities.
- B. Temporary telecommunications services.
- C. Temporary sanitary facilities.
- D. Temporary Controls: Barriers, enclosures, and fencing.
- E. Security requirements.
- F. Vehicular access and parking.
- G. Waste removal facilities and services.
- H. Project identification sign.
- I. Field offices.

**1.02 TEMPORARY UTILITIES**

- A. Owner will provide the following:
  - 1. Electrical power , consisting of connection to existing facilities.
  - 2. Water supply, consisting of connection to existing facilities.
- B. Provide and pay for all lighting, heating and cooling, and ventilation required for construction purposes.
- C. Existing facilities may not be used.
- D. Use trigger-operated nozzles for water hoses, to avoid waste of water.

**1.03 TELECOMMUNICATIONS SERVICES**

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
- B. Provide telephone, cellular phone, and high-speed internet connection to jobsite.
- C. Provide on jobsite capacity of viewing and printing out physical copies of electronic versions of construction documents, submittals, RFIs, ASI, etc.

**1.04 TEMPORARY SANITARY FACILITIES**

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. Maintain daily in clean and sanitary condition.

**1.05 BARRIERS**

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

**1.06 FENCING**

- A. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.
- B. Used material may be used for construction fence. Provide duplicate keys of any gate lock to Owner. Contractor to be responsible for maintenance of fence for duration of project.

**1.07 SECURITY**

- A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

#### **1.08 VEHICULAR ACCESS AND PARKING**

- A. Coordinate access and haul routes with governing authorities and Owner.
- B. Provide and maintain access to fire hydrants, free of obstructions.
- C. Provide means of removing mud from vehicle wheels before entering streets.
- D. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

#### **1.09 WASTE REMOVAL**

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site periodically.
- C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

#### **1.10 PROJECT IDENTIFICATION**

- A. Provide project identification sign of design and construction as detailed by Architect.
- B. Erect on site at location established by Architect.
- C. Project Identification Signs:
  - 1. One painted sign, 64 square feet area, bottom 3 feet above ground.
  - 2. Content:
    - a. Project title, logo and name of Owner as indicated on Contract Documents.
    - b. Names and titles of authorities.
    - c. Names and titles of Architect/Engineer.
    - d. Name of Prime Contractor.
  - 3. Graphic Design, Colors, Style of Lettering: Designated by Architect/Engineer.
- D. Sign Materials:
  - 1. Structure and Framing: New wood, structurally adequate.
  - 2. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4-inch thick, standard large sizes to minimize joints.
  - 3. Paint and Primers: Exterior quality, two coats; sign background of color as selected.
  - 4. Lettering: Exterior quality paint, contrasting colors as selected.
- E. Installation:
  - 1. Install project identification signs within 15 days after date fixed by Notice to Proceed.
  - 2. Erect at location directed by the Architect.
  - 3. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
  - 4. Install signs surface plumb and level, with butt joints. Anchor securely.
  - 5. Paint exposed surfaces of signs, supports, and framing.
- F. Maintenance: Maintain signs and supports clean, repair deterioration and damage.
- G. Removal: Remove signs, framing, supports, and foundations at completion of Project and restore the area.
- H. No other signs are allowed without Owner permission except those required by law.

#### **1.11 FIELD OFFICES**

- A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.

- B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.
- C. Locate offices a minimum distance of 30 feet from existing and new structures.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

**SECTION 01 6000  
PRODUCT REQUIREMENTS**

**PART 1 GENERAL V.20**

**1.01 SECTION INCLUDES**

- A. General product requirements.
- B. Re-use of existing products.
- C. Transportation, handling, storage and protection.
- D. Product option requirements.
- E. Substitution limitations.
- F. Procedures for Owner-supplied products.
- G. Maintenance materials, including extra materials, spare parts, tools, and software.

**1.02 REFERENCE STANDARDS**

- A. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

**1.03 SUBMITTALS**

- A. Proposed Products List: Submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
  - 1. Submit within 15 days after date of Agreement.
  - 2. For products specified only by reference standards, list applicable reference standards.
- B. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, warranties and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- C. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- D. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
  - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

**PART 2 PRODUCTS**

**2.01 EXISTING PRODUCTS**

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.
- B. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.
- C. Reused Products: Reused products include materials and equipment previously used in this or other construction, salvaged and refurbished as specified.

**2.02 NEW PRODUCTS**

- A. Provide new products unless specifically required or permitted by Contract Documents.
- B. Use of products having any of the following characteristics is not permitted:
  - 1. Made of wood from newly cut old growth timber.
- C. Where other criteria are met, Contractor shall give preference to products that:
  - 1. If used on interior, have lower emissions, as defined in Section 01 6116.
  - 2. If wet-applied, have lower VOC content, as defined in Section 01 6116.
  - 3. Are extracted, harvested, and/or manufactured closer to the location of the project.
  - 4. Have longer documented life span under normal use.

5. Result in less construction waste. See Section 01 7419
6. Are made of recycled materials.
7. Are Cradle-to-Cradle Certified.
8. Have a published GreenScreen Chemical Hazard Analysis.

D. Provide interchangeable components of the same manufacture for components being replaced.

### **2.03 PRODUCT OPTIONS**

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

### **2.04 MAINTENANCE MATERIALS**

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

### **2.05 WARRANTY**

- A. For all products, where no specific extended warranty period has been identified, provide no less than manufacturer's standard warranty for product line for quality grade specified.

## **PART 3 EXECUTION**

### **3.01 SUBSTITUTION LIMITATIONS**

- A. See Section 01 2500 - Substitution Procedures.

### **3.02 OWNER-SUPPLIED PRODUCTS**

- A. Owner's Responsibilities:
  1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
  2. Arrange and pay for product delivery to site.
  3. On delivery, inspect products jointly with Contractor.
  4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
  5. Arrange for manufacturers' warranties, inspections, and service.
- B. Contractor's Responsibilities:
  1. Review Owner reviewed shop drawings, product data, and samples. Notify Owner and Architect immediately if supplied product affects installed final work.
  2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
  3. Handle, store, install and finish products.
  4. Repair or replace items damaged after receipt.

### **3.03 TRANSPORTATION AND HANDLING**

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

#### **3.04 STORAGE AND PROTECTION**

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 7419.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Provide off-site storage and protection when site does not permit on-site storage or protection.
- G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- H. Comply with manufacturer's warranty conditions, if any.
- I. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- J. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- K. Prevent contact with material that may cause corrosion, discoloration, or staining.
- L. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- M. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

**END OF SECTION**

**SECTION 01 7000  
EXECUTION AND CLOSEOUT REQUIREMENTS**

**PART 1 GENERAL V.20**

**1.01 SECTION INCLUDES**

- A. Examination, preparation, and general installation procedures.
- B. Requirements for alterations work, and selective demolition.
- C. Pre-installation meetings.
- D. Cutting and patching.
- E. Surveying for laying out the work.
- F. Cleaning and protection.
- G. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

**1.02 REFERENCE STANDARDS**

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations 2022, with Errata (2021).

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
  - 1. On request, submit documentation verifying accuracy of survey work.
  - 2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
  - 3. Submit surveys and survey logs for the project record.
- C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
  - 1. Structural integrity of any element of Project.
  - 2. Integrity of weather exposed or moisture resistant element.
  - 3. Efficiency, maintenance, or safety of any operational element.
  - 4. Visual qualities of sight exposed elements.
  - 5. Work of Owner or separate Contractor.

**1.04 QUALIFICATIONS**

- A. For surveying work, employ a land surveyor registered in the State of Arkansas and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

**1.05 PROJECT CONDITIONS**

- A. Use of explosives is not permitted.
- B. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

**1.06 COORDINATION**

- A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Notify affected utility companies and comply with their requirements.
- C. Verify that utility requirements and characteristics of new 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.



- D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of work of separate sections.
- G. 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.

## **PART 2 PRODUCTS**

### **2.01 PATCHING MATERIALS**

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

### **3.02 PREPARATION**

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

### **3.03 PREINSTALLATION MEETINGS**

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
  1. Review conditions of examination, preparation and installation procedures.
  2. Review coordination with related work.

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

### **3.04 LAYING OUT THE WORK**

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- F. Utilize recognized engineering survey practices.
- G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
  - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
  - 2. Grid or axis for structures.
  - 3. Building foundation, column locations, and ground floor elevations.
- H. Periodically verify layouts by same means.
- I. Maintain a complete and accurate log of control and survey work as it progresses.

### **3.05 GENERAL INSTALLATION REQUIREMENTS**

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

### **3.06 ALTERATIONS**

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
  - 1. Verify that construction and utility arrangements are as indicated.
  - 2. Report discrepancies to Architect before disturbing existing installation.
  - 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Remove existing work as indicated and as required to accomplish new work.
  - 1. Remove items indicated on drawings.
  - 2. Relocate items indicated on drawings.
  - 3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
  - 4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- C. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
  - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.

2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
  3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
    - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
    - b. Provide temporary connections as required to maintain existing systems in service.
  4. Verify that abandoned services serve only abandoned facilities.
  5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.
- D. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
  2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
  3. Repair adjacent construction and finishes damaged during removal work.
- E. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
- F. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- G. Refinish existing surfaces as indicated:
1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
  2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.
- H. Clean existing systems and equipment.
- I. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- J. Do not begin new construction in alterations areas before demolition is complete.
- K. Comply with all other applicable requirements of this section.

### **3.07 CUTTING AND PATCHING**

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. See Alterations article above for additional requirements.
- C. Perform whatever cutting and patching is necessary to:
  1. Complete the work.
  2. Fit products together to integrate with other work.
  3. Provide openings for penetration of mechanical, electrical, and other services.
  4. Match work that has been cut to adjacent work.
  5. Repair areas adjacent to cuts to required condition.
  6. Repair new work damaged by subsequent work.
  7. Remove samples of installed work for testing when requested.
  8. Remove and replace defective and non-complying work.
- D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

- F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- G. Restore work with new products in accordance with requirements of Contract Documents.
- H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.
- J. Patching:
  - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
  - 2. Match color, texture, and appearance.
  - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

### **3.08 PROGRESS CLEANING**

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

### **3.09 PROTECTION OF INSTALLED WORK**

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

### **3.10 ADJUSTING**

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

### **3.11 FINAL CLEANING**

- A. Use cleaning materials that are nonhazardous.
- B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- C. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

- E. Clean filters of operating equipment.
- F. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
- G. Clean site; sweep paved areas, rake clean landscaped surfaces.
- H. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

### **3.12 CLOSEOUT PROCEDURES**

- A. Make submittals that are required by governing or other authorities.
- B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
- D. Submit written certification containing Contractor's Correction Punch List, 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 Substantial Completion inspection.
- E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
- F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

### **END OF SECTION**

**SECTION 01 7800  
CLOSEOUT SUBMITTALS**

**PART 1 GENERAL V.20**

**1.01 SECTION INCLUDES**

- A. Project Completion Documents.
- B. Project Record Documents.
- C. Operation and Maintenance Manuals.
- D. Warranties and bonds.

**1.02 SUBMITTALS**

- A. Close Out Document Manuals: All information to be scanned to digital format and submitted to Architect. Retain all hard copies for one complete set for the Owner. Submit complete sets of the following:
  - 1. Project Completion Documents:
  - 2. Project Record Documents:
  - 3. Operation and Maintenance Manuals:
- B. Final Application for Payment: Submit fully executed

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 PROJECT COMPLETION DOCUMENTS**

- A. Project Directory: Include list of all Contractors, Owner, Architects, Engineers, Subcontractor and prime material suppliers. List to include trade involved, primary contact name, phone number, mailing address and email address.
- B. Waiver of Liens: Provide for all trades and prime material suppliers.
- C. Warranties: Submit for contractors installation warranty, manufacturer's warranties and warranties for equipment or component parts of equipment. Warranty begins on the date of acceptance
  - 1. Submit for contractors installation warranty, manufacturer's warranties and warranties for equipment or component parts of equipment.
  - 2. Warranties begin on the Date of Substantial Completion, unless delayed or specifically excluded.
  - 3. For items of Work for which acceptance is delayed beyond the Date of Substantial Completion, the listing date of acceptance is the beginning of the warranty period.
  - 4. Verify that documents are in proper form, contain full information, and are notarized.
  - 5. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.
- D. Certificate of Substantial Completion: Provide fully executed form with punch list attached.
- E. Contractor's Punch List: Provide completed list of items requiring completion or correction. Include any attachments for revisions provided by Architect and/or Engineer. Punch list should be noted that all items were corrected and completed with trade responsible identified.
- F. Certificate of Occupancy: Provide form as issued for authority having jurisdiction.
- G. Consent of Surety: Provide fully executed surety letter when project has associated bonds provided by contractor.

**3.02 PROJECT RECORD DOCUMENTS**

- A. Record Drawings : Legibly mark construction drawings with each item to record actual construction including the following:
  - 1. Measured depths of foundations in relation to finish first floor datum.
  - 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
  4. Field changes of dimension and detail.
  5. Details not on original Contract drawings.
  6. Changes made by Addenda and Change Orders.
  7. Record information concurrent with construction progress.
- B. 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, Change Orders and other modifications.
- C. Addenda: Insure all addenda items have been included and posted to record documents.
- D. Change Orders: Include all executed Change Orders, Allowance purchases and other modifications to the contract.
- E. Submittals, Shop Drawings, Product Data and Samples:
1. Shop Drawings: Include records of manufacturer's instruction for assembly, installation and adjusting.
  2. Product Data: Include list of all products and model number provided.
  3. Samples: Include material samples of all selected interior finishes. Samples to include label indicating manufacturer, product model number, color, finish and other identifying elements. Full color photographs are acceptable for larger samples.
- F. Test Reports and Special Inspections:
- G. Maintain on site a complete set of record documents; record actual revisions to the Work:
- H. Ensure entries are complete and accurate, enabling future reference by Owner.
- I. Store record documents separate from documents used for construction.
- J. Record information concurrent with construction progress.

### **3.03 OPERATION AND MAINTENANCE MANUAL GENERAL**

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

### **3.04 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES**

- A. For Each Product, Applied Material, and Finish:
  1. Product data, with catalog number, size, composition, and color and texture designations.
  2. Information for re-ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

### **3.05 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS**

- A. Provide schedule of all equipment that require instruction on operation and/or continual maintenance. Coordinate instruction for all equipment with Owner and/or Owner's

Representative and record name and contact information of all in attendance. Video recording of instructions provided is recommended.

- B. For Each Item of Equipment and Each System:
  - 1. Description of unit or system, and component parts.
  - 2. Identify function, normal operating characteristics, and limiting conditions.
  - 3. Include performance curves, with engineering data and tests.
  - 4. Complete nomenclature and model number of replaceable parts.
- C. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- D. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- G. Provide servicing and lubrication schedule, and list of lubricants required.
- H. Include manufacturer's printed operation and maintenance instructions.
- I. Include sequence of operation by controls manufacturer.
- J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- K. Additional Requirements: As specified in individual product specification sections.

### **3.06 CLOSE OUT DOCUMENT MANUALS**

- A. Provide all Close Out information in digital format, saved in PDF files, and neatly organized for ease of navigation. Arrange by Specification Sections as Table of Contents. Architect can provide file format for use as needed.
- B. Where paper documents are provided by manufacturers, scan into records and combine and include into Hard Copy Close Out Documents.
- C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- F. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
- G. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- H. Arrange content by systems under specification section numbers and sequence of Table of Contents of this Project Manual.
- I. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:
  - 1. Operating instructions.
  - 2. Maintenance instructions for equipment and systems.
  - 3. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.



4. Air and water balance reports.
  5. Certificates.
  6. Photocopies of warranties and bonds.
- J. Provide a listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.
  - K. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect , Consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.
  - L. Arrange digital PDF copies of documents in similar fashion using file folders. Name file type with simple explanation of contents using shortest file names type possible. Provide digital files on flash USB drives.
  - M. Provide owner training videos saved electronically and transmitted in USB drives. Provide sign-in sheets for all attendees for Owner Training sessions and include in closeouts.

**END OF SECTION**

## **SECTION 02 4100 DEMOLITION**

### **PART 1 GENERAL V.20**

#### **1.01 SECTION INCLUDES**

- A. Selective demolition of building elements for alteration purposes.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 01 1000 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 01 1000 - Summary: Description of items to be salvaged or removed for re-use by Contractor.
- C. Section 01 5000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- D. Section 01 6000 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- E. Section 01 7000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
- F. Section 31 2323 - Fill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

#### **1.03 REFERENCE STANDARDS**

- A. 29 CFR 1926 - Safety and Health Regulations for Construction Current Edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations 2022, with Errata (2021).

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Site Plan: Showing:
  - 1. Areas for temporary construction and field offices.
- C. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

### **PART 2 PRODUCTS**

#### **2.01 MATERIALS**

- A. Fill Material: As specified in Section 31 2323 - Fill.

### **PART 3 EXECUTION**

#### **3.01 SCOPE**

- A. Remove other items indicated, for salvage, relocation, and recycling.
- B. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as specified in Section 31 2200.

#### **3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS**

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
  - 1. Obtain required permits.
  - 2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
  - 3. Provide, erect, and maintain temporary barriers and security devices.
  - 4. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
  - 5. Do not close or obstruct roadways or sidewalks without permit.

6. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
  7. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.
  - C. Protect existing structures and other elements that are not to be removed.
    1. Provide bracing and shoring.
    2. Prevent movement or settlement of adjacent structures.
    3. Stop work immediately if adjacent structures appear to be in danger.

### **3.03 EXISTING UTILITIES**

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

### **3.04 SELECTIVE DEMOLITION FOR ALTERATIONS**

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
  1. Verify that construction and utility arrangements are as indicated.
  2. Report discrepancies to Architect before disturbing existing installation.
  3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Remove existing work as indicated and as required to accomplish new work.
  1. Remove items indicated on drawings.
- C. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
  1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
  2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
  3. Verify that abandoned services serve only abandoned facilities before removal.
  4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- D. Protect existing work to remain.
  1. Prevent movement of structure; provide shoring and bracing if necessary.
  2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
  3. Repair adjacent construction and finishes damaged during removal work.
  4. Patch as specified for patching new work.

### **3.05 DEBRIS AND WASTE REMOVAL**

**SECTION 09 2116  
GYPSUM BOARD ASSEMBLIES**

**PART 1 GENERAL V.20**

**1.01 SECTION INCLUDES**

- A. Performance criteria for gypsum board assemblies.
- B. Metal partition and soffit framing.
- C. Metal channel ceiling framing.
- D. Acoustic insulation.
- E. Cementitious backing board.
- F. Gypsum wallboard.
- G. Joint treatment and accessories.
- H. Framing Accessories.

**1.02 REFERENCE STANDARDS**

- A. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board 2017 (Reapproved 2022).
- B. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members 2018.
- C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.
- D. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products 2020.
- E. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2020.
- F. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness 2022.
- G. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs 2022.
- H. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base 2019.
- I. ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.
- J. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels 2019, with Editorial Revision (2020).
- K. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2021.
- L. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
- M. ASTM E413 - Classification for Rating Sound Insulation 2022.
- N. GA-216 - Application and Finishing of Gypsum Panel Products 2021.
- O. GA-600 - Fire Resistance and Sound Control Design Manual 2021.
- P. UL (FRD) - Fire Resistance Directory Current Edition.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
  - 1. Indicate special details associated with fireproofing and acoustical seals.
  - 2. Indicate component details, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories, and items of other related

- work.
3. Describe method for securing studs to track, splicing, and for blocking and reinforcing of framing connections.
  4. Provide partition legend indicating proposed assembly components at each partition type.
- C. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system. Include framing load charts and limitations.
- D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- E. Test Reports: For stud framing products that do not comply with ASTM C645 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

#### **1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 5 years of documented experience.

#### **1.05 MOCK-UP**

- A. Provide mock-up of stud wall, ceiling, and soffit framing including insulation, sheathing, window frame, and door frame and finish specified in other sections. Coordinate installation of associated work specified in other sections.
1. Mock-up may remain part of finish work.

### **PART 2 PRODUCTS**

#### **2.01 GYPSUM BOARD ASSEMBLIES**

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
1. See PART 3 for finishing requirements.
- B. Interior Partitions, Indicated as Acoustic and/or STC on partition schedule: Provide completed assemblies with the following characteristics:
1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
  2. Treat all penetrations and perimeters of wall assembly with acoustical sealant, both sides of wall.
- C. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
  2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- D. Shaft Walls at Elevator Shafts: Provide completed assemblies with the following characteristics:
1. Air Pressure Within Shaft: Intermittent loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
  2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- E. Fire Rated Assemblies: Provide completed assemblies as indicated on partition schedule and complying with applicable code.
1. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

#### **2.02 METAL FRAMING MATERIALS**

- A. Manufacturers - Metal Framing, Connectors, and Accessories:
1. ClarkDietrich: [www.clarkdietrich.com/#sle](http://www.clarkdietrich.com/#sle).
  2. Marino: [www.marinoware.com/#sle](http://www.marinoware.com/#sle).
  3. Phillips Manufacturing Co: [www.phillipsmfg.com/#sle](http://www.phillipsmfg.com/#sle).
  4. Substitutions: See Section 01 6000 - Product Requirements.

- B. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf, with steel thickness not less than 20 gauge (30 mils). Adjust steel thickness to comply with deflection with stud heights. Walls with tile or masonry veneer, comply with deflection of wall framing of L/360 at 5psf.
  - 1. Studs: "C" shaped with knurled or embossed faces.
  - 2. Runners: U shaped, sized to match studs.
  - 3. Ceiling Channels: C-shaped.
  - 4. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch.
- C. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
- D. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.
- E. Tracks and Runners: Same material and thickness as studs, bent leg retainer notched to receive studs.
- F. Furring and Bracing Members: Of same material as studs; thickness to suit purpose; complying with applicable requirements of ASTM C754.
- G. Metal Framing Fasteners: ASTM C1002 self-piercing tapping screws.
- H. Sheet Metal Backing: 0.036 inch thick, galvanized.
- I. Partial Height partitions: Use steel wall stiffeners bolted to floor surface and stud framing at 48" o.c., minimum of two per wall. Provide No-Flex Stud Stiffeners, or approved equal. [www.noflex.com](http://www.noflex.com).

## 2.03 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
  - 1. American Gypsum Company: [www.americangypsum.com/#sle](http://www.americangypsum.com/#sle).
  - 2. Georgia-Pacific Gypsum: [www.gpgypsum.com/#sle](http://www.gpgypsum.com/#sle).
  - 3. National Gypsum Company: [www.nationalgypsum.com/#sle](http://www.nationalgypsum.com/#sle).
  - 4. Temple-Inland Building Product by Georgia-Pacific, LLC: [www.temple.com](http://www.temple.com).
  - 5. USG Corporation: [www.usg.com/#sle](http://www.usg.com/#sle).
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
  - 1. Application: Use for standard vertical surfaces and ceilings, unless otherwise indicated.
  - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
    - a. Mold-resistant board is required whenever board is being installed before the building is enclosed and conditioned.
    - b. Mold resistant board is required at all toilet rooms, janitor closets, laundry rooms, kitchen and similar wet area at all wet locations such as: Locker, shower, toilet rooms, kitchens, janitor closets, etc and behind plumbing fixtures locations. Also refer to partition schedule and locations otherwise noted.
  - 3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
  - 4. Thickness:
    - a. Vertical Surfaces: 5/8 inch.
    - b. Ceilings: 5/8 inch., sag resistant.
  - 5. Paper-Faced Products:
    - a. American Gypsum Company; LightRoc Gypsum Wallboard.
    - b. Georgia-Pacific Gypsum; ToughRock.
    - c. Georgia-Pacific Gypsum; ToughRock Fireguard X.
    - d. Georgia-Pacific Gypsum; ToughRock Fireguard C.
    - e. Substitutions: See Section 01 6000 - Product Requirements.
  - 6. Mold Resistant Paper Faced Products:

- a. American Gypsum Company; M-Bloc.
  - b. Continental Building Products; Mold Defense Type X.
  - c. Georgia-Pacific Gypsum; ToughRock Mold-Guard.
  - d. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold-Guard.
  - e. National Gypsum Company; Gold Bond XP Gypsum Board.
  - f. Lafarge North America Inc; Mold Defense Drywall.
  - g. National Gypsum Company; Gold Bond Brand XP Gypsum Board.
  - h. Temple-Inland Building Product by Georgia-Pacific, LLC; ComfortGuard Mold Resistant Gypsum Board.
  - i. USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels.
- C. Tile Backer Board: As specified in section 09 3000.
  - D. Exterior Sheathing Board: As specified in Section 06 1000.
  - E. Shaftwall and Coreboard: Type X; 1 inch thick by 24 inches wide, beveled long edges, ends square cut.
    - 1. Glass Mat Faced Type: Glass mat shaftliner gypsum panel or glass mat coreboard gypsum panel as defined in ASTM C1658/C1658M.
    - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.

#### **2.04 GYPSUM WALLBOARD ACCESSORIES**

- A. Acoustic Insulation: As specified in Section 07 2100.
- B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
- C. Acoustic Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board.
- D. Water-Resistive Barrier: As specified in Section 07 2500.
- E. Finishing Accessories: ASTM C1047, galvanized steel, pre-approved rigid plastic, rolled zinc, pre-approved rigid plastic, or pre-approved rigid plastic, unless noted otherwise.
  - 1. Types: As detailed or required for finished appearance.
  - 2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.
  - 3. Products:
    - a. Phillips Manufacturing Co: [www.phillipsmfg.com/#sle](http://www.phillipsmfg.com/#sle).
    - b. Trim-tex, Inc: [www.trim-tex.com/#sle](http://www.trim-tex.com/#sle).
    - c. Fry Reglet Corporation; [www.fryreglet.com](http://www.fryreglet.com)
    - d. Substitutions: See Section 01 6000 - Product Requirements.
- F. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
  - 1. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
  - 2. Paper Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
  - 3. Joint Compound: Drying type, vinyl-based, ready-mixed.
  - 4. Joint Compound: Setting type, field-mixed.
- G. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.
- H. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

#### **2.05 FABRICATION**

- A. Fabricate assemblies of framed sections to sizes and profiles required.
- B. Fit, reinforce, and brace framing members to suit design requirements.

#### **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that project conditions are appropriate for work of this section to commence.
- B. Verify existing conditions before starting work.
- C. Verify that rough-in utilities are in proper location.

### **3.02 SHAFT WALL INSTALLATION**

- A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
  - 1. Fasten runners to structure with short leg to finished side, using appropriate power-driven fasteners at not more than 24 inches on center.
  - 2. Install studs at spacing required to meet performance requirements.
- B. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special friction studs.
  - 1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.
  - 2. Seal perimeter of shaft wall and penetrations with acoustical sealant.

### **3.03 FRAMING INSTALLATION**

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members at 16 inches on center.
  - 1. Laterally brace entire suspension system.
- C. Studs: Space studs at 16 inches on center or as otherwise scheduled.
  - 1. Extend partition framing to structure in all locations or as otherwise specifically noted on partition schedule.
  - 2. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.
  - 3. Align stud web openings horizontally.
  - 4. Secure studs to track using fastener method. Do not weld.
  - 5. Stud splicing is not permissible.
  - 6. Fabricate corners using a minimum of three studs.
- D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jamb, not more than 2 inches from each side of opening. Refer to framing details on plans.
- E. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
  - 1. Orientation: Horizontal.
  - 2. Spacing: As indicated.
- F. Acoustic Furring: Install resilient channels at maximum 24 inches on center. Locate joints over framing members.
- G. Furring for Fire-Resistance Ratings: Install as required for fire-resistance ratings indicated and to GA-600 requirements.
- H. Blocking: Coordinate installed bucks, support systems, anchors and blocking with electrical, mechanical and other work to be placed within or behind stud framing. Install wood blocking for support of:
  - 1. Wall-mounted cabinets.
  - 2. Plumbing fixtures.
  - 3. Toilet partitions.
  - 4. Toilet accessories.
  - 5. Wall-mounted door hardware.

### **3.04 CEILING AND SOFFIT FRAMING**



- A. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
- B. Install furring independent of walls, columns, and above-ceiling work.
- C. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflections to criteria indicated. Use rigid hangers at exterior soffits.
- D. Space main carrying channels at maximum 72 inch on center, and not more than 6 inches from wall surfaces. Lap splice securely.
- E. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.
- F. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls and rigid secure. Lap splices securely.
- G. Laterally brace suspension system.

### **3.05 ACOUSTIC ACCESSORIES INSTALLATION**

- A. Install insulation material type as indicated in 07 2100 into partition cavities.
- B. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- C. Acoustic Sealant: Install in accordance with manufacturer's instructions.
  - 1. Place one bead continuously on substrate before installation of perimeter framing members.
  - 2. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

### **3.06 BOARD INSTALLATION**

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
- C. Double-Layer, Nonrated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
- D. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- E. Mold Resistant Gypsum Board: Use at all wall and ceiling surfaces in toilet rooms, janitor closets, laundry rooms, kitchens, and similar wet areas not indicated to receive wall tile.
  - 1. At single plumbing fixtures locations: Install from floor to 24 inches vertically above fixture and 12 inches horizontally past edge of fixture.
- F. Tile Backer Board: Install at all locations scheduled to receive tile. Seal all joints penetrations through backer board with sealant. Install in accordance with ANSI A108.11 and manufacturer's instructions.
- G. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.
- H. Moisture Protection: Treat cut edges and holes in moisture resistant gypsum board and exterior gypsum soffit board with sealant.

### **3.07 INSTALLATION OF TRIM AND ACCESSORIES**

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
  - 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
  - 2. Not more than 30 feet apart on ceiling over 50 feet long and/or where framing changes directions.
  - 3. At exterior soffits, not more than 30 feet apart in both directions.

- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.
- D. Exterior Soffit Vents: Install according to manufacturer's written instructions and in locations indicated on the drawings. Provide vent area specified or no less than 1/150 of area vented.

### **3.08 JOINT TREATMENT**

- A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.
- B. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.
- C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
  - 1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish, walls behind specialty dry-erase coatings and other areas specifically indicated.
  - 2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
  - 3. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
  - 4. Level 1: Wall areas above finished ceilings, whether or not accessible in the completed construction. Installation must conform to UL or STC ratings at Fire Rated and Acoustical Partitions.
- D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
  - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
  - 2. Taping, filling, and sanding are not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
  - 3. Taping, filling and sanding is not required at base layer of double layer applications, unless required by UL fire resistance rating.
- E. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

### **3.09 QUALITY CONTROL**

- A. Prior to installation of wall board on stud walls, coordinate review with Architect and AHJ inspections and approvals.
- B. Prior to covering up with suspended ceilings, coordinate above ceiling review with Architect. Review to observe installation of acoustical sealant, fire wall installation and labels, mechanical equipment installation and clearances, etc. Coordinate with AHJ inspections and approvals.

### **3.10 TOLERANCES**

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

**END OF SECTION**

**SECTION 09 5100  
ACOUSTICAL CEILINGS**

**PART 1 GENERAL V.20**

**1.01 SECTION INCLUDES**

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

**1.02 REFERENCE STANDARDS**

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.
- C. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings 2022.
- D. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels 2019.
- E. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions 2022.
- F. ASTM E1264 - Standard Classification for Acoustical Ceiling Products 2022.
- G. UL (FRD) - Fire Resistance Directory Current Edition.

**1.03 ADMINISTRATIVE REQUIREMENTS**

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning.
- C. Product Data: Provide data on suspension system components and acoustical units.
- D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Acoustical Units: Quantity equal to 5 percent of total installed. Provide at a minimum 1 box or carton of ceiling tile.

**1.05 QUALITY ASSURANCE**

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

**1.06 FIELD CONDITIONS**

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Acoustic Tiles/Panels:
  - 1. Armstrong World Industries, Inc: [www.armstrongceilings.com/#sle](http://www.armstrongceilings.com/#sle).
  - 2. CertainTeed Corporation: [www.certainteed.com/#sle](http://www.certainteed.com/#sle).

3. USG Corporation: [www.usg.com/ceilings/#sle](http://www.usg.com/ceilings/#sle).
  4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Suspension Systems:
1. Same as for acoustical units.

## **2.02 ACOUSTICAL UNITS**

- A. Acoustical Units - General: ASTM E1264, Class A.
- B. Acoustical Panels, Type ACT-1: Painted mineral fiber, with the following characteristics:
1. Classification: ASTM E1264 Type IV, Form 2, Pattern E.
  2. Size: 24 by 24 inches.
  3. Thickness: 5/8 inches.
  4. Composition: Wet felted.
  5. Light Reflectance: 80 percent, determined in accordance with ASTM E1264.
  6. NRC Range: 060, determined in accordance with ASTM E1264.
  7. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
  8. Panel Edge: Beveled Tegular.
  9. Surface Pattern: Fine Texture.
  10. Color: White.
  11. Suspension System: Exposed grid.
  12. Products:
    - a. Armstrong World Industries, Inc; Canyon 1492 [www.armstrongceilings.com/#sle](http://www.armstrongceilings.com/#sle).

## **2.03 SUSPENSION SYSTEM(S)**

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
- B. Exposed Suspension System: Hot-dipped galvanized steel grid with aluminum cap; factory-applied closed-cell foam gaskets.
1. Structural Classification: Heavy-duty, when tested in accordance with ASTM C635/C635M.
  2. Profile: Tee; 15/16 inch face width.
  3. Finish: Baked enamel.
  4. Products:
    - a. Armstrong: Prelude XL 15/16" Exposed Tee. [www.armstrongceilings.com](http://www.armstrongceilings.com).
    - b. Substitutions: See Section 01 6000 - Product Requirements.

## **2.04 ACCESSORIES**

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Hanger Wire: 12-gage 0.08 inch galvanized steel wire.
- C. Perimeter Moldings: Same metal and finish as grid.
1. Angle Molding: L-shaped, for mounting at same elevation as face of grid.
- D. Acoustical Insulation: Specified in Section 07 2100.
1. Thickness: 2 inch.
  2. Size: To fit acoustical suspension system.
- E. Gypsum Board: Fire rated type; 5/8 inch thick, ends and edges square, paper faced.
- F. Acoustical Sealant For Perimeter Moldings: Specified in Section 07 9005.
- G. Touch-up Paint: Type and color to match acoustical ceiling tiles and grid units.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Coordinate and verify that layout of hangers will not interfere with other work.

### **3.02 INSTALLATION - SUSPENSION SYSTEM**

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, ASTM C636/C636M, ASTM E580/E580M, ASTM C636/C636M, and ASTM E580/E580M and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
  - 1. Use longest practical lengths.
- D. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- E. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- F. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- G. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- H. Do not eccentrically load system or induce rotation of runners.

### **3.03 INSTALLATION - ACOUSTICAL UNITS**

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- E. Cutting Acoustical Units:
  - 1. Make field cut edges of same profile as factory edges.
  - 2. Double cut and field paint exposed reveal edges.
- F. Where round obstructions occur, provide preformed closures to match perimeter molding.
- G. At partitions that extend only to underside of ceiling grid, lay acoustical insulation for a distance of 48 inches either side of acoustical partitions.
- H. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.

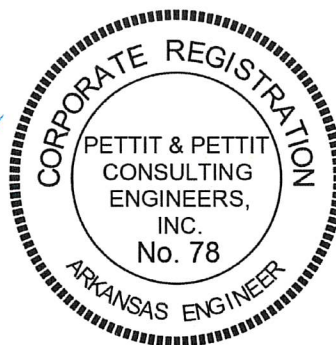
### **3.04 TOLERANCES**

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

**END OF SECTION**

The Engineer of Record for Divisions 22 and 23 of the Specifications for the Schichtl Hall HVAC Upgrades Project, University of Central Arkansas, Conway, Arkansas, (Pettit & Pettit Job No. 22-003A) is:

1/3/23  
Date



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CONSULTING ENGINEERS, INC.

**SECTION 22 0500  
COMMON WORK RESULTS FOR PLUMBING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Basic Requirements for complete plumbing system.

**1.02 RELATED SECTIONS**

- A. Section 22 0548 – Vibration and Seismic Controls for Plumbing Piping and Equipment.
- B. Section 22 1005 – Plumbing Piping.
- C. Section 22 3000 – Plumbing Equipment.
- D. Section 22 4000 – Plumbing Fixtures.
- E. Section 31 2316 – Excavation.

**1.03 SITE INSPECTION**

- A. Examine premises and understand the conditions which may affect performance of work of this Division before submitting proposals for this work.
- B. No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.

**1.04 DRAWINGS**

- A. Mechanical drawings show general arrangement of piping ductwork, equipment, etc. Follow closely as actual building construction and work of other trades will permit.
- B. Consider architectural and structural drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over mechanical drawings.
- C. Because of the small scale of mechanical drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves and accessories required to meet the conditions.
- D. Record difference between mechanical work as installed and as shown in Contract Documents on a set of prints of mechanical drawings to be furnished by Architect. Return these prints to Architect at completion of project. These will be labeled "Contractor Revised Drawings".

**1.05 SUBSTITUTIONS**

- A. The naming of specified items on the drawings or in the specifications is intended to establish a level of quality and performance. Substitution requests may be submitted at the time of shop drawing submittal. Review of substituted equipment or material prior to the Bid Date will not be considered unless otherwise specified.

- B. Substitution shall be submitted as specified in Division 01.

#### **1.06 CODE REQUIREMENTS, FEES & PERMITS**

- A. Perform work in accordance with applicable provisions of state and local Plumbing Code, gas ordinances and adoptions thereof. Provide materials and labor necessary to comply with rules, regulations and ordinances.
- B. In case of differences between building codes, state laws, local ordinances, utility company regulations and Contract Documents, the most stringent shall govern. Promptly notify Architect in writing of such differences.

#### **1.07 CONTRACTOR REVISED DRAWINGS**

- A. The contractor shall, during the progress of the work, keep an accurate record of all changes and corrections from the layouts shown on the drawings. Record of changes may be kept by accurately making all changes on a set of prints during the progress of the job.
- B. Exact location of all underground utility service entrances and their connections to utility mains, well heads, loop piping and all valves, etc., which will be concealed in the finished work shall be accurately indicated on the drawings by measured distances.
- C. Upon completion of the work and prior to final payment, the contractor shall furnish to the Architect, one set of "contractor revised" prints, legibly and accurately marked to indicate all changes, additions, deletions, etc., from the contract drawings.
- D. Contractor shall include all addendum items and field change order information on the revised drawings. Revise all schedules shown on the drawings to reflect the actual model numbers, capacities and electrical characteristics of substituted equipment.

#### **1.08 COORDINATION OF WORK**

- A. It is understood that while Drawings are to be followed as closely as circumstances permit, this Division will be held responsible for installation of systems according to the true intent and meaning of the Contract Documents. Anything not clear or in conflict will be explained by making application to Architect. Should conditions arise where certain changes would be advisable, secure Architect's approval of these changes before proceeding with work.
- B. Coordinate work of various trades in installing inter-related work. Before installation of mechanical items, make proper provisions to avoid interferences in a manner approved by Architect. Changes required in work specified in Division 22 caused by neglect to do so shall be made at no cost to Owner.
- C. Provide inserts and supports required by Division 22 unless otherwise noted. Furnish sleeves, inserts, supports and equipment that are an integral part of other divisions of the Work to Sections involved in sufficient time to be built into construction as the Work proceeds. Locate these items and see that they are properly installed. Expense resulting from improper location of installation of items above shall be borne by Division 22.
- D. Be responsible for required digging, cutting and patching incident to work of this Division and make required repairs afterward to satisfaction of Architect. Cut carefully to minimize necessity for repairs to existing work. Do not cut beams, columns or trusses.
  - 1. Each Section of this Division shall bear expense of cutting, patching, repairing and



- replacing of work of other Sections required because of its fault, error, tardiness or because of damage done by it.
2. Cutting, patching, repairing and replacing pavements, sidewalks, roads and curbs to permit installation of work of this Division is responsibility of Section installing work.
- E. Adjust locations of pipes, etc. to accommodate work from interferences anticipated and encountered. Determine exact route and location of each pipe and duct prior to fabrication.
1. Make offsets, transitions, and changes in direction of pipes, as required to maintain proper headroom and pitch of sloping lines whether or not indicated on Drawings.
- F. Slots and openings through floors, walls, ceilings and roofs shall be provided by other Divisions in their respective materials. This Division shall see that they are properly located and do any cutting and patching caused by its neglect to do so.

#### **1.09 EXCAVATION AND TRENCHING FOR PIPING**

- A. Excavate to the depths indicated on the Drawings or as otherwise specified. Coordinate with Geotechnical Engineer for undercut requirements due to expansive soils. Excavated materials not required or suitable for backfill or fill shall be removed from the site. Do such grading as is necessary to prevent surface water from flowing into trenches or other excavations. Water accumulated therein shall be removed by pumping or by other approved method. Do sheeting and shoring as may be necessary for protection of the work and for safety of personnel. Excavation shall be by open cut except that short sections of trench may be tunneled if the pipe can be safely and properly installed and backfill can be properly tamped in such tunnel sections.
- B. Trench Excavation: Bottom of trench for tile or concrete pipe shall be rounded so that at least the bottom quadrant of the pipe rests firmly on undisturbed soil for as nearly the full length of the barrel as proper jointing operations will permit. Grade bottom of trenches to provide uniform bearing and support for each section of pipe on undisturbed soil. Where rock is encountered, excavate to a minimum overdepth of 4" below trench depths indicated on the drawings or specified. Overdepths in rock excavation and unauthorized overdepths shall be backfilled. Whenever wet or otherwise unstable soil incapable of properly supporting the pipe is encountered, such soil shall be removed and the trench backfilled to proper grade as hereinafter specified.
- C. Depth of Cover: Trenches shall be of depth that will provide a minimum depth of cover of three feet for water, sanitary and storm sewer and two feet for gas piping from existing grade or from indicated finish grade, whichever is lower, unless otherwise specifically shown.

#### **1.10 BACKFILLING OF TRENCHES**

- A. Trenches shall not be backfilled until required pressure and other tests have been performed, inspection of utility and Code officials have been accomplished, and until the utilities systems as installed conform to requirements of drawings and specifications.
- B. Backfill trenches with excavated materials consisting of earth, sandy clay, sand, gravel, soft shale or other approved materials, free from clods of earth or stones over 2-1/2-inch maximum dimension, deposited in 6-inch layers and compacted to 95% of the maximum laboratory density determined in accordance with ASTM D-698, Moisture-Density Relation of Soils. Tests for maximum density will be made with expense borne by contractor. If fills fail to meet the specified densities, the contractor shall remove and recompact the fill until specified densities are achieved.

- C. Tests for Displacement of Sewers: After the trench has been backfilled to 2 feet or more above the pipe, if the pipe shows poor alignment, displaced pipe, or any other defects, such defects shall be remedied by the contractor at his expense.

## 1.11 GENERAL PIPING INSTALLATION

- A. Furnish and install a complete system of piping. The piping drawings are diagrammatic and indicate the general location and connections. If the size of any piping is not clearly evident, obtain instructions from the Architect before proceeding with the work. The piping may have to be offset, lowered or raised as required or as directed at the site. This does not relieve the contractor from responsibility for the proper erection of systems of piping in every respect suitable for the work intended. Piping systems that are not to be installed complete shall be so noted.
- B. Erection: Piping shall be cut accurately for fabrication to measurements established at the construction site. Pipe shall be worked into place without springing and/or forcing. Remove all burrs and cutting slag by reaming or other cleaning methods. Changes in direction shall be made with fittings, except that bendings of pipe will be permitted, providing a hydraulic pipe bender is used. Bent pipe showing kinks, wrinkles, or other malformation will not be acceptable. Piping shall be arranged so as not to interfere with removal of other equipment or devices nor to block access manholes or other access openings. Piping shall be installed to ensure noiseless circulation.
- C. Minimum slope of piping shall be in accordance with the following unless otherwise specifically shown on the drawings or specified:

<u>Type of Piping</u> <u>Fluid Conveyed</u>	<u>System Component</u>	<u>Length for</u> <u>1" Fall</u>	<u>Direction</u> <u>of Fall</u>
Sewer, Sanitary	Main or Branch	4 feet	Direction of flow
Domestic Water	Main or branch	40 feet	Back to mains

Sanitary and storm drainage piping 4 inches in diameter and larger may be pitched with one (1) inch fall for eight (8) foot lengths.

- D. Protection: Open ends of pipes and equipment shall be properly capped or plugged to keep dirt and other foreign materials out of the system. Plugs or rags, wood, cotton, concrete, waste or similar materials must not be used in plugging.
- E. Installation of Underground Pipe: Bottom of trench shall be shaped to give substantially uniform circumferential support to lower third of each pipe. Pipe shall be laid true to line and grade in such manner as to form a close concentric joint with adjoining pipe and to prevent sudden offsets to flow line. As work progresses, interior of pipe shall be cleared of dirt and superfluous materials. Where cleaning after laying is difficult because of small pipe size, a suitable swag or drain shall be kept in pipe and pulled forward past each joint immediately after jointing has been completed. Trenches shall be kept free from water until pipe jointing has set and pipe shall not be laid when condition of trench or weather is unsuitable for such work.
- F. Cleaning and Flushing: Contractor shall take every precaution to remove dirt, grease, and all other foreign matter from each length of piping before making connections in the field. After each section of piping is installed, it shall be flushed with clean water except where specified otherwise.

- G. Pipe Sizes: If the size of any piping is not clearly evident in the drawings, the contractor shall request instructions from the Architect as to the proper sizing. Any changes resulting from the contractor's failure to request clarification shall be at his expense.

#### **1.12 THERMAL AND MOISTURE PROTECTION**

- A. Install flashing, counterflashing and caulk or seal all penetrations in exterior walls or floors as required to prevent exterior moisture from entering building.

#### **1.13 EQUIPMENT AND MATERIALS**

- A. Product Approvals:
  - 1. If approval is received to use other than specified items, responsibility for specified capacities and insuring that items to be furnished will fit space available lies with this Division.
  - 2. In the event other than specified equipment is used and will not fit job site conditions, this Division assumes responsibility for replacement with items named in specification.
- B. Use domestic made pipe, pipe fittings and motors on project.
- C. Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connection and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents.
- D. Follow Manufacturer's directions in delivery, storage, protection and installation of equipment and materials.
  - 1. Promptly notify Architect in writing of conflicts between requirements of Contract Documents and manufacturer's directions and obtain Architect's written instructions before proceeding with work. Bear expenses arising from correcting deficiencies of work that do not comply with Manufacturer's directions or such written instructions from Architect.
- E. Deliver equipment and material to site and tightly cover to protect against dirt, water, and chemical or mechanical injury but have readily accessible for inspection. Store items subject to moisture damage (such as controls) in a dry, heated space.

#### **1.14 REVIEW OF MATERIALS AND EQUIPMENT**

- A. Furnish complete catalog data for manufactured items of equipment to be used in Work to Architect for review within 30 days after award of Contract.
- B. Submit six (6) copies of data in 3-ring binders with tab indices in same order and name as they appear in specification.
  - 1. State sizes, capacities, brand names, motor HP, accessories, materials, gauges, dimensions and other pertinent information. Pertinent information shall include as a minimum those items as scheduled on the drawings. Arrange submittal information to reflect these categories scheduled on the drawings.
  - 2. Provide an index of tab numbers at the front of each binder. List the specification number and category included under each tab as described in the specifications and as scheduled on the drawings.
  - 3. Provide cover sheet for each tab section. List each piece of equipment by name, model number and supplier.

- 4. Underline applicable data and indicate model being supplied on each submittal sheet.
- C. If data is not submitted as specified or submittal is not complete, it will be returned without review.
- D. Catalog data or shop drawings for equipment which are noted as being reviewed by the Architect, shall not supersede Contract Documents.
- E. Review comments of Architect shall not relieve this Division from responsibility for deviations from Contract Documents unless Architect's attention has been called to such deviations in writing at the time of submission, nor shall they relieve this Division from responsibility for errors in items submitted.
- F. Check work described in catalog data with Contract Documents for deviations and errors.

#### **1.15 GUARANTEE**

- A. The work herein specified shall be free from defects in workmanship and material under normal use and service. If, within twelve (12) months from date of substantial completion and Owner acceptance of the work herein described, any of the equipment or materials, or in the installation thereof, is found to be defective in workmanship or material, it shall be replaced or repaired free of charge.
- B. The Contractor shall, after completion of the original test of the installation, and acceptance of the Architect, provide any service incidental to the proper performance of the mechanical systems under guarantees outlined above for a period of one (1) year.

#### **1.16 FINALLY**

- A. It is the intention that this specification shall provide a complete installation except as hereinbefore specifically excepted. All accessory construction and apparatus necessary or advantageous in the operation and testing of the work shall be included.
- B. The omission of specific reference to any part of the work necessary for such complete installation shall not be interpreted as relieving this Contractor from furnishing and installing such parts.

### **PART 2 PRODUCTS**

**Not Applicable.**

### **PART 3 EXECUTION**

**Not Applicable.**

**END OF SECTION**

**SECTION 22 0513**  
**COMMON ELECTRICAL REQUIREMENTS FOR PLUMBING EQUIPMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. This section specifies the basic requirements for electrical components which are an integral part of packaged PLUMBING equipment. These components include, but are not limited to factory installed motors furnished as an integral part of plumbing equipment.
- B. This section specifies the basic requirements for electrical components required to be furnished under Division 22, which are to be turned over to and installed by Division 26. These components include but are not limited to motors.
- C. Specific electrical requirements (i.e., horsepower and electrical characteristics) for plumbing equipment are scheduled on the drawings.

**1.02 RELATED SECTIONS**

- A. Section 22 3000 – Plumbing Equipment.

**1.03 REFERENCES**

- A. NEMA Standards MG-1: Motors and Generators.
- B. NEMA Standard ICS 2: Industrial Control Devices, Controllers and Assemblies.
- C. NEMA Standard 250: Enclosures for Electrical Equipment.
- D. NEMA Standard KS 1: Enclosed Switches.
- E. Comply with National Electrical Code (NFPA 70).
- F. Compliance and Labeling: Provide motors and starters which have been listed and labeled by a nationally recognized testing facility engaged in and equipped to test electrical equipment and materials.

**1.04 SUBMITTALS**

- A. No separate submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification sections.

**1.05 QUALITY ASSURANCE**

- A. Electrical components and materials shall be UL labeled.

**PART 2 PRODUCTS**

**2.01 MOTORS**

- A. The following are basic requirements for simple or common motors, for special motors, more detailed and specific requirements are specified in the individual equipment

specifications.

1. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
2. Motor sizes shall be large enough so that driven load will not requirement the motor to operate in the service factor range.
3. 2-speed motors shall be 2 separate windings on polyphase motors.
4. Temperature Rating: Rated for 40 deg. environment, with maximum 50 deg. C temperature rise for continuous duty at full load (Class A Insulation).
5. Starting capability: Frequency of starts as indicated by automatic control system, and not less than 5 evenly timed spaced starts per hour for manually controlled motors.
6. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.

B. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.

1. Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit specific application.
2. Bearings:
  - a. Ball or roller bearings with inner and outer shaft seals;
  - b. Regreasable, except permanently sealed where motor is normally inaccessible for regular maintenance.
  - c. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.
  - d. For fractional horsepower, light duty motors, sleeve type bearings are permitted.
3. Enclosure Type:
  - a. Open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation.
  - b. Guarded drip-proof motors where exposed to contact by employees or building occupants.
  - c. Weather protected Type I for outdoor use, Type II where not housed;
4. Overload Protection: Built-in thermal overload protection and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.
5. Noise Rating: "Quiet" rating on motors located in occupied spaces of building.
6. Efficiency: Provide "Energy Efficient" motors with a minimum efficiency as scheduled in accordance with IEEE Standard 112, test method B. If efficiency not specified, motors shall have a minimum efficiency as listed below.

1HP	80% Eff'y	10HP	87%
1-1/2 to 2HP	82%	15HP	89%
3HP	83%	20HP	90%
5HP	84%	25HP and up	91%
7-1/2 HP	85%		

C. Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following:

Baldor Electric Co.  
Century Electric, Inc.  
General Electric Co.  
Marathon Electric Mfg. Co.  
Reliance Electric Co.  
Westinghouse Electric Corp.

D. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

**PART 3 EXECUTION**

**Not Applicable.**

**END OF SECTION**

**SECTION 22 0516  
EXPANSION COMPENSATION FOR PLUMBING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Basic Requirements for expansion compensation for the plumbing system.

**1.02 RELATED SECTIONS**

- A. Section 22 0548 – Vibration and Seismic controls for Plumbing Piping and Equipment.
- B. Section 22 1005 – Plumbing Piping.
- C. Section 22 3000 – Plumbing Equipment.
- D. Section 22 4000 – Plumbing Fixtures.
- E. Section 31 2316 – Excavation.

**1.03 SUBMITTALS**

- A. Product Data: Submit catalog cuts, specifications, installation instructions, and dimensioned drawings for each type of expansion compensation product. Submit schedule showing Manufacturer's figure number, size, location, and features for each required expansion compensation product.
- B. Shop Drawings: Submit shop drawings for fabricated expansion loops indicating location, dimensions, pipe sizes, location and method of attachment of anchors.
- C. Maintenance Data: Submit maintenance data and spare parts lists for each type of expansion compensation product. Include this data in Maintenance Manual.

**1.04 QUALITY ASSURANCE**

- A. Manufacturers: Firms regularly engaged in manufacture of expansion compensation products of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Comply with standards of the Expansion Joint Manufacturer's Association (EJMA).

**PART 2 PRODUCTS**

**2.01 PIPE ALIGNMENT GUIDES**

- A. General: Provide pipe alignment guides on both sides of expansion joints, and elsewhere as indicated. Construct with 4 finger spider traveling inside a guiding sleeve, with provision for anchoring to building substrate.
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering pipe alignment guides which may be incorporated in the work include, but are not limited to, the following:  
Keflex, Inc.



Metraflex (The) Co.

### **PART 3 EXECUTION**

#### **3.01 EXPANSION LOOPS**

- A. General: Fabricate expansion loops as indicated, in locations indicated, and elsewhere as determined by Installer for adequate expansion of installed piping system. Subject loop to cold spring which will absorb 50% of total expansion between hot and cold conditions. Provide pipe anchors and pipe alignment guides as indicated, and elsewhere as determined by Installer to properly anchor piping in relationship to expansion loops.

**END OF SECTION**

**SECTION 22 0519**  
**METERS AND GAUGES FOR PLUMBING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Extent of meters and gauges required by this section is indicated on drawings and/or specified in other Division-22 sections.
- B. Types of meters and gauges specified in this section include the following:
  - 1. Temperature Gauges and Fittings:
    - Glass Thermometers.
    - Dial Type Insertion Thermometers.
    - Thermometer Wells.
    - Temperature Gauge Connector Plugs.
  - 2. Pressure Gauges and Fittings:
    - Pressure Gauges.
    - Pressure Gauge Cocks.
    - Pressure Gauge Connector Plugs.
- C. Meters and gauges furnished as part of factory-fabricated equipment, are specified as part of the equipment assembly in other Division-22 sections.

**1.02 RELATED SECTIONS**

- A. Section 22 1005 – Plumbing Piping.
- B. Section 22 3000 – Plumbing Equipment.

**1.03 QUALITY ASSURANCE**

- A. Manufacturers: Firms regularly engaged in manufacture of meters, gauges, and fittings, or types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.
- B. UL Compliance: Comply with applicable UL standards pertaining to meters and gauges.
- C. ANSI and ISA Compliances: Comply with applicable portions of ANSI and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gauges.

**1.04 SUBMITTALS**

- A. Product Data: Submit catalog cuts, specifications, installation instructions, and dimensioned drawings for each type of meter, gauge and fitting. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit meter, gauge and fitting schedule shown manufacturer's figure number, scale range, location, and accessories for each meter, gauge and fitting.
- B. Maintenance Data: Submit maintenance data and spare parts lists for each type of meter and gauge. Include this data in maintenance manual.

**PART 2 PRODUCTS**

## 2.01 TEMPERATURE GAGES

### A. Glass Thermometers:

1. General: Provide glass thermometers of materials, capacities and ranges indicated, designed and constructed for use in service indicated.
2. Case: Die cast aluminum, finished in baked epoxy enamel, clear acrylic plastic front, spring secure, 9 inches long.
3. Adjustable Joint: Die cast aluminum, finished to match case, 180 degree adjustment in vertical plane, 360 degree adjustment in horizontal plane, with locking device.
4. Tube and Capillary: Mercury filled, magnifying lens, 1 percent scale range accuracy, shock mounted.
5. Scale: Satin faced, non-reflective aluminum permanently etched markings.
6. Stem: Copper-plated steel, or brass, for separable socket, length to suit installation.
7. Range: Conform to the following:
  - a. Hot Water: 30 degrees - 240 degrees F with 2 degree F scale divisions (0 degrees - 160 degrees Celsius) with 1 degree Celsius scale divisions.
  - b. Chilled Water: 30 degrees - 180 degrees F with 2 degrees F scale divisions (0 degrees-100 degrees Celsius) with 1 degree Celsius scale divisions.
8. Available Manufacturers: Subject to compliance with requirements, manufacturers offering glass thermometers which may be incorporated in the work include, but are not limited to, the following:  
Marshalltown Instruments, an Eltra Co.  
Trerice (H.O.) Co.  
Weiss (Albert A) & Son, Inc.

### B. Dial Type Insertion Thermometers:

1. General: Provide diam type insertion thermometers of materials, capacities and ranges indicated, designed and constructed for use in service indicated.
2. Type: Bi-metal, stainless steel case and stem, 1 inch diameter dial, dust and leak proof, 1/8 inch diameter stem with nominal length of 5 inches.
3. Accuracy: 0.5 percent of dial range.
4. Range: Conform to the following:
  - a. Hot Water: 0 degrees - 220 degrees F (-10 degrees - 110 degrees C).
5. Available Manufacturers: Subject to compliance with requirements, manufacturers offering direct mount dial type insertion thermometers which may be incorporated in the work include, but are not limited to, the following:  
Marsh Instrument Co, Unit of General Signal.  
Taylor Instrument Process Control Div. of Sybron Corp.  
Trerice (H.O.) Co.  
Weiss (Albert A.) & Son, Inc.

### C. Thermometer Separable Wells:

1. General: Provide thermometer wells constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 2 inch extension for insulated piping.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering thermometer wells which may be incorporated in the work include, but are not limited to the following:  
Marsh Instrument Co., Unit of General Signal.  
Trerice (H.O.) Co.

Weiss (Albert A.) & Sons, Inc.

- D. Temperature Gage Connector Plugs:
1. General: Provide temperature gage connector plugs pressure rated for 500 psi and 200 degrees F. Construct of brass and finish in nickel-plate, equip with 1/2 inch NPT fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8 inch O.D. probe assembly from dial type insertion thermometer. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness for insulated piping.
  2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering temperature gage connector plugs which may be incorporated in the work include, but are not limited to, the following:  
Peterson Engineering Co.

## 2.02 PRESSURE GAGES AND FITTINGS

- A. Pressure Gages:
1. General: Provide pressure gages of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.
  2. Type: General use, 1 percent accuracy, ANSI B40.1, Grade A, phosphor bronze bourbon type, bottom connection.
  3. Case: Drawn steel or brass, clear acrylic plastic lends, 4-1/2 inch diameter.
  4. Connector: Brass with 1/4 inch male NPT. Provide protective syphon when used for steam service.
  5. Scale: White coated aluminum with permanent etched markings.
  6. Range: Conform to the following:
    - a. Water: 0 - 100 psi.
  7. Available Manufacturers: Subject to compliance with requirements, manufacturers offering pressure gauges which may be incorporated in the work include, but are not limited to, the following:  
Ametek, U.S. Gauge Div.  
Marsh Instrument Co., Unit of General Signal.  
Marshalltown, an Eltra Company  
Trerice (H.O.) Co.  
Weiss (Albert A.) & Son, Inc.
- B. Pressure Gage Cocks:
1. General: Provide pressure gauge cocks between pressure gages and gauge tees on piping systems. Construct gage cock of brass with 1/4 inch female NPT on each end, and "T" handle brass plug.
  2. Syphon: 1/4 inch straight coil constructed of brass tubing with 1/2 inch male NPT on each end.
  3. Snubber: 1/4 inch brass bushing with corrosion resistant porous metal disc, through which pressure fluid is filtered. Select disc material for fluid served and pressure rating.
  4. Manufacturers: Subject to compliance with requirements, manufacturers offering pressure gage cocks which may be incorporated in the work include, but are not limited to, the following:  
Ametek, U.S. Gauge Div.  
Marsh Instrument Co., Unit of General Signal.  
Marshalltown, An Eltra Company  
Trerice (H.O.) Co.  
Weiss (Albert A.) & Son, Inc

- C. Pressure Gage Connector Plugs:
  - 1. General: Provide pressure gage connector plugs pressure rated for 500 psi and 200 degrees Fahrenheit. Construct of brass and finish in nickel-plate, equip with 1/2 inch NPT fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8 inch O.D. probe assembly from dial type insertion pressure gage. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness for insulated piping.
  - 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering pressure gauge connector plugs which may be incorporated in the work include, but are not limited to, the following:  
Peterson Engineering Co.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION OF TEMPERATURE GAGES**

- A. General: Install temperature gages in vertical upright position, and tilted so as to be easily read by observer standing on floor.
- B. Thermometer Separable Wells: Install in piping for each temperature gage.
- C. Temperature Gage Connector Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap.

### **3.02 INSTALLATION OF PRESSURE GAGES**

- A. General: Install pressure gages in piping with pressure gage cock, located on pipe at most readable position.
- B. Locations: Install in the following locations, and elsewhere as indicated:
  - 1. At suction and discharge of each hydronic pump or as a common gauge, if so detailed on drawings.
  - 2. At each pressure reducing valve on both the high pressure and low pressure sides.
  - 3. At water service outlet.
- C. Pressure Gage Cocks: Install in piping tee with snubber.
- D. Pressure Gage Connector Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap.

**END OF SECTION**

**SECTION 22 0548  
VIBRATION AND SEISMIC CONTROLS FOR PLUMBING**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. The requirements for seismic protection measures to be applied to plumbing equipment specified herein are in addition to any other items called for in other sections of these specifications. The seismic protection shall conform to Category C of the 2002 Arkansas Fire Prevention Code. The Plumbing equipment shall include the following items to the extent required on plans or in other sections of the following specifications:

Piping, 2-1/2 inches or larger  
Components weighting more than 75 pounds  
Water Heaters

**1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Basic Requirements – Section 22 0500.

**1.03 APPLICABLE PUBLICATIONS**

- A. American Society of Civil Engineers: ASCE 7
- B. Federal Specifications:
1. RR-W-410D

**1.04 REGULATORY REQUIREMENTS**

- A. Conform to 2012 Fire Prevention Code.

**PART 2 PRODUCTS**

- 2.01** Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and shown.
- 2.02** Sway brace of structural steel conforming with ASTM A36.
- 2.03** Mechanical couplings of the sleeve type to provide a tight flexible joint under all reasonable conditions.
- 2.04** Squarehead bolts and heavy hexagon nuts, ANSI B18.2.1 and B12.2.2 and ASTM A307 or 306.
- 2.05** Guy wires where required shall conform to Fed Spec. RR-W-441 as follows:
- |                         |                 |
|-------------------------|-----------------|
| 5/32" diameter          | Type V, Class 1 |
| 3/16" to 5/16" diameter | Type V, Class 2 |
| 1/4" to 5/8" diameter   | Type I, Class 2 |

**PART 3 EXECUTION**

- 3.01** All rigidly mounted equipment will have a minimum of four (4) anchor bolts securely fastened through bases or backs. Anchor bolts must conform to ASTM A307. Anchor bolts shall have an embedded straight length equal to at least twelve times the nominal diameter of the bolt and shall conform to the

applicable tables for various equipment weights.

Maximum Equipment Weight (Pounds)	
500	1/2
1,000	1/2
5,000	1/2
10,000	1/2
20,000	1/2
30,000	5/8
50,000	3/4
100,000	1

Based on four (4) bolts per item, a minimum embedment of 12 bolt diameters, a minimum bolt spacing of 16 bolt diameters and a minimum edge distance of 12 bolt diameters. Use equivalent total cross-sectional area when more than four bolts per item are provided. Anchor bolts that exceed normal depth of equipment foundation piers or pads shall either extend into concrete floor or the foundation shall be increased in depth to accommodate bolt lengths. When height-to-width ratio of the equipment exceeds 8.9, overturning must be investigated. Expansion anchors shall not be used to resist seismic or vibratory loads unless test data are provided to verify the adequacy of the specific anchor and application. In no case shall the expansion anchor size be less than that required for bolts in the preceding table. Selection of anchor bolts for vibration isolation devices and/or snubbers to equipment base and foundations shall follow the same procedure, except that an equipment weight equal to five times the actual equipment weight shall be used

- 3.02** Equipment Sway Bracing shall be provided for all items supported from overhead floor or roof structures. Braces shall consist of angles, rods, bars, or pipes run at a 45-degree angle from the equipment frame to the building structure secured at both ends with no less than 1/2 inch bolts. Braces shall conform to all applicable codes and standards for Seismic Classification. Bracing shall be provided in two planes of directions, 90 degrees apart, for each item of equipment. Details of all equipment bracing shall be submitted for approval. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45-degrees, provided that supporting members are properly sized to supporting operating weight of equipment when inclined at a 45-degree angle.
- 3.03** Sway bracing shall be provided for all 2-1/2 inch or larger pipes, not individually supported with hangers 12 inches or less in length. Longitudinal bracing shall be at 80' max spacing. Traverse bracing shall be at 40' max spacing.
- 3.04** All components that weight more than 75 pounds shall have a safety chain or safety cable in addition to its other support.
- 3.05** Water heaters and pumps shall be bolted to the housekeeping pads in accordance with Paragraph 3.01.
- 3.06** Powder-activated fasteners (shot pins) shall not be used for anchorage.
- 3.07** Vibration isolators shall have a bumper restraint in each horizontal direction, and vertical restraints shall be provided where required to resist overturning.
- 3.08** Oversized plate washers extending to the equipment wall shall be used at bolted connections through the base sheet metal if the base is not reinforced with stiffeners or not capable of transferring the required loads.

#### **END OF SECTION**

**SECTION 22 0553**  
**IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Extent of mechanical identification work required by this section is indicated on drawings and/or specified in other Division-23 sections.
- B. Type of identification devices specified in this section include the following:
  - Plastic Pipe Markers.
  - Valve Tags.
  - Valve Schedule Frames.
  - Engraved Plastic-Laminate Signs.
  - Ceiling Tacks.
- C. Mechanical identification furnished as part of factory-fabricated equipment, is specified as part of the equipment assembly in other Division-23 sections.

**1.02 RELATED SECTIONS**

- A. Section 22 1005 – Plumbing Piping.

**1.03 QUALITY ASSURANCE**

- A. Manufacturers: Firms regularly engaged in manufacture of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.
- B. ANSI Standards: Comply with ANSI A13.1 for lettering size, colors, and viewing angles of identification devices.

**1.04 SUBMITTALS**

- A. Product Data: Submit product specifications and installation instructions for each identification material and device desired.
- B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.
- C. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 1.

**PART 2 PRODUCTS**

**2.01 MECHANICAL IDENTIFICATION MATERIALS**

- A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division-21 sections. Where more than single



type is specified for application, selection is Installer's option, but provide single selection for each product category.

B. Plastic Pipe Markers:

1. General: Provide manufacturer's standard pre-printed, flexible or semi-rigid, permanent, color-coded, plastic-sheet pipe markers, complying with ANSI A13.1.
  - a. Small Pipes: For external diameters less than 6 inches (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
    - (1) Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
    - (2) Adhesive lap joint in pipe marker overlap.
    - (3) Laminated or bonded application of pipe marker to pipe (or insulation).
  - b. Large Pipes: For external diameters of 6 inches and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:
    - (1) Laminated or bonded application of pipe marker to pipe (or insulation)
    - (2) Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless-steel bands.
  - c. Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by Architect/Engineer in cases of variance with names as shown or specified.
  - d. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.
  - e. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

C. Valve Tags:

1. At the Contractor's option, provide one of the following:
  - a. Brass Valve Tags: provide 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4-inch-high letters and sequenced valve numbers 1/2 inch high, and with 5/32-inch hole for fastener. Provide 1-1/2-inch diameter tags, except as otherwise indicated.
  - b. Plastic Laminate Valve Tags: Provide manufacturer's standard 3/32-inch-thick engraved plastic laminate valve tags, with piping system abbreviation in 1/4-inch-high letters and sequenced valve numbers 1/2 inch high, and with 5/32-inch hole for fastener. Provide 1-1/2-inch square black tags with white lettering, except as otherwise indicated.
2. Valve Tag Fasteners: Manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

D. Valve Schedule Frames:

1. General: For each page of the valve schedule, provide a glazed display frame, with screws for removable mounting on walls. Provide frames of rigid plastic or metal, with plastic glazing.

- E. Engraved Plastic-Laminate Signs:
1. General: Provide engraving stock melamine plastic laminate, complying with FS L- P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
  2. Thickness: 1/16 inch for units up to 20 square inches or 8-inch length; 1/8 inch for larger units.
  3. Fasteners: Self-tapping stainless-steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
- F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering plastic pipe markers which may be incorporated in the work include, but are not limited to, the following:

Seton Name Plate Company  
EMED Co., Inc.  
Approved equal.

## **2.02 LETTERING AND GRAPHICS**

- A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturer or as required for proper identification and operation/maintenance of plumbing systems and equipment.
- B. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service.

## **PART 3 EXECUTION**

### **3.01 APPLICATION AND INSTALLATION**

- A. General Installation Requirements:
1. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.
- B. Piping System Identification:
1. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces, (shafts, tunnels, plenums), exterior non-concealed locations and above removable acoustical ceilings.
    - a. Near each valve and control device.
    - b. Near each branch, excluding short take-offs for fixtures, mark each pipe at branch, where there could be question of flow pattern.
    - c. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
    - d. At access doors, manholes and similar access points which permit view of concealed piping.

- e. Near major equipment items and other points of origination and termination.
  - f. Spaced intermittently at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
  - g. On piping above removable acoustical ceilings.
- C. Valve Identification:
  - 1. General: Provide valve tag on every valve, cock and control device in each piping system.
  - 2. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect/Engineer.
    - a. Where more than one major machine room is shown for project, install mounted valve schedule in each major machine room, and repeat only main valves which are to be operated in conjunction with operations of more than single machine room.
- D. Plumbing Equipment Identification:
  - 1. General: Install engraved plastic laminate sign on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
    - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    - b. Pumps and similar motor-driven units.
    - c. Fans, blowers, primary balancing dampers and mixing boxes.
    - d. Central-station units.
    - e. Tanks and pressure vessels.
    - f. Motor starters and other control equipment.
- E. Refer to Division-22 sections for identification requirements at central-station mechanical control center; not work of this section.
- F. Refer to Division-26 sections for identification requirements of electrical work; not work of this section.
- G. Lettering Size: Minimum 3/8-inch-high lettering for name of unit where viewing distance is less than 2'-0"; 3/4 inch high for distances up to 6'-0"; and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 the size of principal lettering.
- H. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, and warn of hazards and improper operations.
- I. Operational valves and similar minor equipment items located in non-occupied spaces (including machine rooms) may, at installer's option, be identified by installation of plasticized tags in lieu of engraved plastic signs.

#### **END OF SECTION**

**SECTION 22 0719  
PLUMBING PIPING INSULATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Insulation Requirements for complete plumbing piping system.

**1.02 RELATED SECTIONS**

- A. Section 22 0500 – Common Work Results for Plumbing.
- B. Section 22 0553 – Identification for Plumbing Piping
- C. Section 22 0548 – Vibration and Seismic Controls for Plumbing Piping and Equipment.
- D. Section 22 1005 – Plumbing Piping.
- E. Section 22 3000 – Plumbing Equipment.
- F. Section 22 4000 – Plumbing Fixtures.

**1.03 REFERENCES**

- A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- B. ASTM C195 - Mineral Fiber Thermal Insulation Cement.
- C. ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
- D. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.
- E. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- F. ASTM C547 - Mineral Fiber Preformed Pipe Insulation.
- G. ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
- H. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
- I. ASTM D2842 - Water Absorption of Rigid Cellular Plastics.
- J. ASTM E96 - Water Vapor Transmission of Materials.

**1.04 SUBMITTALS**

- A. Submit under provisions of Division 01 and Section 22 0500.
- B. Product Data: Provide product description, list of materials and thickness for each service, and locations.
- C. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable

workmanship and installation standards will be achieved.

#### **1.05 QUALITY ASSURANCE**

- A. Materials: Flame spread/smoke developed rating of 25/100 or less in accordance with ASTM E84, NFPA 255, and UL 723.

#### **1.06 QUALIFICATIONS**

- A. Applicator: Company specializing in performing the work of this section with minimum three years experience.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect, and handle products to site under provisions of Section 22 0500.
- B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Store insulation in original wrapping and protect from weather and construction traffic.
- D. Protect insulation against dirt, water, chemical, and mechanical damage.

#### **1.08 ENVIRONMENTAL REQUIREMENTS**

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

### **PART 2 PRODUCTS**

#### **2.01 GLASS FIBER**

- A. Insulation: ASTM C547; rigid molded, noncombustible.
  - 1. "K" value: ASTM C335, 0.24 at 75 degrees F.
  - 2. Minimum Service Temperature: -20 degrees F.
  - 3. Maximum Service Temperature: 850 degrees F.
  - 4. Maximum Moisture Absorption: 0.2 percent by volume.
- B. Vapor Barrier Jacket:
  - 1. ASTM C921, white kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
  - 2. Moisture Vapor Transmission: ASTM E96; 0.02 perm inches.
  - 3. Secure with adhesive applied to longitudinal laps and butt strips.
  - 4. Secure with vapor barrier mastic.
  - 5. Self-sealing laps may be used provided lap seal is additionally sealed with vapor barrier masters.
  - 6. Maximum Water Vapor Transmission: 0.1 perm.

#### **2.02 APPROVED MANUFACTURERS**

- A. Glass Fiber:
  - 1. Owens/Corning Fiberglass.
  - 2. Architect Approved - Other acceptable manufacturers offering equivalent products.

- B. Vapor Barrier Jacket Lap Adhesive - Compatible with insulation:
  - 1. Foster 25.
  - 2. Architect Approved.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

### **3.02 INSTALLATION**

- A. Install materials in accordance with manufacturer's instructions.
- B. On exposed piping, locate insulation and cover seams in least visible locations.
- C. Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:
  - 1. Provide vapor barrier jackets, factory applied or field applied.
  - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe.
  - 3. Finish with glass cloth and vapor barrier adhesive.
  - 4. PVC fitting covers may be used.
  - 5. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
  - 6. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- D. For insulated pipes conveying fluids above ambient temperature:
  - 1. Provide standard jackets, with or without vapor barrier, factory applied or field applied.
  - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
  - 3. Finish with glass cloth and adhesive.
  - 4. PVC fitting covers may be used.
  - 5. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
  - 6. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.
- E. Inserts and Shields:
  - 1. Application: Piping 1-1/2 inches diameter or larger.
  - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
  - 3. Insert Location: Between support shield and piping and under the finish jacket.
  - 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
- F. Finish insulation at supports, protrusions, and interruptions.
- G. For exterior applications, provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum or stainless steel jacket with seams located on bottom side of horizontal piping.

- H. For buried piping, provide factory fabricated assembly with inner all-purpose service jacket with self sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.
- I. For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- J. Valves and fittings insulated with block insulation shall be finished with insulating cement and troweled to a smooth and uniform finish.

### 3.03 TOLERANCE

- A. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

### 3.04 GLASS FIBER INSULATION SCHEDULE

PIPING SYSTEMS	THICKNESS
A. Plumbing Systems	
Domestic Hot Water Supply	1 inch
Domestic Hot Water Recirculation	1 inch
Domestic Cold Water (Indoors)	1 inch
Domestic Cold Water (Out of Doors)	2 inch
Storm Water	1 inch

**END OF SECTION**

## **SECTION 22 1005 PLUMBING PIPING**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Basic Requirements for complete plumbing piping system.

#### **1.02 RELATED SECTIONS**

- A. Section 22 0500 – Common Work Results for Plumbing.
- B. Section 22 0553 – Identification for Plumbing Piping
- C. Section 22 0548 – Vibration and Seismic controls for Plumbing Piping and Equipment.
- D. Section 22 3000 – Plumbing Equipment.
- E. Section 22 4000 – Plumbing Fixtures.
- F. Section 31 2316 – Excavation.

#### **1.03 QUALITY ASSURANCE**

- A. Manufacturers shall be firms regularly engaged in manufacturer of plumbing piping products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer shall be a firm with at least 3 years of successful installation experience on projects with plumbing piping system work similar to that required for project.
- C. Comply with applicable provisions of ANSI B31.2 "Fuel Gas Piping", applicable provisions of NFPA 54 (ANSI Z223.1) "National Fuel Gas Code", ANSI Z223.1a "Supplement to National Fuel Gas Code" and with requirements of the local gas company.
- D. Comply with applicable codes and standards.

#### **1.04 SUBMITTALS**

- A. Submit under provisions of Division 01 and Section 22 0500.
- B. Product Data: Provide product description, list of materials and thickness for each service, and locations.
- C. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

#### **1.05 QUALIFICATIONS**

- A. Applicator: Company specializing in performing the work of this section with a minimum three years experience.

### **PART 2 PRODUCTS**



## **2.01 DOMESTIC HOT AND COLD WATER SYSTEMS**

- A. Pipe
  - 1. Type "K" hard drawn copper, as made by Mueller Brass Co., for piping underground or beneath concrete slab.
  - 2. Type "L" hard drawn copper, as manufactured by Mueller Brass Co., for above ground applications.
- B. Fittings
  - 1. Wrought copper.
- C. Connections
  - 1. Sweat copper type with Stay-Safe "Bridgit" lead free silver bearing solder with Stay-Clean liquid or Stay-Clean paste flux as manufactured by J. W. Harris Co., Inc. Joints under slabs shall be brazed with Silfos brazing alloy.
- D. Valves
  - 1. Use gate valves exclusively unless otherwise specified. All valves shall be by a single manufacturer from the approved list (reference Section 15100). Valves shall be for 150psi SWP.
  - 2. All valves shall be brass, of screwed pattern, gland stuffing box, solid wedge double seal for gate valves, non-rising stem.
- E. Unions
  - 1. All union connections on piping 2" and smaller shall be ground joint brass union, having brass taper seat and both screw ends hexagonal and shall be designed for a steam working pressure up to 150 pounds.
- F. Origin
  - 1. Unless specifically specified otherwise, all material and products shall be manufactured in the United States of America.

## **2.02 SANITARY SEWER, SOIL, STORM, WASTE AND VENT PIPING SYSTEMS**

- A. Piping Above Floor:
  - 1. All lines of 2 inches and larger shall be service weight cast iron soil piping and fittings, coated inside and outside with coal tar varnish and shall be labeled with cast iron mark of quality and permanence as illustrated in Commercial Standard CS188, which indicates that it complies with this Standard.
  - 2. Pipe and fittings used in the hubless system shall bear the registered insignia indicating that these items used in the system shall comply with the Cast Iron Soil Pipe Institute's Standard 302 (latest revision) and the ASTM "Standard Specifications for Cast Iron Soil Pipe and Fittings".
  - 3. In horizontal installations hangers shall be provided at every other point except when the developed length between hangers exceeds four feet (4'0") they shall be provided at each joint. Hangers shall be provided at each horizontal branch and shall be placed on or immediately adjacent to the coupling. Adequate provision shall be made to prevent "shear". Where hubless components are suspended in excess of 18 inches by means of non-rigid hangers, they shall be suitably braced against movement horizontally. Piping at ceiling of mechanical room shall be suspended from spring hangers.
  - 4. Vertical sections and their connecting branches and components shall be secured at each stack base and at sufficiently close intervals to keep the system

- in alignment and to adequately support the weight of the pipe and its contents.
5. Waste arms for lavatories and urinals shall be DWV copper with cast brass adapters and wrought copper fittings.
- B. Piping Below Grade Except for Kitchen Drainage – PVC Drainage Pipe:
1. All piping below grade shall be PVC, Schedule 40, DWV, ASTM D-2655, shall adhere to the installation standards set forth in ASTM D2321 or its equivalent and the bedding and backfilling of PVC pipe shall be completed as described below.
  2. For all PVC pipe, the trench excavation shall be extended to a minimum depth of 6 inches below the bottom of the pipe. Where additional excavation is required due to unacceptable soil conditions, the trench bottom shall be brought back up to grade using Class I or II bedding material. This bedding material shall be installed in no greater than 8-inch compacted lifts. All bedding material shall be compacted to a minimum density of 90 percent modified proctor as outlined in AASHTO-T180. The intent of this bedding is to provide uniform support for the flexible pipe. The remaining backfill shall be in accordance to the standard details and trench requirements. The Class I or II material shall extend for 6 inches below the pipe to 6 inches above the pipe. The maximum depth of bury for PVC pipe.
- C. Piping Below Grade – Hub and Spigot Type (Kitchen Piping):
1. All piping below the floor and extended outside the building shall be standard weight cast iron soil pipe and fittings unless noted otherwise, as manufactured by Tyler Pipe, Charlotte Pipe, or Griffin Pipe. All cast iron soil pipe and fittings shall be of the reinforced hub type, coated inside and outside with coal tar varnish and shall conform to the ASTM "Standard Specifications for Cast Iron Soil Pipe and Fittings".
- D. Soil, waste, drain and vent piping must be of sizes noted and run as indicated on the drawings, and shall be given a uniform grade of 1/4 inch per foot wherever possible, but in no case less than 1/8 inch per foot. The soil and waste pipes shall be extended through the roof. Each riser extending through the roof shall project 14" above roofline. Flashing shall be by roofing contractor. Counter flashing shall be by plumbing contractor. Where so shown, connect vents below roof.
- E. Piping Exterior of Building:
1. Sanitary sewer pipe and fittings (exterior of the building) shall be same as waste piping it connects to.
- F. Pipe Joints
1. PVC Solvent Welded Joints:
    - a. All joints shall first be primed with purple primer/cleaner manufactured for PVC pipe. Do not use water, rags, gasoline, sandpaper or other substitutes for cleaning PVC surfaces.
    - b. The cement shall be a bodied cement of approximately 800 to 1000 centipoise viscosity containing 10-20 percent (by weight) virgin PVC material solvated with tetrahydrofuran (THF). Select the proper cement (Schedule 40 cement for PVC shall be used with Schedule 40 PC pipe).
    - c. Do not use all-purpose cements, ABS cement to joint PVC pipe and fittings. Apply cement with recommended applicators or pure bristle type paintbrush or the recommended size.
    - d. All piping shall be cut squarely and deburred. Remove all excess cement from around the pipe and fittings with a dry cotton rag while cement is

still soft. Do not attempt cementing in the rain or the presence of moisture.

2. a) The cast iron hubless joint shall consist of cast iron soil pipe, fittings Clamp All Corporation, Anaheim Foundry Co. "Husky", or approved equal, hubless soil pipe coupling made of 24-gauge Type 304 stainless steel with Hi-Torque Clamps tightened to 100+125 inch-pounds of torque. Coupling gaskets shall be made of neoprene and shall interlock with the housing assembly to make slip free joint. Pipe and fittings shall be inserted into the sleeve and firmly seated against the center rib or shoulder of the gasket. A sound joint shall be provided in field cut lengths of pipe by having square cut ends as smooth as possible. The stainless-steel bands shall be tightened alternately and firmly to not less than 100 inch-pounds of torque.
- b) The reinforced hub cast iron soil pipes shall be joined with Tyler "Ty-Seal" neoprene joints.
- c) Support piping at each joint and fitting and 10'-0" maximum spacing.

G. Cleanouts

1. Cleanouts shall be provided at the ends and points in change of direction of all drain, soil and waste pipes and branches thereof, at the foot of each riser, at all offsets, in all horizontal runs at approximately 50-foot intervals for piping 4" and smaller and 100' for larger piping, and at other points where indicated on the plans or where required.
2. All cleanouts in connection with cast iron pipe, except the traps and fittings on horizontal branches, shall have tapped "Y" fittings of same size as pipe up to 4 inches, and 4 inches for all larger pipe, closed with screw plugs. All other cleanouts in connection with cast iron pipe, except those that occur in finished floor and walls, shall have heavy cast iron ferrules same size as pipe up to 4 inches, and 4 inches for all larger pipe, caulked into hub and closed with a bronze screw plug.
3. All cleanouts in finished floors shall be Zurn ZN-1400-BP-LC "Level Trol", Wade, or Jay R. Smith, with anchor flange and clamp collar, scoriated nickel-bronze access cover and adjustable frame; bronze cleanout plug shall be straight threaded with tapered shoulder.
4. All cleanouts in finished walls shall be Zurn ZN-1443-BP, Wade, or Jay R. Smith with polished nickel-bronze access cover and adjustable frame; bronze cleanout plug shall be straight threaded with tapered shoulder.
5. All cleanouts on exterior piping of building shall be Zurn "Level-Trol" ZN-1400-BP-HD, Wade, or Jay R. Smith, having heavy duty bronze top, as detailed on the Drawings.

H. Traps and Drains

1. P-traps shall be placed under all floor drains and where indicated in wastes, and at other points indicated on plans. P-traps shall be standard weight cast iron, ddeep seal type, bell and spigot pattern.
2. Drains shall be Zurn, Wade, or Jay R. Smith, in accordance with the schedule on the drawings.

I. Drain Pans

1. All floor drains, except for those in concrete slab above earthfill, shall be provided with non-plasticized chlorinated polyethylene, "Chloraloy 240", brand concealed water proofing membrane as manufactured by the Noble Company of Grand Haven, Michigan, Compotite Corp. "Composeal", or approved equal. Membrane shall be medium gray in color, textured surface finish both sides, have white or black lettering continuously marked "Chloraloy 240", size 18 inches by 18 inches,

turned up at least 1 inch, and meet applicable standards of ASTM. Complete installation shall be in accordance with manufacturer's recommendations.

- J. Origin
  - 1. Unless specifically specified otherwise, all material and products shall be manufactured in the United States of America.

## **2.03 NATURAL GAS PIPING SYSTEM**

- A. Includes:
  - 1. Necessary labor, materials, appliances and equipment required to provide gas service from existing campus master meter on east end of building and new meter on west end of building, building distribution system from (pound to ounce) pressure regulator valve at the building to gas fired equipment connections and accessories as shown on the drawings.
- B. Quality Assurance
  - 1. Manufacturers shall be firms regularly engaged in manufacturer of natural gas piping products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
  - 2. Installer shall be a firm with at least 3 years of successful installation experience on projects with natural gas piping system work similar to that required for project.
  - 3. Comply with applicable provisions of ANSI B31.2 "Fuel Gas Piping", applicable provisions of NFPA 54 (ANSI Z223.1) "National Fuel Gas Code", ANSI Z223.1a "Supplement to National Fuel Gas Code" and with requirements of Arkansas Louisiana Gas Company.
- C. Natural Gas Piping Materials and Products
  - 1. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with ANSI B31.2 where applicable, base pressure rating on natural gas piping system maximum design pressures. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials use in natural gas piping systems. Where more than one type of material or product is indicated, selection is Installer's option.
- D. Basic Identification
  - 1. Provide identification complying with Division-15 Basic Materials and Methods, Section 15050 "Mechanical Identification".
- E. Piping
  - 1. Piping inside building shall be ASTM A-120-79, carbon steel, butt welded, Schedule 40 black steel.
  - 2. Gas service outside building in ground shall be plastic pipe. Plastic pipe shall be "SDR-11 Driscopipe 6500" with copper trace wire, or approved equal, conforming to ASTM C2513. Connections and transition fittings shall be made by heat fusion, mechanical coupling. Mechanical coupling shall have internal stiffeners. Insulated fittings shall be provided at the meter and in the vertical rise above grade at the building. Transition fittings shall be provided at a minimum of 12 inches from all vertical risers to above grade. Gas piping shall be laid at least 24 inches below grade at all points.
  - 3. Risers to building and to meter or pressure regulators shall be standard line pipe provided with a mill installed protective covering of Republic "X-Tru-Coat", high

density polyethylene applied over an adhesive undercoating. All field joints and fittings shall be protected with Republic "X-Tru-Tape" and primer, applied as per manufacturer's recommendations. Pipe coat/wrap shall extend a minimum of 6 inches above finish grade.

F. Fittings

1. Black Pipe:
  - a. Welded forged steel fittings meeting requirements of ASTM A 234-79a, or standard weight malleable iron screwed.
2. Fittings outside building shall have "X-Tru-Coat" covering.

G. Plug Valves (Cocks)

1. 1 inch and smaller:
  - a. Domestic Water shall be bronze, screw pattern, 125 psig, non-shock W.O.G. operating pressure, square head, lubricated tapered brass plug design, less check, FIP thread.
  - b. Natural gas and HVAC shall be iron, screw pattern, 125 psig, non-shock W.O.G. operating pressure, square head, lubricated tapered brass plug design, less check, FIP thread.
  - c. A.Y. McDonald Mfg. Co. #10686B, Dezurik/Sartell, or A/E approved equal.
2. 1-1/4 inches thru 2 inches:
  - a. Shall be semi-steel, screwed gland type, regular pattern, 200 CWP operating pressure, 400 psig test pressure, square head, lubricated tapered plug, FIP thread and conform to ANSI B2.1; ANSI B16.1; B116.10; API 5B; -A126, Class B and MSS SP-78.
  - b. Rockwell Nordstrom Valves, Inc. #114, Resun or Homestead.
3. 2-1/2 inches thru 4 inches:
  - a. Shall be iron, screw gland type, regular pattern, 200 CWP operating pressure, 400 psig test pressure, square head, lubricated tapered plug design, FIP thread or flanges drilled to ANSI class 125 cast iron flange standard template and conform to ANSI B2.1; ANSI B16.1; B116.10; API 5B; ASTM-A126, Class B and MSS SP-78.
  - b. Rockwell Nordstrom Valves, Inc. #115, Resun or Homestead.
4. 6 inches and larger:
  - a. Shall be iron, bolted gland type, short pattern, 200 CWP operating pressure, 400 psig test pressure, square head, lubricated tapered plug design, flanges drilled to ANSI class 125 cast iron flange standard template and conform to ANSI B2.1; ANSI B16.1; B116.10; API 5B; ASTM-A126, Class B and MSS SP-78.
  - b. Rockwell Nordstrom Valves, Inc. #143, Resun or Homestead.

H. Pressure Regulating Valves

1. Provide single stage, steel jacketed, corrosion-resistant gas pressure regulators; with atmospheric vent, elevation compensator; with threaded ends for 2 inches and smaller, flanged ends for 2-1/2 inches and larger; for inlet and outlet gas pressures, specific gravity, and volume flow indicated.
2. Regulators installed indoors shall be vented to outside full size or larger as required to eliminate excessive back pressure.
3. Regulators installed outdoors shall be installed such that vent face is downward, so as to avoid the entry of water and matter which would interfere with its operation.
4. Regulators shall be equal to Rockwell Mfg. Co. (Equimeter) with internal relief.

I. Meter and Setting

1. The existing gas meter one east end of building shall be reworked (if required) by

the local gas company as required by new additional gas demand indicated on the drawings. Install new meter of west end of building. All cost including any street and sidewalk repair shall be borne by this contractor.

NOTE: A new smaller gas meter and regulator and new gas service shall also be installed on southwest side of building shown on Drawing P101.

## **PART 3 EXECUTION**

### **3.01 HOT AND COLD WATER PIPING SYSTEMS**

- A. For general piping insulation, see Section 22 0719.
- B. Install copper tubing under slabs without joints where possible.
- C. Provide adaptors in copper lines for all valves.
- D. Locate cold water lines a minimum of 12 inches from hot water line.
- E. Before pipes are covered, test systems in presence of Architect at 100 psi hydrostatic pressure for two (2) hours and show no leaks.
- F. Sterilize domestic water system with solution containing at least 250 parts per million of available chloride. Introduce chlorinating materials into system in manner approved by Architect. Allow sterilization solution to remain for 24 hours and open and close valves and faucets several times during that time.
- G. After sterilization, flush solution from system with clean water until residual chlorine content is less than 0.2 parts per million.
- H. Water system will not be accepted until a negative bacteriological test is made on water taken from system and dosing shall be repeated as necessary until such negative test is accomplished. Submit written report of test to Architect for his approval.
- I. Install water hammer arresters as noted on the drawings.
- J. Extend water service piping of size and in location indicated to water service entrance at building. Provide sleeve in foundation wall for water service entry; make entry weathertight. Provide gate valve at water service entry inside building, strainer, pressure gauge, test tee and valve.
- K. Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by National Standard Plumbing Code.
- L. Connect hot and cold water piping system to mechanical equipment as indicated, and comply with equipment manufacturer's installation instructions. Provide shut-off valve and union for each connection. Provide drain valve on drain connections.

### **3.02 SANITARY SEWER, SOIL, STORM, WASTE AND VENT PIPING SYSTEMS**

- A. Provide floor drains and other specialties as specified in the Schedule on the drawings and set forth in these specifications.
- B. Each fixture and appliance discharging water into sanitary sewer or building sewer lines shall have a seal trap in connection with a complete venting system so gasses pass freely to atmosphere with no pressure or syphon condition on water seal.

- C. Before piping is covered, conduct tests in presence of Architect and correct leaks or defective work. Do not caulk threaded work. Fill waste and vent system to roof level (a minimum of 10 feet) with water and show no leaks for two (2) hours.
- D. Vent entire system to atmosphere. Discharge 14 inches above roof. Joint lines together in fewest practicable number before projecting above roof. Set back vent lines so they will not pierce roof near an edge or valley.
- E. Use torque wrench to obtain proper tension in cinch bands when using hubless cast iron pipe. Butt ends of pipe against centering flange of coupling.
- F. Flash pipes passing through roof with six (6) lb/sq.ft. lead flashing fitted around pipes and turned down into pipe 1/2 inch with turned edge hammered against pipe wall.

### **3.03 INSTALLATION OF NATURAL GAS PIPING**

- A. Install natural gas distribution piping in accordance with applicable codes and local Utility Company requirements.
- B. Use sealants on metal gas piping threads which are chemically resistant to natural gas. Use sealants sparingly, and apply to only male threads of metal joints.
- C. Remove cutting and threaded burrs before assembling piping.
- D. Do not install defective piping or fittings. Do not use pipe with threads which are chipped, stripped, or damaged.
- E. Plug each gas outlet, including valves, with threaded plug or cap immediately after installation and retain until continuing piping, or equipment connections are completed.
- F. Install minimum 6-inch-long drip-legs in gas piping where indicated, and where required by code or regulation.
- G. Install "Tee" fitting with bottom outlet plugged or capped, at bottom of pipe risers.
- H. Use dielectric unions where dissimilar metals are joined together.
- I. Install piping with 1 inch drop in 60-foot pipe run (0.14%) in direction of flow.
- J. Install piping parallel to other piping, but maintain minimum of 12-inch clearance between gas piping and steam or hot water piping above 200 degrees F.
- K. Wrap and lay underground pipe with minimum of two (2) feet of cover in accordance with local gas utility company regulations and specifications.
- L. Install gas cocks and unions at all final connections to equipment.
- M. Do not use flexible pipe connections.
- N. All field joints and fittings shall be protected with "X-Tru-Tape" and primer.
- O. Bushings will not be accepted.

- P. Test all gas piping with air pump and 3-inch dial gauge to pressure that will maintain 25 psig for 15 minutes.
- Q. Provide sacrificial type cathodic protection for each vertical riser to the building.
- R. Provide 5/8 inch by 8'-0" copper clad steel ground rod, ground rod clamp and No. 6 stranded copper conductor from ground rod to vertical riser at every instance where piping exits the earth.

#### **3.04 GAS SERVICE**

- A. Consult with Gas Company as to extent of its work, meter requirements with consideration of Owner needs, costs, fees, and permits involved. Pay such costs and fees; obtain permits.

**END OF SECTION**



**SECTION 22 1006  
PLUMBING PIPING SPECIALTIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Valves and piping specialties, for complete Plumbing System.

**1.02 RELATED SECTIONS**

- A. Section 22 0500 – Common Work Results for Plumbing.
- B. Section 22 0553 – Identification for Plumbing Piping.
- C. Section 22 0548 – Vibration and Seismic Controls for Plumbing Piping and Equipment.
- D. Section 22 1005 – Plumbing Piping.
- E. Section 22 3000 – Plumbing Equipment.
- F. Section 22 4000 – Plumbing Fixtures.
- G. Section 31 2316 – Excavation.

**1.03 QUALITY ASSURANCE**

- A. Manufacturers: Firms regularly engaged in manufacture of piping specialties of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

**1.04 SUBMITTALS**

- A. Product Data: Submit catalog cuts, specifications, installation instructions, and dimensioned drawings for pipeline strainers. Include pressure drop curve or chart for each type and size of pipeline strainer. Submit schedule showing manufacturer's figure number, size, location, and features for each required pipeline strainer.
- B. Maintenance Data: Submit maintenance data and spare parts lists for each type of pipeline strainer. Include this data in Maintenance Manual.

**PART 2 PRODUCTS**

**2.01 MANUFACTURED PIPING SPECIALTIES**

- A. General: Provide factory-fabricated piping specialties recommended by manufacturer for use in service indicated. Provide piping specialties of types and pressure ratings indicated for each service, or if not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's option.
- B. Pipe Escutcheons:
  - 1. General: Provide pipe escutcheons as specified herein with inside diameter closely

fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings, and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.

2. Pipe Escutcheons for Moist and Wet Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.
3. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.

C. Low Pressure Y-Type Pipeline Strainers:

1. General: Comply with FCI 73-1. Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 125 psi working pressure, with Type 304 stainless steel screens, with 3/64 inch perforations at 233 sq. in. Mechanical grooved type strainer may be used in grooved piping system.
2. Threaded ends, 2 Inches and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.
3. Flanged Ends, 2-1/2 Inches and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.
4. Available Manufacturers: Subject to compliance with requirements, manufacturers offering low pressure Y-type strainers which may be incorporated in the work include, but are not limited to, the following:  
American Air Filter, an Allis-Chalmers Co.  
Armstrong Machine Works.  
Hoffman Specialty, ITT Fluid Handling Div.  
Metraflex Co.  
Sarco Co., Div. of White Consolidated.  
Trerice (H.O.) Co.  
Victaulic Co. of America

D. High Pressure Y-Type Pipeline Strainers:

1. General: Comply with FCI 73-1. Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 250 psi working pressure, with Type 304 stainless steel screens, with 3/64" perforations at 233 sq. in. Mechanical grooved type strainer may be used in grooved piping systems.
2. Threaded Ends, 2 Inches and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.
3. Flanged Ends, 2-1/2 Inches and Larger: Cast-iron body, bolted steel retainer with off-center blowdown fitted with pipe plug.
4. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high pressure Y-type strainers which may be incorporated in the work include, but are not limited to, the following:  
American Air Filter, an Allis-Chalmers Co.  
Armstrong Machine Works.  
Hoffman Specialty, ITT Fluid Handling Div.  
Metraflex Co.  
Sarco Co., Div. of White Consolidated.  
Trerice (H.O.) Co.  
Victaulic Co. of America

E. Dielectric Unions:

1. General: Provide standard products recommended by manufacturer for use in service indicated, which effectively isolates ferrous from non-ferrous piping

- (electrical conductance), present galvanic action, and stop corrosion.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering dielectric unions which may be incorporated in the work include, but are not limited to, the following:
- Atlas Products Co.
  - Capital Mfg. Co., Div. of Harsco Corp.
  - Eclipse, Inc.
  - Epco Sales, Inc.
  - FMC Corp.
  - McNally, Inc.
  - PSI Industries.
  - Stockham Valves and Fittings.

## **2.02 FABRICATED PIPING SPECIALTIES**

- A. Drip Pans: Provide drip pans fabricated from not less than 18-gauge corrosion-resistant sheet metal with watertight joints, and with edges turned up 2-1/2 inches. Reinforce top, either by structural angles or by rolling top over 1/4-inch steel rod. Provide hole, gasket, and flange at low point for watertight joint and 1" drain line connection.
- B. Pipe Sleeves: Provide pipe sleeves of one of the following:
1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gauges: 3 inches and smaller, 20-gauge; 4 inches to 6 inches, 16-gauge; over 6 inches, 14-gauge.
  2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.
  3. Iron-Pipe: Fabricate from cast-iron or ductile-iron pipe, remove burrs.
- C. Sleeve Seals: Provide sleeve seals for sleeves located in foundation walls below grade, or in exterior walls, of one of the following:
1. Lead and Oakum: Caulked between sleeve and pipe.
  2. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
- D. Available Manufacturers: Subject to compliance with requirements, manufacturers offering mechanical sleeve seals which may be incorporated in the work include, but are not limited to following:
- Thunderline Corp.

## **2.03 VALVES**

- A. General: Provide factory-fabricated valves recommended by manufacturer for use in service indicated. Provide valves of types and pressure ratings indicated; provide proper selection as determined by Installer to comply with installation requirements. Provide sizes as indicated, and connections which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's option.

## **2.04 GATE VALVES**

- A. Packing: Select valves designed for repacking under pressure when fully opened, equipped with packing suitable for intended service. Select valves designed so back

seating protects packing and stem threads from fluid when valve is fully opened, and equipped with gland follower.

- B. Comply with the following standards.
  - 1. Cast-Iron Valves: MSS SP-70.
  - 2. Bronze Valves: MSS SP-80.
  - 3. Steel Valves: ANSI B16.34.
- C. For Domestic Water Service:
  - 1. Threaded Ends 2 inches and smaller: Class 150, bronze body, union bonnet, rising stem, solid wedge, Milwaukee 1151.
  - 2. Flanged Ends 2-1/2 inches and larger: Class 125, iron body bronze mounted, bolted bonnet, rising stem, OS&Y, solid wedge, Milwaukee F-2885M.
- D. For Fire Protection Service:
  - 1. Threaded Ends 2 inches and smaller: Class 200, bronze body, yoke bonnet, rising stem, OS&Y, solid wedge, UL/FM approved, Stockham B-133.
  - 2. Flanged Ends 2-1/2 inches and larger: Class 200, iron body, bolted bonnet, rising stem, OS&Y, solid wedge, UL/FM approved, Stockham G-634.
- E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering gate valves which may be incorporated in the work include, but are not limited to, the following:
  - 1. Milwaukee Valve Company.
  - 2. Nibco Valve Company.
  - 3. Stockham Valves and Fittings, Inc.

## **2.05 GLOBE VALVES**

- A. Packing: Select valves designed for repacking under pressure when fully opened, equipped with packing suitable for intended service. Select valves designed so back seating protects packing and stem threads from fluid when valve is fully opened, and equipped with gland follower.
- B. Composition Discs: Where required, provide suitable material for intended service. For stem throttling service, fit composition disc valve with throttling nut. For metal seated globe valves, provide hardened stainless-steel disc and seat ring.
- C. Comply with the following standard:
  - 1. Cast-Iron Valves: MSS SP-85.
  - 2. Bronze Valves: MSS SP-80.
  - 3. Steel Valves: ANSI B16.34.
- D. For Domestic Water Service:
  - 1. Threaded Ends 2 inches and smaller: Class 150, bronze body, union bonnet, rising stem, composition disc, Milwaukee 590T.
  - 2. Flanged Ends 2-1/2 inches and larger: Class 125, iron body, bronze trimmed, bolted bonnet, rising stem, OS&Y, renewable seat and disc, Milwaukee F2981.
- E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering globe valves which may be incorporated in the work include, but are not limited to, the following:
  - 1. Milwaukee Valve Company.
  - 2. Nibco Valve Company.

3. Stockham Valves and Fittings, Inc.

## **2.06 DRAIN VALVES**

- A. For Low Pressure Drainage Service:
  1. Threaded Ends 2 Inches and Smaller: Class 125, bronze body, screwed bonnet, rising stem, composition disc, 3/4-inch hose outlet connection, Milwaukee 1152M.
  2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering drain valves which may be incorporated in the work include, but are not limited to, the following:
    - a. Milwaukee Valve Company.
    - b. Nibco Valve Company.
    - c. Stockham Valves and Fittings, Inc.

## **2.07 BALL VALVES**

- A. General: Select with port area equal to or greater than connecting pipe area, include seat ring designed to hold sealing material.
- B. Comply with the following standards:
  1. Steel Valves: ANSI B16.34.
- C. For Domestic Water Service:
  1. Threaded Ends 2 inches and smaller: Class 125, bronze 2-piece body, bronze ball, bronze stem, Milwaukee BA-500.
- D. Available Manufacturers: Subject to compliance with requirements, manufacturers offering ball valves which may be incorporated in the work include, but are not limited to the, the following:
  1. Milwaukee Valve Company.
  2. Nibco Valve Company.
  3. Stockham Valves and Fittings, Inc.

## **2.08 SWING CHECK VALVES**

- A. General: Construct pressure containing parts of valves as follows:
  1. Bronze Valves, 125 or 150 psi: ANSI/ASTM B62.
  2. Metallic Seated Bronze Valves, 200 or 300 psi: ANSI/ASTM B61.
  3. Iron Body Valves: ANSI/ASTM A126, Grade B.
- B. Comply with MSS SP-71 for design, workmanship, material, and testing.
- C. Construct valves of pressure castings free of any impregnating materials.
- D. Construct valves of bronze, regrinding, with seating angle 40 degrees to 45 degrees, unless composition disc is specified.
- E. Provide stop plug as renewable stop for disc hanger, unless otherwise specified.
- F. Construct disc and hanger as separate parts, with disc free to rotate.
- G. Support hanger pins on both ends by removable side plugs.

- H. For Domestic Water Service:
  - 1. Threaded Ends 2 inches and smaller: Class 125, bronze body, screwed cap, horizontal swing, bronze disc, Milwaukee 509.
  - 2. Flanged Ends 2-1/2 inches and larger: Class 125, iron body bronze mounted, bolted cap, horizontal swing, cast-bronze disc, Milwaukee 297A.
- I. For Fire Protection System:
  - 1. Threaded Ends 2 inches and smaller: Class 200, bronze body, bolted cap, horizontal swing, composition disc, UL listed, Stockham B-305-B.
  - 2. Flanged Ends 2-1/2 inches and larger: Class 2005, iron body bronze mounted, bolted cap, horizontal swing, malleable iron disc, UL/FM approved, Stockham G-939.
- J. Available Manufacturers: Subject to compliance with requirements, manufacturers offering swing check valves which may be incorporated in the work include, but are not limited to, the following:
  - 1. Milwaukee Valve Company.
  - 2. Nibco Valve Company.
  - 3. Stockham Valves and Fittings, Inc.

## **2.09 VALVE FEATURES**

- A. General: Provide valves with features indicated and, where not otherwise indicated, provide proper valve features as determined by Installer for installation requirements. Comply with ANSI B31.1.
- B. Bypass: Comply with MSS SP-45, and except as otherwise indicated provide manufacturer's standard bypass piping and valving.
- C. Drain: Comply with MSS SP-45, and provide threaded pipe plug complying with Division-15 "Pipe, Tube, and Fittings" section.
- D. Flanged: Valve flanges complying with ANSI B16.5 (steel) or ANSI B16.24 (bronze).
- E. Threaded: Valve ends complying with ANSI B2.1.
- F. Butt-Welding: Valve ends complying with ANSI B16.25.
- G. Flangeless: Valve bodies manufactured to fit between flanges complying with ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).
- H. Wafer: Flangeless valves.
- I. Trim: Fabricate pressure-containing components of valve, including stems (shafts) and seats from brass or bronze materials, of standard alloy recognized in valve manufacturing industry.
- J. Non-Metallic Disc: Non-metallic material selected for service indicated in accordance with manufacturer's published literature.
- K. Renewable Seat: Design seat of valve with removable disc, and assembly valve so disc can be replaced when worn.
- L. Extended Stem: Increase stem length by 2 inches minimum, to accommodate insulation

applied over valve.

- M. Mechanical Actuator: Factory-fabricated gears, gear enclosure, external chain attachment, and chain designed to provide mechanical advantage in operating valve.
- N. Bonnet: Part of gate or globe valve through which stem passes to valve body, and attached to valve body by screws, bolts, union, or welding.
- O. Solid Wedge: One-piece tapered disc in gate valve, designed for contact on both sides.
- P. Outside Screw and Yoke: Stem and handwheel designed to rise out of bonnet or yoke as valve is operated from closed to open position.

## **2.10 PLUG VALVES (COCKS)**

- A. Valve body shall be screw pattern, iron, except that sizes 1-1/4 inches through 2 inches shall be semi-steel, rated for 125 psig, non-shock W.O.G. operating pressure.
- B. Plug shall be tapered, lubricated brass with square head operator.
- C. APPROVED MANUFACTURERS
  - 1. 1-inch and smaller - A. Y. McDonnell Manufacturing Company #10686.
  - 2. 1-1/4 inches through 1-1/2 inches - Nordstrom #114.
  - 3. 2-1/2 inches and larger - Nordstrom #115.
  - 4. Architect Approved.

## **2.11 PRESSURE RELIEF VALVES**

- A. Body: Bronze or iron with testing lever.
- B. Trim: Bronze or stainless steel.
- C. Construction: Comply with ASME Code for Pressure Vessels, Section VIII and shall bear ASME stamp.
- D. Maximum Permissible over Pressure: 25 percent (water).
- E. APPROVED MANUFACTURERS
  - 1. Bell and Gossett.
  - 2. McDonnell Miller.
  - 3. Kunkle Valve Company.

## **2.12 PRESSURE REDUCING VALVES**

- A. Body: Cast iron.
- B. Trim: Bronze.
- C. Rating: 125 psig working pressure at 200 degrees F.
- D. Operator: Spring loaded diaphragm with adjustable range.
- E. Diaphragms and Disc: Nitrile.

- F. Pressure Reducing Valves - Water Service:
  - 1. Spence Regulators - Type D 34.
  - 2. Watts Regulators.
  - 3. Architect Approved.

## **2.13 BACK FLOW PREVENTERS**

- A. Reduced pressure type. Rated 175 psig at 140 degrees F, manufactured in the United States of America.
- B. Body:
  - 1. Bronze construction.
  - 2. Bronze body test cocks.
  - 3. NPT body connections.
  - 4. Non-rising stem gate valves.
- C. Check Valve:
  - 1. Celcon seats.
  - 2. Rubber check valve.
- D. Relief Valve:
  - 1. Stainless steel seat.
  - 2. Stainless steel shaft and flange bolts.
- E. Approved Manufactures
  - 1. Watts Regulator Series 909-SAG.
  - 2. Wilkins Regulators.
  - 3. Febco.

## **2.14 HORIZONTAL-PIPING HANGERS AND SUPPORTS**

- A. General: Except as otherwise indicated, provide factory-fabricated horizontal-piping hangers and supports complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.
- B. Adjustable Steel Clevises: MSS Type 1.
- C. Steel Double Bolt Pipe Clamps: MSS Type 3.
- D. Adjustable Swivel Pipe Rings: MSS Type 6.
- E. Split Pipe Rings: MSS Type 11.
- F. Extension Split Pipe Clamps: MSS Type 12.
- G. Pipe Saddle Supports: MSS Type 36, including steel pipe base support and cast-iron floor flange.
- H. Pipe Stanchion Saddle: MSS Type 37, including steel pipe base support and cast-iron floor flange.



- I. Adjustable Pipe Saddle Supports: MSS Type 38 including steel pipe base support and cast-iron floor flange.
- J. Single Pipe Rolls: MSS Type 41.
- K. Adjustable Roller Hangers: MSS Type 43.

## **2.15 VERTICAL-PIPING CLAMPS**

- A. General: Except as otherwise indicated, provide factory-fabricated vertical-piping clamps complying with ANSI/MSS SP-58, of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.
- B. Two-Bolt Riser Clamps: MSS Type 8.
- C. Four-Bolt Riser Clamps: MSS Type 42.

## **2.16 HANGER-ROD ATTACHMENTS**

- A. General: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.
- B. Steel Turnbuckles: MSS Type 13.
- C. Swivel Turnbuckles: MSS Type 15.
- D. Malleable Iron Sockets: MSS Type 16.
- E. Steel Weldless Eye Nuts: MSS Type 17.

## **2.17 BUILDING ATTACHMENTS**

- A. General: Except as otherwise indicated, provide factory-fabricated building attachments complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.
- B. Concrete Inserts: MSS Type 18.
- C. Top Beam C-Clamps: MSS Type 19.
- D. Side Beam or Channel Clamps: MSS Type 20.
- E. Center Beam Clamps: MSS Type 21.
- F. C-Clamps: MSS Type 23.

- G. Top I-Beam Clamps: MSS Type 25.
- H. Side I-Beam Clamps: MSS Type 27.
- I. Steel I-Beam Clamps with Eye Nut: MSS Type 28.
- J. Steel WF-Beam Clamps with Eye Nut: MSS Type 29.
- K. Malleable Beam Clamps: MSS Type 30.
- L. Steel Brackets: One of the following for indicated loading:  
     Light Duty: MSS Type 31.  
     Medium Duty: MSS Type 32.  
     Heavy Duty: MSS Type 33.

## **2.18 SADDLES AND SHIELDS**

- A. General: Except as otherwise indicated, provide saddles or shields for piping hangers and supports, factory-fabricated, for all insulated piping. Side saddles and shields for exact fit to mate with pipe insulation.
- B. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.
- C. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.

## **2.19 MANUFACTURERS OF HANGERS AND SUPPORTS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering hangers and supports which may be incorporated in the work include, but are not limited to the following:  
     C & S Mfg. Corp.  
     Carpenter and Patterson, Inc.  
     Elcen Metal Products Co.  
     F & S Central Mfg. Corp.  
     ITT Grinnell Corp.

## **2.20 MISCELLANEOUS MATERIALS**

- A. Metal Framing: Provide products complying with NEMA Std. ML 1.
- B. Steel Plates, Shapes and Bars: Provide products complying with ANSI/ASTM A36.
- C. Cement Grout: Portland cement (ANSI/ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ANSI/ASTM C404, Size No. 2). Mix at a ratio of 1.0-part cement to 3 parts sand, by volume, with minimum amount of water required for placement and hydration.
- D. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for load required; weld steel in accordance with AWS standards.
- E. Pipe Guides: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of a bolted two-section outer cylinder and base with a two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), by cylinder.

Provide guides of length recommended by manufacturer to allow indicated travel.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION OF MANUFACTURED PIPING SPECIALTIES**

- A. Pipe Escutcheons: Install pipe escutcheons on each pipe penetration through floors, walls, partitions, and ceilings where penetration is exposed to view; and on exterior of building. Secure escutcheon to pipe or insulation so escutcheon covers penetration hole, and is flush with adjoining surface.
- B. Y-Type Strainers: Install Y-type strainers full size of pipeline, in accordance with manufacturer's installation instructions. Install pipe nipple and shutoff valve in strainer blow down connection, full size of connection, except for strainers 2 inches and smaller installed ahead of control valves feeding individual terminals. Where indicated, provide drain line from shutoff valve to plumbing drain, full size of blow down connection.
  - 1. Locate Y-type strainers in supply line ahead of the following equipment, and elsewhere as indicated, if integral strainer is not included in equipment.
    - Pumps.
    - Steam traps serving steam main drips.
    - Temperature control valves.
    - Pressure reducing valves.
    - Temperature or pressure regulating valves.
- C. Dielectric Unions: Install at each piping joint between ferrous and non-ferrous piping. Comply with manufacturer's installation instructions.

### **3.02 INSTALLATION OF FABRICATED PIPING SPECIALTIES**

- A. Drip Pans: Locate drip pans under piping passing over or within 3' horizontally of electrical equipment, and elsewhere as indicated. Hang from structure with rods and building attachments, weld rods to sides of drip pan. Brace to prevent sagging or swaying. Connect 1 inch drain line to drain connection, and run to nearest plumbing drain or elsewhere as indicated.
- B. Sleeves: Install pipe sleeves of types indicated where piping passes through walls, floors, ceilings, and roofs. Do not install sleeves through structural members of work, except as detailed on drawings, or as reviewed by Architect/Engineer. Install sleeves accurately centered on pipe runs. Size sleeves so that piping and insulation (if any) will have free movement in sleeve, including allowance for thermal expansion; but not less than 2 pipe sizes larger than piping run. Where insulation includes vapor-barrier jacket, provide sleeve with sufficient clearance for installation. Install length of sleeve equal to thickness of construction penetrated, and finish flush to surface except floor sleeve. Extend floor sleeves 1/4 inch above level floor finish, and 3/4 inch above floor finish sloped to drain. Provide temporary support of sleeves during placement of concrete and other work around sleeves, and provide temporary closure to prevent concrete and other materials from entering sleeves.
  - 1. Install sheet-metal sleeves at interior partitions and ceilings other than suspended ceilings.
  - 2. Install iron-pipe sleeves at exterior penetrations, both above and below grade.
  - 3. Install steel-pipe sleeves except as otherwise indicated.
- C. Sleeve Seals: Install in accordance with the following:
  - 1. Mechanical Sleeve Seals: Loosely assemble rubber links around pipe with bolts

and pressure plates located under each bolt head and nut. Push into sleeve and center. Tighten bolts until links have expanded to form watertight seal.

### 3.03 INSTALLATION OF VALVES

- A. General: Except as otherwise indicated, comply with the following requirements.
  - 1. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.
  - 2. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward for horizontal plane unless unavoidable. Install valve drains with hose-end adapter for each valve that must be installed with stem below horizontal plane.
- B. Insulation: Where insulation is indicated, install extended-stem valves, arranged in proper manner to receive insulation.
- C. Applications Subject to Shock: Install valves with bodies of metal other than cast iron where thermal or mechanical shock is indicated or can be expected to occur.
- D. Applications Subject to Corrosion: Do not install bronze valves and valve components in direct contact with steel, unless bronze and steel are separated by dielectric insulator. Install bronze valves in steam and condensate service and in other services where corrosion is indicated or can be expected to occur.
- E. Mechanical Actuators: Install mechanical actuator with chain operators where indicated, and where valves 4" and larger are mounted more than 7'-0" above floor in mechanical rooms, boiler rooms; and where recommended by valve manufacturer because of valve size, pressure differential or other operating condition making manual operation difficult.
- F. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select and install valves with the following ends or types of pipe/tube connections.
  - 1. Pipe Size 2 inches and smaller: One of the following, at Installer's option:
    - a. Threaded valves.
    - b. Grooved-end valves (Fire Protection Only).
    - c. Flanged valves.
  - 2. Pipe Size 2-1/2 inches and larger: One of the following, at Installer's option:
    - a. Grooved-end valves (Fire Protection Only).
    - b. Flanged valves.
- G. Valve System: Select and install valves with outside screw and yoke stems, except provide inside screw non-rising stem valves where headroom prevents full opening of OS&Y valves.
- H. Non-Metallic Disc: Limit selection and installation of valves with non-metallic discs to locations indicated and where foreign material in piping system can be expected to prevent tight shutoff of metal seated valves.
- I. Renewable Seats: Select and install valves with renewable seats except where otherwise indicated.
- J. Fluid Control: Except as otherwise indicated, install, gate, ball, globe and butterfly valves to comply with ANSI B31.1. Where throttling is indicated or recognized as principal

reason for valve, install globe or butterfly valve.

K. Installation of Check Valves:

1. Swing Check Valves: Install in horizontal position with hinge pin horizontally perpendicular to centerline of pipe. Install for proper direction of flow.
2. Horizontal Lift Check Valve: Install in horizontal piping line with stem vertically upward, position for proper direction of flow.
3. Vertical Lift Check Valve: Install in vertical piping line with upward flow with stem vertically upward.
4. Spring Loaded Horizontal Lift Check Valve: Install in horizontal piping line with stem vertically upward, position for proper direction of flow.

### **3.04 INSTALLATION OF BACKFLOW PREVENTERS**

- A. Install backflow preventers where shown on the plans with elbow and air gap, and as may be required to prevent cross contamination of potable water systems.

### **3.05 PREPARATION**

- A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.
- B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Architect/Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

### **3.06 INSTALLATION OF BUILDING ATTACHMENTS**

- A. Install building attachments at required locations, within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-59. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.

### **3.07 INSTALLATION OF HANGERS AND SUPPORTS**

- A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping, ductwork or other supported mechanical or electrical items.
1. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as

- installed for adjacent similar piping.
  - 2. Support fire-water piping independently of other piping.
  - 3. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.
- B. Provisions for Movement:
- 1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion bends and similar units.
  - 2. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
  - 3. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 are not exceeded.
- C. Insulated Piping: Comply with the following installation requirements.
- 1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
  - 2. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold or chilled water piping, install galvanized coated protective shields. Install Foam-Glas insulation saddles.
  - 3. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.

### **3.08 INSTALLATION OF ANCHORS**

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.
- C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximum recommended by manufacturer for each unit.
- D. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

### **3.09 ADJUSTMENT OF HANGERS AND SUPPORTS**

- A. Adjust hangers and supports and place grout as required under supports to bring piping to proper levels and elevations.

### **3.10 EQUIPMENT BASES**

- A. Concrete housekeeping bases will be provided as work of Division 3. Furnish to Contractor, scaled layouts of all required bases with dimensions of bases, and location to column center-lines. Furnish templates, anchor bolts, and accessories, necessary for base construction.
- B. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-

fabricated tank saddles for tanks mounted on steel stands. Structural steel stands to be supported from housekeeping pad bases. Steel supports shall not be allowed to be in direct contact with slab floors.

**END OF SECTION**

**SECTION 23 0500**  
**COMMON WORK RESULTS FOR HEATING, VENTILATING AND AIR CONDITIONING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Basic Requirements for complete heating, ventilating, and air conditioning system.

**1.02 RELATED SECTIONS**

- A. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.
- B. Section 23 21 13 – Hydronic Piping.
- C. Section 23 31 00 – HVAC Ducts and Casings.
- D. Division 23 – All Sections.
- E. Section 31 23 16 – Excavation.

**1.03 SITE CONDITIONS**

- A. Examine premises and understand the conditions which may affect performance of work of this Division before submitting proposals for this work.
- B. No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.

**1.04 SCOPE**

- A. Includes:
  - 1. Labor, materials and equipment necessary for completion of work unless indicated or noted otherwise.
  - 2. Installation of complete heating, ventilation and air conditioning systems.
  - 3. Providing motors specified in this Division and be responsible for proper operation of electrical power equipment furnished by this Division.
  - 4. Furnish exact location of electrical connections and completed information on motor controls to Division 26.
  - 5. Putting heating, ventilating, cooling and exhaust systems into full operation during each working day of testing and balancing.
  - 6. Making changes in pulleys, belts and dampers or adding dampers as required for correct balance.
- B. Related Work Specified Elsewhere:
  - 1. Conduit (unless specified otherwise), line voltage wiring, outlets and disconnect switches specified in Division 26.
  - 2. Magnetic starters and thermal protective devices (heaters) not a factory mounted integral part of packaged equipment are specified in Division 26.

**1.05 SITE INSPECTION**

- A. Examine premises and understand the conditions which may affect performance of work



of this Division before submitting proposals for this work.

- B. No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.

#### **1.06 DRAWINGS**

- A. Mechanical drawings show general arrangement of piping, ductwork, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.
- B. Consider architectural and structural drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over mechanical drawings.
- C. Because of the small scale of mechanical drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves and
- D. Record difference between mechanical work as installed and as shown in Contract Documents on a set of prints of mechanical drawings to be furnished by Engineer. Return these prints to Engineer at completion of project. These will be labeled "Contractor Revised Drawings".

#### **1.07 SUBSTITUTIONS**

- A. The naming of specified items on the drawings or in the specifications is intended to establish a level of quality and performance. Substitution requests may be submitted at the time of shop drawing submittal. Review of substituted equipment or material prior to the Bid Date will not be considered unless otherwise specified.
- B. Substitution shall be submitted as specified in Division 0.

#### **1.08 CODE REQUIREMENTS, FEES & PERMITS**

- A. Perform work in accordance with applicable provisions of state and local Plumbing Code, gas ordinances and adoptions thereof. Provide materials and labor necessary to comply with rules, regulations and ordinances.
- B. In case of differences between building codes, state laws, local ordinances, utility company regulations and Contract Documents, the most stringent shall govern. Promptly notify Engineer in writing of such differences.

#### **1.09 COORDINATION OF WORK**

- A. It is understood that while Drawings are to be followed as closely as circumstances permit, this Division will be held responsible for installation of systems according to the true intent and meaning of the Contract Documents. Anything not clear or in conflict will be explained by making application to Architect. Should conditions arise where certain changes would be advisable, secure Architect's approval of these changes before proceeding with work.
- B. Coordinate work of various trades in installing inter-related work. Before installation of mechanical items, make proper provisions to avoid interferences in a manner approved by

Architect. Changes required in work specified in Division 23 caused by neglect to do so shall be made at no cost to Owner.

- C. Provide inserts and supports required by Division 23 unless otherwise noted. Furnish sleeves, inserts, supports and equipment that are an integral part of other divisions of the Work to Sections involved in sufficient time to be built into construction as the Work proceeds. Locate these items and see that they are properly installed. Expense resulting from improper location of installation of items above shall be borne by Division 23.
- D. Be responsible for required digging, cutting and patching incident to work of this Division and make required repairs afterward to satisfaction of Engineer. Cut carefully to minimize necessity for repairs to existing work. Do not cut beams, columns or trusses.
  - 1. Each Section of this Division shall bear expense of cutting, patching, repairing and replacing of work of other Sections required because of its fault, error, tardiness or because of damage done by it.
  - 2. Cutting, patching, repairing and replacing pavements, sidewalks, roads and curbs to permit installation of work of this Division is responsibility of Section installing work.
- E. Adjust locations of pipes, etc. to accommodate work from interferences anticipated and encountered. Determine exact route and location of each pipe and duct prior to fabrication.
  - 1. Make offsets, transitions, and changes in direction of pipes, as required to maintain proper headroom and pitch of sloping lines whether or not indicated on Drawings.
- F. Slots and openings through floors, walls, ceilings and roofs shall be provided by other Divisions in their respective materials. This Division shall see that they are properly located and do any cutting and patching caused by its neglect to do so.

#### **1.10 CLEANING AND FINISHING**

- A. Clean exposed piping, ductwork, and equipment. Repair damaged finishes and leave everything in working order satisfactory to Engineer.

#### **1.11 LUBRICATION**

- A. Properly lubricate equipment before Owner's acceptance.
- B. Provide lubricating chart listing each item of equipment, type of lubricant required and frequency of lubrication.

#### **1.5 EXCAVATION AND TRENCHING FOR PIPING**

- A. Excavate to the depths indicated on the Drawings or as otherwise specified. Excavated materials not required or suitable for backfill or fill shall be removed from the site. Do such grading as is necessary to prevent surface water from flowing into trenches or other excavations. Water accumulated therein shall be removed by pumping or by other approved method. Do sheeting and shoring as may be necessary for protection of the work and for safety of personnel. Excavation shall be by open cut except that short sections of trench may be tunneled if the pipe can be safely and properly installed and backfill can be properly tamped in such tunnel sections.
- B. Trench Excavation: Bottom of trench for tile or concrete pipe shall be rounded so that at least the bottom quadrant of the pipe rests firmly on undisturbed soil for as nearly the full length of the barrel as proper jointing operations will permit. Grade bottom of trenches to

provide uniform bearing and support for each section of pipe on undisturbed soil. Where rock is encountered, excavate to a minimum overdepth of 4 inches below trench depths indicated on the drawings or specified. Overdepths in rock excavation and unauthorized overdepths shall be backfilled. Whenever wet or otherwise unstable soil incapable of properly supporting the pipe is encountered, such soil shall be removed and the trench backfilled to proper grade as hereinafter specified.

- C. Depth of Cover: Trenches shall be of depth that will provide a minimum depth of cover of three feet for water, sanitary and storm sewer and two feet for gas piping from existing grade or from indicated finish grade, whichever is lower, unless otherwise specifically shown.
- D. Protection of Existing Utilities: Existing utility lines to be retained that are shown on the drawings, or the locations of which are made known to the contractor prior to excavation, shall be protected from damage during excavation and backfilling, and if damaged, shall be repaired by the contractor, at his expense.

#### **1.12 BACKFILLING OF TRENCHES**

- A. Trenches shall not be backfilled until required pressure and other tests have been performed, inspection of utility and Code officials have been accomplished, and until the utilities systems as installed conform to requirements of drawings and specifications.
- B. Backfill trenches with excavated materials consisting of earth, sandy clay, sand, gravel, soft shale or other approved materials, free from clods of earth or stones over 2-1/2-inch maximum dimension, deposited in 6-inch layers and compacted to 95% of the maximum laboratory density determined in accordance with ASTM D-698, Moisture-Density Relation of Soils. Tests for maximum density will be made with expense borne by contractor. If fills fail to meet the specified densities, the contractor shall remove and recompact the fill until specified densities are achieved.
- C. Tests for Displacement of Pipes: After the trench has been backfilled to 2 feet or more above the pipe, if the pipe shows poor alignment, displaced pipe, or any other defects, such defects shall be remedied by the contractor at his expense.

#### **1.13 GENERAL PIPING INSTALLATION**

- A. Furnish and install a complete system of piping, all valved as indicated or as necessary to completely control the entire system. The piping drawings are diagrammatic and indicate the general location and connections. If the size of any piping is not clearly evident, obtain instructions from the Engineer before proceeding with the work. The piping may have to be offset, lowered or raised as required or as directed at the site. This does not relieve the contractor from responsibility for the proper erection of systems of piping in every respect suitable for the work intended. Piping systems that are not to be installed complete shall be so noted.
- B. Erection: Piping shall be cut accurately for fabrication to measurements established at the construction site. Pipe shall be worked into place without springing and/or forcing, properly clearing all windows, doors, and other openings and equipment. Remove all burrs and cutting slag by reaming or other cleaning methods. Changes in direction shall be made with fittings, except that bendings of pipe will be permitted, providing a hydraulic pipe bender is used. Bent pipe showing kinks, wrinkles, or other malformation will not be acceptable. Piping shall be arranged so as not to interfere with removal of other

equipment or devices nor to block access to doors, windows, manholes or other access openings. Piping shall be installed to ensure noiseless circulation. Valves and specialties shall be placed to permit easy operation and access, and valves shall be regulated, packed and glands adjusted at the completion of the work before final acceptance. Piping shall be installed so as to avoid liquid or air pockets. Eccentric reducers shall be used wherever changes in pipe sizes occur in hot water and chill water mains. Locate reducers approximately 18 inches beyond the nearest upstream branch.

- C. Expansion and contraction of piping shall be provided by expansion loops, bends or expansion joints to prevent injury to connections, piping, equipment or the building.
- D. Minimum slope of piping shall be in accordance with the following unless otherwise specifically shown on the drawings or specified:

Type of Piping			Length for Direction of Fall
<u>Fluid Conveyed</u>	<u>System Component</u>	<u>1" Fall</u>	
Heating Water Chilled Water	Runouts to fan coil units or risers	4 feet	Back to mains
Heating Water Chilled Water Condenser Water	Supply and return mains	Level	
Domestic Water	Main or branch	40 feet	Back to mains

- E. Unions shall be installed on bypasses, ahead of traps, at connections to equipment, where shown on drawings, or where required to facilitate removal of equipment whether shown or not.
- F. Escutcheons shall be provided where pipes are exposed in finish locations of the building and run through walls, floors, or ceiling. Plates shall be chrome plated spun brass of plain pattern and shall be set tight on the pipe and to the building surface.
- G. Protection: Open ends of pipes and equipment shall be properly capped or plugged to keep dirt and other foreign materials out of the system. Plugs of rags, wood, cotton, concrete, waste or similar materials must not be used in plugging.
- H. Installation of Underground Pipe: Bottom of trench shall be shaped to give substantially uniform circumferential support to lower third of each pipe. Pipe shall be laid true to line and grade in such manner as to form a close concentric joint with adjoining pipe and to prevent sudden offsets to flow line. As work progresses, interior of pipe shall be cleared of dirt and superfluous materials. Where cleaning after laying is difficult because of small pipe size, a suitable swag or drain shall be kept in pipe and pulled forward past each joint immediately after jointing has been completed. Trenches shall be kept free from water until pipe jointing has set and pipe shall not be laid when condition of trench or weather is unsuitable for such work.
- I. Cleaning and Flushing: Contractor shall take every precaution to remove dirt, grease, and all other foreign matter from each length of piping before making connections in the field. After each section of piping is installed, it shall be flushed with clean water except where specified otherwise.

- J. A temporary flushing connection shall be arranged for each section of piping and flushing arranged for all piping. Water required for flushing and testing shall be furnished by the contractor. Temporary cross connections for flushing and drainage connections shall be furnished, installed, and subsequently removed by the contractor.
- K. Pipe Sizes: If the size of any piping is not clearly evident in the drawings, the contractor shall request instructions from the Engineer as to the proper sizing. Any changes resulting from the contractor's failure to request clarification shall be at his expense.

#### **1.14 THERMAL AND MOISTURE PROTECTION**

- A. Install all insulation products in accordance with manufacturer's written instructions and in accordance with industry practices to ensure that insulation serves its intended purpose.
- B. Insulate all piping, ducts and equipment, whether indicated or not, which are subject to freezing or condensation formation.
- C. Insulate tops of all ceiling mounted air devices and the body of all side-wall mounted air devices with a minimum of 1/2 inch thick fiberglass blanket.
- D. Insulate all piping, ducts and equipment, whether indicated or not, whose normal operating surface temperature exceeds 120°F unless specifically noted otherwise.
- E. Insulation and vapor barrier shall be continuous throughout the system unless specified otherwise.
- F. Install flashing, counterflashing and caulk or seal all penetrations in roof, exterior walls or floors as required to prevent exterior moisture from entering building.
- G. Install all piping located in exterior walls, attic spaces or crawl spaces on the room side of the building insulation to prevent freezing.
- H. Provide heat trace cable on all water piping above grade outdoors which is subject to freezing whether insulated or not. Cable shall be installed in strict accordance with the manufacturer's installation instructions.

#### **1.15 EQUIPMENT AND MATERIALS**

- A. Product Approvals:
  - 1. If approval is received to use other than specified items, responsibility for specified capacities and insuring that items to be furnished will fit space available lies with this Division.
  - 2. In the event other than specified equipment is used and will not fit job site conditions, this Division assumes responsibility for replacement with items named in specification.
- B. Use domestic made pipe, pipe fittings and motors on project.
- C. Motor and equipment name plates as well as applicable UL and AGA labels shall be in place before pre-final inspection.
- D. Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connection and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents.

- E. Follow Manufacturer's directions in delivery, storage, protection and installation of equipment and materials.
  - 1. Promptly notify Architect in writing of conflicts between requirements of Contract Documents and manufacturer's directions and obtain Architect's written instructions before proceeding with work. Bear expenses arising from correcting deficiencies of work that do not comply with Manufacturer's directions or such written instructions from Architect.
- F. Deliver equipment and material to site and tightly cover to protect against dirt, water, and chemical or mechanical injury but have readily accessible for inspection. Store items subject to moisture damage (such as controls) in a dry, heated space.

#### **1.16 OPERATIONS AND MAINTENANCE MANUAL FOR MECHANICAL SYSTEMS**

- A. Bind two (2) Operations & Maintenance Manuals for Mechanical Systems in 3-ring, hardback binders. Spline of each binder shall have the following lettering done in silk-screen -

OPERATION AND MAINTENANCE MANUAL  
for MECHANICAL SYSTEMS OF  
SCHICHTL HALL RENOVATIONS  
UNIVERSITY OF CENTRAL ARKANSAS  
CONWAY, ARKANSAS

- 1. Provide a master index at beginning of Manual showing items included. Include name and phone number of nearest supplier and Manufacturer's representative. Use plastic tab indexes for sections of Manual.
  - 2. Step by step procedure to follow in putting each piece of mechanical equipment into operation.
  - 3. Provide schematic control diagrams for each separate fan system, refrigeration system, heating system, control panel, etc. Each diagram shall show locations of start-stop switches, insertion thermostats, room thermostats, thermometers, firestats, pressure gages, automatic valves and refrigeration accessories. Mark correct operating settings for each control instrument on these diagrams.
  - 4. Provide diagram for electrical control system showing wiring of related electrical control items such as firestats, fuses, interlocks, electrical switches and relays.
  - 5. Provide drawings of each temperature control panel identifying components on the panels and their function.
- B. Maintenance instructions shall include:
  - 1. Manufacturer's maintenance instructions for each piece of mechanical equipment installed in project. Instructions shall include name of vendor, installation instructions, parts numbers and lists, operations instructions of equipment and maintenance and lubrication instructions.
  - 2. Summary list of mechanical equipment requiring lubrication showing name of equipment, location, and type and frequency of lubrication.
  - 3. List of mechanical equipment used to indicate name, model, serial number and nameplate data of each item together with number and name associated with each system item.
- C. Air Balance and Test Run Reports.
  - 1. Include a copy of air balance reports and certifications.

2. Include a copy of the 3-day operating test data.
- D. Provide a complete set of approved shop drawing submittals as an Appendix item.

#### **1.17 OPERATIONS AND MAINTENANCE INSTRUCTIONS**

- A. Instruct Owner/Owner's Representative in operation and maintenance of mechanical systems utilizing Operations and Maintenance Manual when so doing.
- B. Minimum instruction periods shall be as follows:
1. Mechanical - Sixteen (16) hours.
  2. Temperature Controls - Sixteen (16) hours.
- C. Instruction periods shall occur after pre-final inspection when systems are properly working and before final payment is made.
- D. None of these instructional periods shall overlap another.

#### **1.18 CONTRACTOR REVISED DRAWINGS**

- A. The contractor shall, during the progress of the work, keep an accurate record of all changes and corrections from the layouts shown on the drawings. Record of changes may be kept by accurately making all changes on a set of prints during the progress of the job.
- B. Exact location of all underground utility service entrances and their connections to utility mains, terminal boxes, piping and all valves, etc., which will be concealed in the finished work shall be accurately indicated on the drawings by measured distances.
- C. Upon completion of the work and prior to final payment, the contractor shall furnish to the Engineer, one set of "contractor revised" prints, legibly and accurately marked to indicate all changes, additions, deletions, etc., from the contract drawings.
- D. Contractor shall include all addendum items and field change order information on the revised drawings. Revise all schedules shown on the drawings to reflect the actual model numbers, capacities and electrical characteristics of substituted equipment.

#### **1.19 VISIT SITE**

- A. This contractor shall visit the site of the building before submitting a proposal on this work, and shall thoroughly familiarize himself with the existing conditions and operations. Failure on his part to do this will not be cause for extras after the contract is signed by reason of unforeseen conditions. Any existing electric wiring and conduit, gas, water drainage piping encountered within the building area shall be relocated or removed where required by this contractor at no extra cost to the Owner.

#### **1.20 GUARANTEE**

- A. The work herein specified shall be free from defects in workmanship and material under normal use and service. If, within twelve (12) months from date of substantial completion and Owner acceptance of the work herein described, any of the equipment or materials, or in the installation thereof, is found to be defective in workmanship or material, it shall be replaced or repaired free of charge.

- B. The Contractor shall, after completion of the original test of the installation, and acceptance of the Engineer, provide any service incidental to the proper performance of the mechanical systems under guarantees outlined above for a period of one (1) year.

## **1.21 REVIEW OF MATERIALS AND EQUIPMENT**

- A. Furnish complete catalog data for manufactured items of equipment to be used in Work to Architect for review within 30 days after award of Contract.
- B. Submit six (6) copies of data in 3-ring binders with tab indices in same order and name as they appear in specification.
  - 1. State sizes, capacities, brand names, motor HP, accessories, materials, gauges, dimensions and other pertinent information. Pertinent information shall include as a minimum those items as scheduled on the drawings. Arrange submittal information to reflect these categories scheduled on the drawings.
  - 2. Provide an index of tab numbers at the front of each binder. List the specification number and category included under each tab as described in the specifications and as scheduled on the drawings.
  - 3. Provide cover sheet for each tab section. List each piece of equipment by name, model number and supplier.
  - 4. Underline applicable data and indicate model being supplied on each submittal sheet.
- C. If data is not submitted as specified or submittal is not complete, it will be returned without review.
- D. Catalog data or shop drawings for equipment which are noted as being reviewed by the Architect, shall not supersede Contract Documents.
- E. Review comments of Architect shall not relieve this Division from responsibility for deviations from Contract Documents unless Architects' attention has been called to such deviations in writing at the time of submission, nor shall they relieve this Division from responsibility for errors in items submitted.
- F. Check work described in catalog data with Contract Documents for deviations and errors.

## **1.22 FINALLY**

- A. It is the intention that this specification shall provide a complete installation except as hereinbefore specifically excepted. All accessory construction and apparatus necessary or advantageous in the operation and testing of the work shall be included.
- B. The omission of specific reference to any part of the work necessary for such complete installation shall not be interpreted as relieving this Contractor from furnishing and installing such parts.

## **PART 2 PRODUCTS**

### **2.01 PRODUCTS AND MATERIALS**

- A. Products or materials containing iron or steel shall originate in the USA in accordance with Section 1605 of the American Recovery and Reinvestment Act of 2009.



## **2.02 HEAT TRACE TAPE**

- A. Cable shall be 120-volt, single phase, braided and jacketed, self-regulating cable for low temperature applications. Manufacturer shall provide system design and installation drawings for the heat trace system.
- B. Cable construction shall be as follows:
  - 1. Buss Wires: Twin #16 AWG copper.
  - 2. Matrix: Semi-conductive polymer core whose electrical resistance varies with temperature.
  - 3. Jacket: Flame retardant insulation of thermoplastic.
  - 4. Braid: Tinned copper.
  - 5. Capacity: Calculated based on service pipe type and insulation thickness. Submit calculation for approval.

## **2.03 APPROVED MANUFACTURERS**

- A. Chromalox: Model SRL.
- B. Engineer Approved.

## **PART 3 EXECUTION**

- 3.01** Install heat trace cable in strict accordance with the manufacturer's instructions.
- 3.02** Coordinate electrical power and disconnect requirements with Division 26.
- 3.03** Provide power connection kits, end seals, tees, ambient sensing thermostats and all required accessories for a complete installation.

**END OF SECTION**

**SECTION 23 0501  
MECHANICAL DEMOLITION**

**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 0 Specification sections, apply to work specified in this section.

**1.02 DESCRIPTION OF WORK**

- A. The extent of general demolition work is shown on drawings. Coordinate the required mechanical and plumbing work with the general demolition.
- B. Demolition includes removal of systems and removal and disposal of demolished materials, as shown on drawings and herein specified.
- C. The Owner shall have the option of retaining any items removed. The Contractor shall deliver these items to the Owner's designated storage area. Any items not retained by the Owner shall be disposed of off-site by the Contractor.

**1.03 JOB CONDITIONS**

- A. Condition of Structures: The Owner assumes no responsibility for actual condition of structures to be demolished.
  - 1. Conditions of the structure existing at time of inspection for bidding purposes will be maintained by Owner in so far as practicable. However, variations within structure may occur by Owner's removal and salvage operations prior to start of demolition work. The drawings are schematic and provided as an aid in bidding. The contractor shall visit the site and determine the actual conditions prior to bidding.
- B. Partial Removal: Items of salvable value to Contractor may be removed from structure as work progresses. Salvaged items must be transported from site as they are removed.
  - 1. Storage or sale of removed items on site will not be permitted.
- C. Traffic: Conduct demolition operations and removal of debris to ensure minimum interference with roads, streets, walks, occupied areas, and other adjacent occupied or used facilities.
- D. Protections: Ensure safe passage of persons around or through area of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities, and persons.
  - 1. Install temporary mechanical services, plumbing, temperature control, etc., as required by the Owner or authorities having jurisdiction.
- E. Damages: Promptly repair damages caused to adjacent facilities by demolition operations at no cost to Owner.
- F. Utility Services: Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations. Allow no interruption in service unless coordinated with Owner at least 24 hours in advance.
  - 1. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary

- services during interruptions to existing utilities, as acceptable to governing authorities.
- 2. Contractor will disconnect and seal utilities serving each structure to be demolished, or interior area to be demolished, prior to start of demolition work.
- G. If Contractor is required to disconnect utility services or other services to an occupied area, the Contractor shall provide temporary or alternative service to that area, as required by Owner.

## **PART 2 PRODUCTS**

(Not applicable)

## **PART 3 EXECUTION**

### **3.01 DEMOLITION**

- A. Remove all equipment, piping, etc., as indicated on the drawings.
- B. All items shown to remain active shall be furnished with necessary devices or accessories.

### **3.02 DISPOSAL OF DEMOLISHED MATERIALS**

- A. General: Remove from site debris, rubbish, and other materials resulting from demolition operations. Pay all fees related to removal and dumping.
  - 1. Burning of removed materials from demolished structures will not be permitted on site.
- B. Removal:
  - 1. Transport materials removed from demolished structures and dispose of off site.

**END OF SECTION**

**SECTION 23 0513**  
**COMMON ELECTRICAL REQUIREMENTS FOR HVAC EQUIPMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. This section specifies the basic requirements for electrical components which are an integral part of packaged HVAC equipment. These components include, but are not limited to factory installed motors furnished as an integral part of plumbing equipment.
- B. This section specifies the basic requirements for electrical components required to be furnished under Division 23, which are to be turned over to and installed by Division 26. These components include but are not limited to motors.
- C. Specific electrical requirements (i.e., horsepower and electrical characteristics) for plumbing equipment are scheduled on the drawings.

**1.02 RELATED SECTIONS**

- A. Section 23 2113 – Hydronic Piping.
- B. Section 23 2123 – Hydronic Pumps.
- C. Section 23 3423 – HVAC Power Ventilators.
- D. Section 23 3813 – Kitchen Ventilation System.
- E. Section 23 6116 – Centrifugal Chillers.
- F. Section 23 3616 – Air Terminal Units – Variable Volume.

**1.03 REFERENCES**

- A. NEMA Standards MG-1: Motors and Generators.
- B. NEMA Standard ICS 2: Industrial Control Devices, Controllers and Assemblies.
- C. NEMA Standard 250: Enclosures for Electrical Equipment.
- D. NEMA Standard KS 1: Enclosed Switches.
- E. Comply with National Electrical Code (NFPA 70).
- F. Compliance and Labeling: Provide motors and starters which have been listed and labeled by a nationally recognized testing facility engaged in and equipped to test electrical equipment and materials.

**1.04 SUBMITTALS**

- A. No separate submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification sections.

## 1.05 QUALITY ASSURANCE

- A. Electrical components and materials shall be UL labeled.

## PART 2 PRODUCTS

### 2.01 MOTORS

- A. The following are basic requirements for simple or common motors, for special motors, more detailed and specific requirements are specified in the individual equipment specifications.
1. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
  2. Motor sizes shall be large enough so that driven load will not requirement the motor to operate in the service factor range.
  3. 2-speed motors shall be 2 separate windings on polyphase motors.
  4. Temperature Rating: Rated for 40 deg. environment, with maximum 50 deg. C temperature rise for continuous duty at full load (Class A Insulation).
  5. Starting capability: Frequency of starts as indicated by automatic control system, and not less than 5 evenly timed spaced starts per hour for manually controlled motors.
  6. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.
- B. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.
1. Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit specific application.
  2. Bearings:
    - a. Ball or roller bearings with inner and outer shaft seals;
    - b. Regreasable, except permanently sealed where motor is normally inaccessible for regular maintenance.
    - c. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.
    - d. For fractional horsepower, light duty motors, sleeve type bearings are permitted.
  3. Enclosure Type:
    - a. Open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation;
    - b. Guarded drip-proof motors where exposed to contact by employees or building occupants;
    - c. Weather protected Type I for outdoor use, Type II where not housed;
  4. Overload Protection: Built-in thermal overload protection and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.
  5. Noise Rating: "Quiet" rating on motors located in occupied spaces of building.
  6. Efficiency: Provide "Energy Efficient" motors with a minimum efficiency as scheduled in accordance with IEEE Standard 112, test method B. If efficiency not specified, motors shall have a minimum efficiency as listed below.

1HP	80% Eff'y	10HP	87%
1-1/2 to 2HP	82%	15HP	89%
3HP	83%	20HP	90%
5HP	84%	25HP and up	91%
7-1/2 HP	85%		

- C. Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following:  
Baldor Electric Co.  
Century Electric, Inc.  
General Electric Co.  
Marathon Electric Mfg. Co.  
Reliance Electric Co.  
Westinghouse Electric Corp.
- D. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

### **PART 3 EXECUTION**

**Not Applicable.**

**END OF SECTION**

**SECTION 23 0515**  
**VARIABLE FREQUENCY MOTOR CONTROLS – BUILDINGS AND HVAC**

**PART 1 GENERAL**

**1.01 DESCRIPTION**

- A. This specification is to cover a complete Variable Frequency Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use with both asynchronous and permanent magnet motors.
- B. The drive manufacturer shall supply the drive and all necessary options as specified. All drives installed on this project shall be from the same manufacturer and have a common user interface (control panel). The manufacturer shall have been engaged in the production of this type of equipment for a minimum of 5 years. Drives that are manufactured by a third party and “brand labeled” shall not be acceptable. Drive manufacturers who do not build their own power boards and assemblies, or do not have full control of the power board manufacturing and quality control, shall be considered as a “brand labeled” drive.
- C. This specification is intended to supplement a drive schedule. The drive schedule identifies the optimized BOM for the project and includes quantity, size, voltage, enclosure rating, options, and harmonic mitigation requirements of the drives. IEEE 519-2014 is an electrical system standard for harmonic mitigation and not intended to be applied to an individual piece of equipment. Drives are only one of many sources of harmonics, thus verification of system IEEE 519-2014 compliance is beyond the VFD manufacturer’s scope.

**1.02 QUALITY ASSURANCE**

- A. Referenced Standards and Guidelines:
  - 1. Institute of Electrical and Electronic Engineers (IEEE)
    - a. IEEE 519-2014, IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems
  - 2. Underwriters Laboratories (as appropriate)
    - a. UL 508, 508A, 508C
    - b. UL 61800, 61800-5-1, 61800-5-2
    - c. UL 1995
  - 3. The Association of Electrical Equipment and Medical Imaging Manufacturers (NEMA)
    - a. NEMA ICS 7-2014, Adjustable Speed Drives
  - 4. International Electrotechnical Commission (IEC)
    - a. EN/IEC 61800
  - 5. National Electric Code (NEC)
    - a. NEC 430.120, Adjustable-Speed Drive Systems
  - 6. CSA Group
    - a. CSA C22.2 No. 274
  - 7. International Building Code (IBC)
    - a. IBC 2018 Seismic – referencing ASCE 7-16 and ICC AC-156
- B. Qualifications:

1. Drives shall be UL labeled as a complete assembly. The base VFD shall be UL listed for 100 kA SCCR when installed in accordance with the manufacturer's guidelines.
2. CE Mark – The base drive shall conform to the European Union Electromagnetic Compatibility directive, a requirement for CE marking. The base drive shall meet product standard EN 61800-3 for the First Environment restricted distribution (Category C2).
3. The base drive shall be seismically certified and labeled as such in accordance with the 2018 International Building Code (IBC):
  - a. Seismic importance factor of 1.5, and minimum 2.5 SDS rating is required.
  - b. Ratings shall be based upon actual shake test data as defined by ICC AC-156, via all three axis of motion.
  - c. Seismic certification of equipment and components shall be provided by OSHPD preapproval.
4. The base drive shall be SEMI-F47 certified. The drive must tolerate voltage sags to 50% for up to 0.2 seconds, sags to 70% for up to 0.5 seconds, and sags to 80% for up to one second.

### **1.03 SUBMITTALS**

- A. Submittals shall include the following information:
  1. Outline dimensions, conduit entry locations and weights.
  2. Customer connection and power wiring diagrams.
  3. OSHPD preapproval, seismic certification and installation requirements where applicable.
  4. Complete technical product description with complete list of options provided. Any portions of this specification not met must be clearly indicated or the supplier and contractor shall be liable to provide all additional components required to meet this specification.
  5. Building Information Modeling (BIM) objects shall be available online.

## **PART 2 PRODUCTS**

### **2.01 ACCEPTABLE MANUFACTURERS**

- A. ABB (ACH 580 Series).
- B. Danfoss.
- C. Yaskawa.

Note: No other alternate manufacturers will be accepted.

### **2.01 VARIABLE FREQUENCY DRIVES**

- A. The drive package as specified herein and defined on the drive schedule shall be enclosed in a UL Type enclosure (enclosures with only NEMA ratings are not acceptable), completely assembled and tested by the manufacturer to ISO9001 standards.
- B. The drive shall provide full rated output from a line of +10% to -15% of nominal voltage. The drive shall continue to operate without faulting from a line of +25% to -35% of nominal voltage.



1. Drives shall be capable of continuous full load operation under the following environmental operating conditions:
    - a. Ambient temperature -15 to 40° C (5 to 104° F).
    - b. Altitude 0 to 1000 m (0 to 3,300 ft) above sea level.
    - c. Humidity 5 to 95%, non-condensing.
- C. All drives shall utilize the same Advanced Control Panel (keypad) user interface.
1. Plain English text
    - a. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable).
    - b. Safety interlock and run permissive status shall be displayed using predetermined application specific nomenclature, such as: Damper end switch, smoke alarm, vibration trip, and overpressure.
    - c. Safety interlock, run permissive, and external fault status shall have the option of additional customized project specific terms, such as: AHU-1 End Switch, Office Smoke Alarm, CT-2 Vibration.
  2. The control panel shall include at minimum the followings controls:
    - a. Four navigation keys (Up, Down, Left, Right) and two soft keys to simplify operation and programming.
    - b. Hand-Off-Auto selections and manual speed control without having to navigate to a parameter.
    - c. Fault Reset and Help keys. The Help key shall include assistance for programming and troubleshooting.
  3. Multiple Home View screens shall be capable of displaying up to 21 points of information. Customizable modules shall include bar charts, graphs, meters, and data lists. Displays shall provide real time graphical trending of output power, frequency, and current within selectable intervals of 15/30/60 minutes and 24 hours.
  4. The control panel shall display the following items on a single screen; output frequency, output current, reference signal, drive name, time, and operating mode (Hand vs Auto, Run vs Stop). Bi-color (red/green) status LED shall be included. Drive (equipment) name shall be customizable.
  5. There shall be a built-in time clock in the control panel. The clock shall have a battery backup with 10 years minimum life span. Daylight savings time shall be selectable.
  6. I/O Summary display with a single screen shall indicate and provide:
    - a. The status/values of all analog inputs, analog outputs, digital inputs, and relay outputs. Drives that require access to internal or live components to measure these values, are not acceptable.
    - b. The programmed function of all analog inputs, analog outputs, digital inputs, and relay outputs.
    - c. The ability to force individual digital I/O high or low and individual analog I/O to desired value, for increased personal protection during drive commissioning and troubleshooting. Drives that require access to internal or live components to perform these functions, are not acceptable.
  7. The drive shall automatically backup parameters to the control panel. In addition to the automatic backup, the drive shall allow two additional unique backup parameter sets to be stored. Backup files shall include a time and date stamp. In the event of a drive failure, the control panel of the original drive can be installed on the replacement drive, and parameters from that control panel can be downloaded into the replacement drive.

8. The control panel shall display local technical support contact information as part of drive fault status.
  9. The control panel shall be removable, capable of remote mounting.
  10. The control panel shall have the ability to store screen shots, which are downloadable via USB.
  11. The control panel shall have the ability to display a QR code for quick access to drive information.
  12. The LCD screen shall be backlit with the ability to adjust the screen brightness and contrast, with inverted contrast mode. A user-selectable timer shall dim the display and save power when not in use.
  13. The control panel shall include assistants specifically designed to facilitate start-up. Assistants shall include: First Start Assistant, Basic Operation, Basic Control, and PID Assistant.
  14. Primary settings for HVAC shall provide quick set-up of all parameters and customer interfaces to reduce programming time.
  15. The drive shall be able to operate with the control panel removed.
- D. All drives shall have the following hardware features/characteristics as standard:
- Two (2) programmable analog inputs shall accept current or voltage signals. Current or
1. Voltage selection configured via control panel. Drives that require access to internal components to perform these functions, are not acceptable.
  2. Two (2) programmable analog outputs. At least one of the analog outputs shall be adjustable for current or voltage signal, configured via control panel. Drives that require access to internal components to perform these functions, are not acceptable.
  3. Six (6) programmable digital inputs. All digital inputs shall be programmable to support both active high and active low logic, and shall include adjustable on/off time delays. The digital input shall be capable of accepting both 24 VDC and 24 VAC.
  4. Three (3) programmable Form-C relay outputs. The relay outputs shall include programmable on/off time delays. The relays shall be rated for a continuous current rating of 2 Amps. Maximum switching voltage of 250 VAC / 30 VDC. Open collector and Form-A relays are not acceptable. Drives that have less than (3) Form-C relay outputs shall provide an option card to provide additional relay outputs.
  5. Drive terminal blocks shall be color coded for easy identification of function.
  6. The drive shall include an isolated USB port for interface between the drive and a laptop. A non-isolated USB port is not acceptable.
  7. An auxiliary power supply rated at 24 VDC, 250 mA shall be included.
  8. At a minimum, the drives shall have internal impedance equivalent to 5% to reduce the harmonics to the power line. 5% impedance may be from dual (positive and negative DC link) chokes, or AC line reactor. Drives with only one DC link choke shall add an AC line choke integral to the drive enclosure. Reference the drive schedule to determine if additional harmonic mitigation is required for the system to comply with IEEE 519-2014.
  9. The drive shall have cooling fans that are designed for field replacement. The primary cooling fan shall operate only when required and be variable speed for increased longevity and lower noise levels. Drives whose primary cooling fans are not variable speed, shall include a spare cooling fan.
  10. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds every minute. The

minimum current rating shall meet or exceed the values in the NEC/UL table 430.250 for 4-pole motors.

11. The input current rating of the drive shall not be greater than the output current rating. Per NFPA 70 430.122, drives with higher input current ratings may require the upstream wiring, protection devices, and source transformers to be upsized.
12. Circuit boards shall be coated per IEC 60721-3-3; Chemical gasses Class 3C2 and Solid particles Class 3S2.
13. Earth (ground) fault detection shall function in both modulating (running) and non-modulating modes.
14. Coordinated AC transient surge protection system consisting of 4 MOVs (phase-to-phase and phase-to-ground), a capacitor clamp, and internal chokes. The MOVs shall comply with UL 1449 4th Edition. Drives that do not include coordinated AC transient surge protection shall include an external TVSS/SPD (Transient Voltage Surge Suppressor/Surge Protection Device).
15. The drive shall include a robust DC bus to provide short term power-loss ride through. The DC bus Joule to drive kVA ratio shall be 4.5 J/kVA or higher. An inertia-based ride through function should help maintain the DC bus voltage during power loss events. Drives with control power ride through only, are not acceptable.

E. All drives shall have the following software features as standard:

1. A Fault Logger that stores the last 16 faults in non-volatile memory.
  - a. The most recent 5 faults save at least 9 data points, including but not limited to: Time/date, frequency, DC bus voltage, motor current, DI status, temperature, and status words.
  - b. The date and time of each fault and fault reset attempt shall be stored in the Fault Logger.
2. An Event Logger that stores the last 16 warnings or events that occurred, in non-volatile memory.
  - a. Events shall include, but not limited to: Warning messages, checksum mismatch, run permissive open, start interlock open, and automatic reset of a fault.
  - b. The date and time of each event's start and completion points shall be stored in the Event Logger.
3. Programmable start method. Start method shall be selectable based on the application: Flying-start, Normal-start, and Brake-on-start.
4. Programmable loss-of-load (broken belt / coupling) indication. Indication shall be selectable as a control panel warning, relay output, or over network communications. This function to include a programmable time delay to eliminate false loss-of-load indications.
5. Motor heating function to prevent condensation build up in the motor. Motor heating adjustment, via parameter, shall be in "Watts." Heating functions based only on "percent current" are not acceptable.
6. Advanced power metering abilities shall be included in the drive. Drives without these data points, must include a separate power meter with each drive.
  - a. Instantaneous output power (kW)
  - b. Total power, broken down by kWh, MWh, and GWh units of measurement. Power meters that only display kWh and roll over or "max out" once the maximum kWh value is reached, are not acceptable. There shall be resettable and non-resettable total power meters within the drive.

- c. Time based kWh metering for: current hour, previous hour, current day, and previous day.
  - d. Energy saving calculation shall be included that shows the energy and dollars saved by the drive.
- 7. The drive shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise.
- 8. Run permissive circuit - There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command, the Drives shall provide a dry contact closure that will signal the damper to open. When the damper is fully open, an end-switch shall close, allowing the drive to run the motor.
  - a. The drive shall also include a programmable start delay, for when an end-switch is not provided.
- 9. Start interlock circuit - Four separate start interlock (safety) inputs shall be provided. When any safety is opened, the motor shall be commanded to stop. The control panel will display the specific safety(s) that are open. The status of each safety shall be transmitted over the network communications. Wiring multiple safeties in series is not acceptable.
- 10. External fault circuit – Three separate external fault inputs shall be provided. This circuit shall have the same features and functionality as the start interlock circuit, except it shall require a manual reset before the drive is allowed to operate the motor.
- 11. The drive shall include a switching frequency control circuit that reduces the switching frequency based on actual drive temperature, and allows higher switching frequency settings without derating the drive. It shall be possible to set a minimum and a target switching frequency.
- 12. Visual function block adaptive programming allowing custom control schemes, minimizing the need for external controllers. i.e., cooling tower staging logic. A free software tool shall be used to configure adaptive programming.
- 13. The ability to automatically restart after an over-current, over-voltage, under-voltage, external fault, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable. Each of these faults may have automatic restart individually disabled via a parameter selection.
- 14. Three (3) programmable critical frequency lockout ranges to prevent the drive from operating the load continuously at an unstable speed/load.
- 15. Seven (7) programmable preset frequencies/speeds.
- 16. Two independently adjustable accel and decel ramps with 1 – 1800 seconds adjustable time ramps.
- 17. PID functionality shall be included in the drive.
  - a. Programmable “Sleep” and “Wake up” functions to allow the drive to be started and stopped based on the level of a process feedback signal.
  - b. The drive shall include an independent PID loop for customer use, assigned to an Analog Output. This PID loop may be used for cooling tower bypass valve control, chilled water valve, etc.
- 18. At least 4 parameter user sets that can be saved to the permanent memory and recalled using a digital input, timed function, or supervision function.
- 19. Drive shall be compatible with an accessory that allows the control board to be powered from an external 24 VDC/VAC source, allowing the drive control to remain powered by a UPS during an extended power outage.

20. A computer-based software tool shall be available to allow a laptop to program the drive. The drive shall be able to support programming without the need for line voltage. All necessary power shall be sourced via the laptop USB port.
21. The drive shall include a fireman's override mode. Upon receipt of a contact closure from the Fire Alarm Life Safety system, the drive shall operate in a dedicated Override mode distinct and separate from the drive's Normal operation mode. The following features will be available in the drive override function:
  - a. The Override mode shall be secured by password to prevent changes once programmed.
  - b. The drive shall ignore external inputs and commands not defined as part of the override function.
  - c. Override operation mode shall be selectable between: single frequency, multiple fixed frequencies, follow an analog input signal, PID control, or come to a forced stop.
  - d. High priority safeties shall stop the drive and lower priority safeties shall be ignored in Override mode.
  - e. Drive faults shall be defined in Critical and Low priority groups. Critical faults shall stop the drive. Low priority faults shall be reset. Reset trials and timing shall be programmable.
  - f. The drive shall be configurable to receive from 1 to 3 discrete digital input signals and operate at up to three discrete speeds.
22. The drive shall have multi-pump functionality and an intelligent master/follower configuration for controlling up to 8 parallel pumps equipped with drives. The drive shall have a parameter synchronization feature to program the PID, multi-pump, and AI parameters in all parallel drives. The functionality to start and stop the pumps based on capacity, operating time or efficiency of the pump to ensure each pump is operated regularly.
  - a. The multi-pump functionality shall control:
    - 1) Flow Control
    - 2) Pressure Control
    - 3) Pump Alternation

F. Security Features

1. The drive manufacture shall clearly define cybersecurity capabilities for their products.
2. The drive shall include password protection against parameter changes.
  - a. There shall be multiple levels of password protection including: End User, Service, Advanced, and Override.
  - b. The drive shall support a customer generated unique password between 0 and 99,999,999.
  - c. The drive shall log an event whenever the drive password has been entered.
  - d. The drive shall provide a security selection that prevents any "back door" entry. This selection even prevents the drive manufacturer from being able to bypass the security of that drive.
  - e. A security level shall be available that prevents the drive from being flashed with new firmware.
3. A checksum feature shall be used to notify the owner of unauthorized parameter changes made to the drive. The checksum feature includes two unique values assigned to a specific programming configuration.
  - a. One checksum value shall represent all user editable parameters in the drive except communication setup parameters. A second checksum

- value shall represent all user editable parameters except communication setup, energy, and motor data parameters.
    - b. Once the drive has been commissioned the two values can be independently saved in the drive.
    - c. The drive shall be configurable to either: Log an Event, provide a Warning, or Fault upon a parameter change when the current checksum value does not equal the saved checksum value.
  - 4. The “Hand” and “Off” control panel buttons shall have the option to be individually disabled (via parameter) for drives mounted in public areas.
  - 5. The capability to disable Bluetooth on control panels that include Bluetooth functionality shall be provided.
- G. Network Communications
  - 1. The drive shall have an EIA-485 port with removable terminal blocks. The onboard protocols shall be BACnet MS/TP, Modbus, and Johnson Controls N2. Optional communication cards for BACnet/IP, LonWorks, Profibus, Profinet, EtherNet/IP, Modbus TCP, and DeviceNet shall be available. The use of third party gateways are not acceptable.
  - 2. The drive shall have the ability to communicate via two protocols at the same time, one onboard protocol and one option card based protocol. Once installed, the drive shall automatically recognize any optional communication cards without the need for additional programming.
  - 3. The drive shall not require a power cycle after communication parameters have been updated.
  - 4. The embedded BACnet connection shall be a MS/TP interface. The drive shall be BTL Listed to Revision 14 or later. Use of non-BTL Listed drives are not acceptable.
  - 5. The drive shall be classified as an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:
    - a. Data Sharing: Read Property Multiple-B, Write Property Multiple-B, COV-B
    - b. Device Management: Time Synchronization-B
    - c. Object Type Support: MSV, Loop
  - 6. The drive's relay output status, digital input status, analog input/output values, Hand-Auto status, warning and fault information shall be capable of being monitored over the network. The drive's start/stop command, speed reference command, relay outputs and analog outputs shall be capable of being controlled over the network. Remote drive fault reset shall be possible.
- H. Disconnect – A circuit breaker or disconnect switch shall be provided when indicated on the drive schedule. The disconnect shall be door interlocked and padlockable. Drive input fusing shall be included on all packaged units that include a disconnecting means. All disconnect configurations shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label. Disconnect packages manufactured by anyone other than the drive manufacturer, are not acceptable.
- I. Bypass – Bypass drive packages shall be provided when indicated on the drive schedule. All drive/bypass configurations shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label. Bypasses manufactured by anyone other than the drive manufacturer, are not acceptable.

1. The drive and bypass package shall be a complete factory wired and tested bypass system consisting of a padlockable disconnect device, drive output contactor, bypass contactor, and drive input fuses.
2. The drive and bypass package shall have a UL listed short circuit current rating of 100 kA, for 240 VAC and 480 VAC systems, and this rating shall be indicated on the rating label.
3. The bypass control shall be powered by a three-phase switch mode power supply with a voltage tolerance of +30%, -35%. Single-phase power supplies and control power transformers (CPT) are not acceptable.
4. The drive and bypass package shall be seismic certified and labeled to the IBC. Seismic importance factor of 1.5 rating is required, and shall be based upon actual shake table test data as defined by ICC AC-156. Seismic certification of equipment and components shall be provided by OSHPD preapproval.
5. All bypass packages shall utilize a dedicated LCD bypass control panel (keypad) user interface. The bypass control panel must be a separate display from the drive control panel. Bypass packages that use a single shared drive/bypass control panel are not acceptable, due to that control panel acting as a single point of failure.
  - a. The bypass shall include a two-line, 20-character LCD display. The display shall allow the user to access parameters and view:
    - 1) Bypass input voltage, current (Amps) and power (kW)
    - 2) Bypass faults, warnings, and fault logs
    - 3) Bypass operating time and energy consumption (resettable)
  - b. The bypass control panel shall include the following controls:
    - 1) Four navigation keys (Up, Down, Enter, Escape)
    - 2) Bypass Hand-Off-Auto, Drive mode / Bypass mode selectors, Bypass fault reset
  - c. The following indicating lights (LED PTT type) or control panel display indications shall be provided.
    - 1) Drive mode selected, Bypass mode selected
    - 2) Drive running, Bypass running
    - 3) Drive fault, Bypass fault
  - d. Safety interlock and run permissive status shall be displayed using predetermined application specific nomenclature, such as: Damper end switch, smoke alarm, vibration trip, and overpressure.
6. All bypasses shall have the following hardware features/characteristics as standard:
  - a. Six (6) digital inputs and five (5) Form-C relay outputs. The digital inputs shall be capable of accepting both 24 VDC and 24 VAC. The bypass control board shall include an auxiliary power supply rated 24 VDC, 250 mA.
  - b. Drive isolation fuses shall be provided. Bypass designs which have no such fuses, or that only incorporate fuses common to both the drive and the bypass are not acceptable. Third contactor "isolation contactors" and service switches are not an acceptable alternative to drive isolation fuses.
  - c. The bypass shall be able to detect a single-phase input power condition while running in bypass, disengage the motor, and provide a single-phase input power indication.
  - d. The bypass shall be designed for stand-alone operation and be completely functional in both Hand and Automatic modes, even if the drive and/or drive's control board has failed. Network communications

- shall remain functional. Bypass systems that do not maintain full functionality in the event of a drive failure, are not acceptable.
7. All bypasses shall have the following software features as standard:
- a. Programmable loss-of-load (broken belt / coupling) indication shall be functional in drive and bypass mode.
  - b. The bypass shall also support run permissive and start interlock control functionality, including start delay, as previously specified in the drive section.
  - c. The bypass control shall monitor the status of the drive and bypass contactors and indicate when there is a welded contactor contact or open contactor coil.
  - d. The bypass shall include a selection for either manual or automatic transfer to bypass. The automatic transfer mode shall allow the user to select the specific drive fault types that result in an automatic transfer to bypass. The automatic transfer mode shall not allow a transfer to bypass on motor related faults. Automatic transfer schemes that do not differentiate between fault types, are not acceptable.
  - e. The bypass shall include the ability to select the operating mode of the system (Drive/Bypass) from either the bypass control panel or digital input.
  - f. The bypass shall include a supervisory control mode that monitors the value of the drive's analog input (feedback). This feedback value is used to control the bypass contactor on/off state. The supervisory mode shall allow the user to maintain hysteresis control over applications such as cooling towers and booster pumps.
  - g. Selectable Class 10, 20, or 30 electronic motor overload protection shall be included in both drive and bypass mode.
  - h. The drive and bypass shall be designed to operate as an integrated system when in Override mode. Whether operating in drive or bypass mode, the low priority safeties will be ignored, and high priority safeties will be followed. External start/stop commands will be ignored. There shall be four selectable Override modes:
    - 1) Bypass only, with two smoke control modes:
      - a) Fixed pre-configuration of digital inputs
      - b) Configurable high/low priority safeties and faults, to allow configuration to meet needs of local Authority Having Jurisdiction.
    - 2) Drive only
    - 3) Drive then transfer to bypass, in the event of a drive fault
    - 4) Force to Stop
8. Network communications – the bypass shall include BACnet MS/TP, Modbus, and Johnson Controls N2 as standard. The bypass BACnet implementation shall be BTL Listed to Revision 14 or later. Optional communication cards for BACnet/IP, LonWorks, Profibus, Profinet, Ethernet/IP, Modbus TCP, and DeviceNet shall be available.
- a. The bypass relay output status, digital input status, warning and fault information can be monitored over the network. Status information shall be monitored, including; operating mode (drive vs bypass), current drawn in bypass mode, broken belt, and phase-to-phase voltage. The bypass start/stop command, force to bypass command, and relay outputs shall be capable of being controlled over the network.



## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. The responsible party shall install the drive in accordance with the recommendations of the drive manufacturer as outlined in the drive installation manual.
- B. Power wiring shall be completed by the responsible party. All wiring shall be installed in accordance with the recommendations of the drive manufacturer as outlined in the installation manual.
- C. Installation shall be in accordance with national, state and local building and electrical codes as may be in force in the installation area.

### **3.02 START-UP**

- A. Start-up shall be provided for each drive by an authorized local service provider.

### **3.03 PRODUCT SUPPORT**

- A. Factory trained application engineering and service personnel that are thoroughly familiar with the drive products offered shall be locally available at both the specifying and installation locations. A toll free 24/365 technical support line connected to factory support personnel located in the US and Canada shall be available.
- B. Training shall include installation, programming and operation of the drive, bypass and network communications. Owner training shall be provided locally upon request.

### **3.04 WARRANTY**

- A. The drive Product Warranty shall be 60 months from the date of shipment from the factory. The warranty shall include: Parts, on-site labor, and travel time and travel costs, or replacement of the complete drive as determined by the drive manufacturer's technical support. Provide factory authorized start-up service, and provide start-up report to A/E for review and approval.

**END OF SECTION**

**SECTION 23 0516**  
**EXPANSION COMPENSATION IN HEATING, VENTILATING**  
**AND AIR CONDITIONING SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Basic Requirements for expansion compensation in the Heating, Ventilating, and Air Conditioning System.

**1.02 RELATED SECTIONS**

- A. Section 23 0548 – Vibration and Seismic controls for HVAC Piping and Equipment.
- B. Section 23 0923 – DDC System for HVAC.
- C. Section 23 2113 - Hydronic Piping.
- D. Section 23 3100 – HVAC Ducts and Casings.
- E. Division 23 – All Sections.

**1.03 QUALITY ASSURANCE**

- A. Manufacturers: Firms regularly engaged in manufacture of expansion compensation products of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Comply with standards of the Expansion Joint Manufacturer's Association (EJMA).

**1.04 SUBMITTALS**

- A. Product Data: Submit catalog cuts, specifications, installation instructions, and dimensioned drawings for each type of expansion compensation product. Submit schedule showing Manufacturer's figure number, size, location, and features for each required expansion compensation product.
- B. Shop Drawings: Submit shop drawings for fabricated expansion loops indicating location, dimensions, pipe sizes, location and method of attachment of anchors.
- C. Maintenance Data: Submit maintenance data and spare parts lists for each type of expansion compensation product. Include this data in Maintenance Manual.

**PART 2 PRODUCTS**

**2.01 PIPE ALIGNMENT GUIDES**

- A. General: Provide pipe alignment guides on both sides of expansion joints, and elsewhere as indicated. Construct with 4 finger spider traveling inside a guiding sleeve, with provision for anchoring to building substrate.
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers

offering pipe alignment guides which may be incorporated in the work include, but are not limited to, the following:  
Keflex, Inc.  
Metraflex (The) Co.

### **PART 3 EXECUTION**

#### **3.01 EXPANSION LOOPS**

- A. General: Fabricate expansion loops as indicated, in locations indicated, and elsewhere as determined by Installer for adequate expansion of installed piping system. Subject loop to cold spring which will absorb 50% of total expansion between hot and cold conditions. Provide pipe anchors and pipe alignment guides as indicated, and elsewhere as determined by Installer to properly anchor piping in relationship to expansion loops.

**END OF SECTION**

**SECTION 23 0519  
METERS AND GAUGES FOR HVAC**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Extent of meters and gauges required by this section is indicated on drawings and/or specified in other Division-23 sections.
- B. Types of meters and gauges specified in this section include the following:
  - 1. Temperature Gauges and Fittings:
    - Glass Thermometers.
    - Dial Type Insertion Thermometers.
    - Thermometer Wells.
    - Temperature Gauge Connector Plugs.
  - 2. Pressure Gauges and Fittings:
    - Pressure Gauges.
    - Pressure Gauge Cocks.
    - Pressure Gauge Connector Plugs.
  - 3. Flow Meters:
    - Hot/Chilled Water.
- C. Meters and gauges furnished as part of factory-fabricated equipment, are specified as part of the equipment assembly in other Division-23 sections.

**1.02 RELATED SECTIONS**

- A. Section 23 2113 – Hydronic Piping.
- B. Section 23 3100 – HVAC Ducts and Casings.

**1.03 QUALITY ASSURANCE**

- A. Manufacturers: Firms regularly engaged in manufacture of meters, gauges, and fittings, or types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.
- B. UL Compliance: Comply with applicable UL standards pertaining to meters and gauges.
- C. ANSI and ISA Compliances: Comply with applicable portions of ANSI and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gauges.

**1.04 SUBMITTALS**

- A. Product Data: Submit catalog cuts, specifications, installation instructions, and dimensioned drawings for each type of meter, gauge and fitting. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit meter, gauge and fitting schedule shown manufacturer's figure number, scale range, location, and accessories for each meter, gauge and fitting.
- B. Maintenance Data: Submit maintenance data and spare parts lists for each type of meter and gauge. Include this data in maintenance manual.

## PART 2 PRODUCTS

### 2.01 TEMPERATURE GAGES

#### A. Glass Thermometers:

1. General: Provide glass thermometers of materials, capacities and ranges indicated, designed and constructed for use in service indicated.
2. Case: Die cast aluminum, finished in baked epoxy enamel, clear acrylic plastic front, spring secure, 9 inches long.
3. Adjustable Joint: Die cast aluminum, finished to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
4. Tube and Capillary: Mercury filled, magnifying lens, 1 percent scale range accuracy, shock mounted.
5. Scale: Satin faced, non-reflective aluminum permanently etched markings.
6. Stem: Copper-plated steel, or brass, for separable socket, length to suit installation.
7. Range: Conform to the following:
  - a. Hot Water: 30 degrees - 240 degrees F with 2-degree F scale divisions (0 degrees - 160 degrees Celsius) with 1-degree Celsius scale divisions.
  - b. Chilled Water: 30 degrees - 180 degrees F with 2 degrees F scale divisions (0 degrees-100 degrees Celsius) with 1-degree Celsius scale divisions.
8. Available Manufacturers: Subject to compliance with requirements, manufacturers offering glass thermometers which may be incorporated in the work include, but are not limited to, the following:  
Marshalltown Instruments, an Eltra Co.  
Terice (H.O.) Co.  
Weiss (Albert A) & Son, Inc.

#### B. Dial Type Insertion Thermometers:

1. General: Provide dial type insertion thermometers of materials, capacities and ranges indicated, designed and constructed for use in service indicated.
2. Type: Bi-metal, stainless steel case and stem, 1 inch diameter dial, dust and leak proof, 1/8-inch diameter stem with nominal length of 5 inches.
3. Accuracy: 0.5 percent of dial range.
4. Range: Conform to the following:
  - a. Hot Water: 0 degrees - 220 degrees F (-10 degrees - 110 degrees C).
5. Available Manufacturers: Subject to compliance with requirements, manufacturers offering direct mount dial type insertion thermometers which may be incorporated in the work include, but are not limited to, the following:  
Marsh Instrument Co, Unit of General Signal.  
Taylor Instrument Process Control Div. of Sybron Corp.  
Terice (H.O.) Co.  
Weiss (Albert A.) & Son, Inc.

#### C. Thermometer Separable Wells:

1. General: Provide thermometer wells constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 2-inch extension for insulated piping.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering thermometer wells which may be incorporated in the work

include, but are not limited to the following:  
Marsh Instrument Co., Unit of General Signal.  
Trerice (H.O.) Co.  
Weiss (Albert A.) & Sons, Inc.

- D. Temperature Gage Connector Plugs:
1. General: Provide temperature gage connector plugs pressure rated for 500 psi and 200 degrees F. Construct of brass and finish in nickel-plate, equip with 1/2-inch NPT fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8-inch O.D. probe assembly from dial type insertion thermometer. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness for insulated piping.
  2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering temperature gage connector plugs which may be incorporated in the work include, but are not limited to, the following:  
Peterson Engineering Co.

## **2.02 PRESSURE GAGES AND FITTINGS**

- A. Pressure Gages:
1. General: Provide pressure gages of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.
  2. Type: General use, 1 percent accuracy, ANSI B40.1, Grade A, phosphor bronze bourbon type, bottom connection.
  3. Case: Drawn steel or brass, clear acrylic plastic lends, 4-1/2-inch diameter.
  4. Connector: Brass with 1/4-inch male NPT. Provide protective syphon when used for steam service.
  5. Scale: White coated aluminum with permanent etched markings.
  6. Range: Conform to the following:
    - a. Water: 0 - 100 psi.
  7. Available Manufacturers: Subject to compliance with requirements, manufacturers offering pressure gauges which may be incorporated in the work include, but are not limited to, the following:  
Ametek, U.S. Gauge Div.  
Marsh Instrument Co., Unit of General Signal.  
Marshalltown, an Eltra Company  
Trerice (H.O.) Co.  
Weiss (Albert A.) & Son, Inc.
- B. Pressure Gage Cocks:
1. General: Provide pressure gauge cocks between pressure gages and gauge tees on piping systems. Construct gage cock of brass with 1/4-inch female NPT on each end, and "T" handle brass plug.
  2. Syphon: 1/4-inch straight coil constructed of brass tubing with 1/2-inch male NPT on each end.
  3. Snubber: 1/4-inch brass bushing with corrosion resistant porous metal disc, through which pressure fluid is filtered. Select disc material for fluid served and pressure rating.
  4. Manufacturers: Subject to compliance with requirements, manufacturers offering pressure gage cocks which may be incorporated in the work include, but are not limited to, the following:  
Ametek, U.S. Gauge Div.  
Marsh Instrument Co., Unit of General Signal.  
Marshalltown, An Eltra Company

Trerice (H.O.) Co.  
Weiss (Albert A.) & Son, Inc

- C. Pressure Gage Connector Plugs:
  - 1. General: Provide pressure gage connector plugs pressure rated for 500 psi and 200 degrees Fahrenheit. Construct of brass and finish in nickel-plate, equip with 1/2-inch NPT fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8-inch O.D. probe assembly from dial type insertion pressure gage. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness for insulated piping.
  - 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering pressure gauge connector plugs which may be incorporated in the work include, but are not limited to, the following:  
Peterson Engineering Co.

## **2.03 HOT/CHILLED WATER FLOW METERS**

- A. The flow meter shall be a retractable insertion, vortex shedding type meter. The flowmeter's wetted measuring element shall have no moving parts. The flow meter shall be installed or removed under full flow conditions. The flow meter shall be installed with 2-inch NPT treadolet. A piezo-resistive sensor shall be used to detect vortex signals.
- B. Each flow meter shall be individually factory wet flow calibrated. Combined linearity and repeatability shall be plus or minus 1 percent of full scale. The flow meter shall be available for line sizes from 4 to 20 inches. Metering range shall be from 0.3 to 15 ft/sec. The operating temperature range shall be from 32 degrees to 250 degrees F. The flow meter shall operate under a maximum process pressure of 150 psi. The flow meter's retractor shall be constructed of aluminum and the ball valve shall be constructed of bronze. The ball valve shall have 2-inch NPTF connections. The sensor shall be constructed of materials suitable for application and the shredder bar construction shall be 316 stainless-steel.
- C. Electronics shall be hermetically sealed. The flow meter shall have a 4-20 mA current output.
- D. The flow meter shall have a 2-year warranty. The flow meter shall be equal to Spirax Sarco VIM20-V-S-L-D-DL-1HL-S-PO-PNPTR, as described above.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION OF TEMPERATURE GAGES**

- A. General: Install temperature gages in vertical upright position, and tilted so as to be easily read by observer standing on floor.
- B. Thermometer Separable Wells: Install in piping for each temperature gage.
- C. Temperature Gage Connector Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap.

### **3.02 INSTALLATION OF PRESSURE GAGES**

- A. General: Install pressure gages in piping with pressure gage cock, located on pipe at most readable position.

- B. Locations: Install in the following locations, and elsewhere as indicated:
1. At suction and discharge of each hydronic pump or as a common gauge, if so detailed on drawings.
  2. At each pressure reducing valve on both the high pressure and low-pressure sides.
  3. At water service outlet.
- C. Pressure Gage Cocks: Install in piping tee with snubber.
- D. Pressure Gage Connector Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap.

**END OF SECTION**



## **SECTION 23 05 23 VALVES**

### **PART 1 GENERAL**

#### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. This section is a Division 23 Basic Materials and Methods section, and is a part of each Division 23 section making reference to valves specified herein.

#### **1.02 DESCRIPTION OF WORK**

- A. Extent of valves required by this section is indicated on drawings and/or specified in other Division 23 sections.
- B. Types of valves specified in this section include the following:
  - Gate Valves
  - Globe Valves
  - Drain Valves
  - Ball Valves
  - Check Valves
  - Swing Check
  - Wafer Check
  - Lift Check
  - Butterfly Valves
- C. Valves furnished as part of factory-fabricated equipment, are specified as part of the equipment assembly in other Division 23 sections.

#### **1.03 QUALITY ASSURANCE**

- A. Manufacturers: Firms regularly engaged in manufacture of domestic valves, of types and sizes required. All valves shall be manufactured in the United States of America.
- B. Marking of Valves: Comply with MSS SP-25.
- C. Valve Dimensions: For face-to-face and end-to-end dimensions of flanged or welding end, valve bodies, comply with ANSI B16.10.
- D. Valves Installed in Boiler Rooms: Comply with ASME Boiler and Pressure Vessel Code.
- E. Valve Types: Provide valves of same type by same manufacturer.

#### **1.04 SUBMITTALS**

- A. Product Data: Submit catalog cuts, specifications, installation instructions, and dimensioned drawings for each type of valve. Include pressure drop curve or chart for each type and size of valve. Submit valve schedule showing Manufacturer's figure number, size, location, and valve features for each required valve.
- B. Maintenance Data: Submit maintenance data and spare parts lists for each type of valve. Include this data in Maintenance Manual.

## **PART 2 PRODUCTS**

### **2.01 VALVES**

- A. General: Provide factory-fabricated valves recommended by manufacturer for use in service indicated. Provide valves of types and pressure ratings indicated; provide proper selection as determined by Installer to comply with installation requirements. Provide sizes as indicated; connections which properly mate with pipe, tube, and equipment connections and where more than one type is indicated, selection is Installer's option.

### **2.02 GATE VALVES**

- A. Packing: Select valves designed for repacking under pressure when fully opened, equipped with packing suitable for intended service. Select valves designed so back seating protects packing and stem threads from fluid when valve is fully opened, and equipped with gland follower.
- B. Comply with the following standards.
  - 1. Cast-Iron Valves: MSS SP-70.
  - 2. Bronze Valves: MSS SP-80.
  - 3. Steel Valves: ANSI B16.34.
- C. For Domestic Water Service:
  - 1. Threaded Ends 2 Inches and Smaller: Class 150, bronze body, union bonnet, rising stem, solid wedge, Milwaukee 1151.
  - 2. Flanged Ends 2-1/2 Inches and Larger: Class 125, iron body bronze mounted, bolted bonnet, rising stem, OS&Y, solid wedge, Milwaukee F-2885M.
- D. For HVAC Hot, Chilled and Condenser Water Service:
  - 1. Threaded Ends 2 Inches and Smaller: Class 150, bronze body, union bonnet, rising stem, solid wedge, Milwaukee 1151.
  - 2. Flanged Ends 2-1/2 Inches and Larger: Class 125, iron body bronze mounted, bolted bonnet, rising stem, OS&Y, solid wedge, Milwaukee F-2886M.
- E. For Low Pressure Steam Services:
  - 1. Threaded Ends 2 Inches and Smaller: Class 150, bronze body, union bonnet, rising stem, solid wedge, Milwaukee 1151.
  - 2. Flanged Ends 2-1/2 Inches and Larger: Class 125, iron body bronze mounted, rising stem. OS&Y, solid wedge, Milwaukee F-2885.
- F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering gate valves which may be incorporated in the work include, but are not limited to, the following:  
Milwaukee Valve Company.  
Powell (Wm.) Co.  
Stockham Valves and Fittings, Inc.

### **2.03 GLOBE VALVES**

- A. Packing: Select valves designed for repacking under pressure when fully opened, equipped with packing suitable for intended service. Select valves designed so back seating protects packing and stem threads from fluid when valve is fully opened, and equipped with gland follower.
- B. Composition Discs: Where required, provide suitable material for intended service. For stem throttling service, fit composition disc valve with throttling nut. For metal seated globe

valves, provide hardened stainless-steel disc and seat ring.

- C. Comply with the following standard:
  - 1. Cast-Iron Valves: MSS SP-85.
  - 2. Bronze Valves: MSS SP-80.
  - 3. Steel Valves: ANSI B16.34.
- D. For Domestic Water Service:
  - 1. Threaded Ends 2 Inches and Smaller: Class 150, bronze body, union bonnet, rising stem, composition disc, Milwaukee 590T.
  - 2. Flanged Ends 2-1/2 Inches and Larger: Class 125, iron body, bronze trimmed, bolted bonnet, rising stem, OS&Y, renewable seat and disc, Milwaukee F2981.
- E. For HVAC Hot and Chilled Water Service:
  - 1. Threaded Ends 2 Inches and Smaller: Class 150, bronze body, union bonnet, rising stem, composition disc.
  - 2. Flanged Ends 2-1/2 Inches and Larger: Class 125, iron body, bolted bonnet, rising stem, OS&Y, renewable seat and disc.
- F. For Low Pressure Steam Services:
  - 1. Threaded Ends 2 Inches and Smaller: Class 150, bronze body, union bonnet, rising stem, composition disc, Milwaukee 590T.
  - 2. Flanged Ends 2-1/2 Inches and Larger: Class 125, iron body, bronze trimmed, bolted bonnet, rising stem, OS&Y, renewable seat and disc, Milwaukee F2981.
- G. Available Manufacturers: Subject to compliance with requirements, manufacturers offering globe valves which may be incorporated in the work include, but are not limited to, the following:  
Milwaukee Valve Company.  
Powell (Wm.) Co.  
Stockham Valves and Fittings, Inc.

## **2.04 DRAIN VALVES**

- A. For Low Pressure Drainage Service:
  - 1. Threaded Ends 2 Inches and Smaller: Class 125, bronze body, screwed bonnet, rising stem, composition disc, 3/4-inch hose outlet connection, Milwaukee 1152M.
  - 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering drain valves which may be incorporated in the work include, but are not limited to, the following:  
Milwaukee Valve Company.  
Powell (Wm.) Co.  
Stockham Valves and Fittings, Inc.

## **2.05 BALL VALVES**

- A. General: Select with port area equal to or greater than connecting pipe area, include seat ring designed to hold sealing material.
- B. Comply with the following standards:
  - 1. Steel Valves: ANSI B16.34.
- C. For Domestic Water Service:
  - 1. Threaded Ends 2 Inches and Smaller: Class 125, bronze 2-piece body, bronze ball, bronze stem, Milwaukee BA-500.

- D. For HVAC Hot, Chilled and Condenser Water Service:
  - 1. Threaded Ends 2 Inches and Smaller: Class 125, bronze 2-piece body, bronze ball, bronze stem, Milwaukee BA-300.
- E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering ball valves which may be incorporated in the work include, but are not limited to the, the following:
  - Milwaukee Valve Company.
  - Powell (Wm.) Co.
  - Stockham Valves and Fittings, Inc.

## **2.06 SWING CHECK VALVES**

- A. General: Construct pressure containing parts of valves as follows:
  - 1. Bronze Valves, 125 or 150 psi: ANSI/ASTM B62.
  - 2. Metallic Seated Bronze Valves, 200 or 300 psi: ANSI/ASTM B61.
  - 3. Iron Body Valves: ANSI/ASTM A126, Grade B.
- B. Comply with MSS SP-71 for design, workmanship, material and testing.
- C. Construct valves of pressure castings free of any impregnating materials.
- D. Construct valves of bronze, regrinding, with seating angle 40 °F to 45 °F, unless composition disc is specified.
- E. Provide stop plug as renewable stop for disc hanger, unless otherwise specified.
- F. Construct disc and hanger as separate parts, with disc free to rotate.
- G. Support hanger pins on both ends by removable side plugs.
- H. For Domestic Water Service:
  - 1. Threaded Ends 2 Inches and Smaller: Class 125, bronze body, screwed cap, horizontal swing, bronze disc, Milwaukee 509.
  - 2. Flanged Ends 2-1/2 Inches and Larger: Class 125, iron body bronze mounted, bolted cap, horizontal swing, cast-bronze disc, Milwaukee 297A.
- I. For HVAC Hot, Chilled and Condenser Water Service:
  - 1. Threaded Ends 2 Inches and Smaller: Class 125, bronze body, screwed cap, horizontal swing, bronze disc, Milwaukee 509.
  - 2. Flanged Ends 2-1/2 Inches and Larger: Class 125, iron body bronze mounted, bolted cap, horizontal swing, cast-bronze disc, Milwaukee 2974.
- J. For Low Pressure Steam Service:
  - 1. Threaded Ends 2 Inches and Smaller: Class 125, bronze body, screwed cap, horizontal swing, bronze disc, Milwaukee 509.
  - 2. Flanged Ends 2-1/2 Inches and Larger: Class 125, iron body bronze mounted, bolted cap, horizontal swing, cast-bronze disc, Milwaukee 2974.
- K. Available Manufacturers: Subject to compliance with requirements, manufacturers offering swing check valves which may be incorporated in the work include, but are not limited to, the following:
  - Milwaukee Valve Company
  - Powell Co (The Wm.)
  - Stockham Valves and Fittings, Inc

## **2.07 BUTTERFLY VALVES**

- A. Butterfly valves in chilled water and condenser water supply and return piping, where shown on plans, shall be Demco Series NE, Milwaukee "M" Series, or approved equal. Ductile iron lug type body drilled and tapped for cap screws. Aluminum bronze disc; 416 stainless steel stems; Buna-N stem seals; Buna-N seat, field renewable type. Neck to provide handles or actuator clearance over 2 inches thick line insulation. Furnish set of ASA 150 Weld-Neck flanges and caps-crews for each valve. Valves on pumped systems shall have operator with wheel handle. Chain operators shall be provided on all valves in Mechanical Rooms mounted 7'-0" or higher above floor level.

## **2.08 VALVE FEATURES**

- A. General: Provide valves with features indicated and, where not otherwise indicated, provide proper valve features as determined by Installer for installation requirements. Comply with ANSI B31.1.
- B. Bypass: Comply with MSS SP-45, and except as otherwise indicated provide manufacturer's standard bypass piping and valving.
- C. Drain: Comply with MSS SP-45, and provide threaded pipe plug complying with Division-15 "Pipe, Tube, and Fittings" section.
- D. Flanged: Valve flanges complying with ANSI B16.5 (steel) or ANSI B16.24 (bronze).
- E. Threaded: Valve ends complying with ANSI B2.1.
- F. Butt-Welding: Valve ends complying with ANSI B16.25.
- G. Flangeless: Valve bodies manufactured to fit between flanges complying with ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).
- H. Wafer: Flangeless valves.
- I. Trim: Fabricate pressure-containing components of valve, including stems (shafts) and seats from brass or bronze materials, of standard alloy recognized in valve manufacturing industry.
- J. Non-Metallic Disc: Non-metallic material selected for service indicated in accordance with manufacturer's published literature.
- K. Renewable Seat: Design seat of valve with removable disc, and assemble valve so disc can be replaced when worn.
- L. Extended Stem: Increase stem length by 2 inches minimum, to accommodate insulation applied over valve.
- M. Mechanical Actuator: Factory-fabricated gears, gear enclosure, external chain attachment and chain designed to provide mechanical advantage in operating valve.
- N. Bonnet: Part of gate or globe valve through which stem passes to valve body, and attached to valve body by screws, bolts, union, or welding.
- O. Solid Wedge: One-piece tapered disc in gate valve, designed for contact on both sides.
- P. Outside Screw and Yoke: Stem and handwheel designed to rise out of bonnet or yoke as

valve is operated from closed to open position.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. General: Except as otherwise indicated, comply with the following requirements.
  - 1. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.
  - 2. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward for horizontal plane unless unavoidable. Install valve drains with hose-end adapter for each valve that must be installed with stem below horizontal plane.
- B. Insulation: Where insulation is indicated, install extended-stem valves, arranged in proper manner to receive insulation.
- C. Applications Subject to Shock: Install valves with bodies of metal other than cast iron where thermal or mechanical shock is indicated or can be expected to occur.
- D. Applications Subject to Corrosion: Do not install bronze valves and valve components in direct contact with steel, unless bronze and steel are separated by dielectric insulator. Install bronze valves in steam and condensate service and in other services where corrosion is indicated or can be expected to occur.
- E. Mechanical Actuators: Install mechanical actuator with chain operators where indicated, and where valves 4" and larger are mounted more than 7'-0" above floor in mechanical rooms, boiler rooms; and where recommended by valve manufacturer because of valve size, pressure differential or other operating condition making manual operation difficult.
- F. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select and install valves with the following ends or types of pipe/tube connections.
  - 1. Pipe Size 2 Inches and Smaller: One of the following, at Installer's option:
    - Threaded valves
    - Grooved-end valves (Fire Protection Only).
    - Flanged valves
  - 2. Pipe Size 2-1/2 Inches and Larger: One of the following, at Installer's option:
    - Grooved-end valves (Fire Protection Only).
    - Flanged valves
- G. Valve System: Select and install valves with outside screw and yoke stems, except provide inside screw non-rising stem valves where headroom prevents full opening of OS&Y valves.
- H. Non-Metallic Disc: Limit selection and installation of valves with non-metallic discs to locations indicated and where foreign material in piping system can be expected to prevent tight shutoff of metal seated valves.
- I. Renewable Seats: Select and install valves with renewable seats except where otherwise indicated.
- J. Fluid Control: Except as otherwise indicated, install, gate, ball, globe and butterfly valves to comply with ANSI B31.1. Where throttling is indicated or recognized as principal reason for valve, install globe or butterfly valve.

- K. Installation of Check Valves:
1. Swing Check Valves: Install in horizontal position with hinge pin horizontally perpendicular to center line of pipe. Install for proper direction of flow.
  2. Horizontal Lift Check Valve: Install in horizontal piping line with stem vertically upward, position for proper direction of flow.
  3. Vertical Lift Check Valve: Install in vertical piping line with upward flow with stem vertically upward.
  4. Spring Loaded Horizontal Lift Check Valve: Install in horizontal piping line with stem vertically upward, position for proper direction of flow.

**END OF SECTION**

**SECTION 23 05 29**  
**HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Pipe and equipment hangers and supports.
- B. Equipment bases and supports.
- C. Sleeves and seals.
- D. Flashing and sealing equipment and pipe stacks.

**1.02 RELATED SECTIONS**

- A. Section 03 30 00 - Cast-In-Place Concrete: Equipment bases.
- B. Section 23 07 19 – HVAC Piping Insulation.
- C. Section 23 21 13 - Hydronic Piping.
- D. Division 23 – All Sections.

**1.03 REFERENCES**

- A. ASME B31.2 - Fuel Gas Piping
- B. ASTM F708 - Design and Installation of Rigid Pipe Hangers.

**1.04 SUBMITTALS**

- A. Submit under provisions of Section 23 05 00 and Section 01 33 23.
- B. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

**PART 2 PRODUCTS**

**2.01 PIPE HANGERS AND SUPPORTS**

- A. Plumbing Piping - Water:
  - 1. Conform to ASME B31.9 and ASTM F708.
  - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.
  - 3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
  - 4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
  - 5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  - 6. Wall Support for Pipe: Welded steel bracket and wrought steel clamp.
  - 7. Vertical Support: Steel riser clamp.
  - 8. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  - 9. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  - 10. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.



- B. Hydronic Piping:
  - 1. Conform to ASME B31.9 and ASTM F708.
  - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.
  - 3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
  - 4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
  - 5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  - 6. Vertical Support: Steel riser clamp.
  - 7. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

## **2.02 ACCESSORIES**

- A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

## **2.03 FLASHING**

- A. Metal Flashing: 28 gage 304 stainless steel.
- B. Copper Flashing: 16 oz./sq. ft.
- C. Lead Flashing:
  - 1. Waterproofing: 6 lb/sq ft.
- D. Caps: Steel, 22 gauge minimum; 16 gauge at fire resistant elements.

## **2.04 SLEEVES**

- A. Sleeves for Pipes Thru Non-fire Rated Floors: 18 gauge galvanized steel.
- B. Sleeves for Pipes Thru Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe.
- C. Sleeves for Ductwork and Pipes Thru Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
- D. Sleeves for Round Ductwork: Galvanized steel.
- E. Sleeves for Rectangular Ductwork: Galvanized steel.

# **PART 3 - EXECUTION**

## **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.

## **3.02 PIPE HANGERS AND SUPPORTS**

- A. Support horizontal piping as scheduled.
- B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- C. Place hangers within 12 inches of each horizontal elbow.
- D. Use hangers with 1-1/2 inch minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing

between hangers.

- F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

### **3.03 EQUIPMENT BASES AND SUPPORTS**

- A. Provide housekeeping pads of concrete, where indicated on Drawings, minimum 4 inches thick and extending 6 inches beyond supported equipment. Refer to Section 03 30 00. Coordinate exact size requirement for pads.
- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

### **3.04 FLASHING**

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 4 inches minimum above finished roof surface with lead worked one inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and calk, metal counterflash, and seal.
- C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36-inch sheet size. Fasten flashing to drain clamp device.
- D. Seal floor drains watertight to adjacent materials.
- E. Adjust storm collars tight to pipe with bolts; calk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

### **3.05 SLEEVES**

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- C. Extend sleeves through floors one inch above finished floor level. Caulk sleeves.

- D. Where piping or ductwork penetrates fire or smoke rated floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and calk. Provide close fitting metal collar or escutcheon covers at both sides of penetration. Secure collar or escutcheon to prevent blow-out. Fire stopping materials shall meet requirements of ASTM E119.
- E. Install chrome plated steel escutcheons at finished surfaces.

### 3.06 SCHEDULES

#### HANGER ROD

<u>PIPE SIZE</u>	<u>MAX. HANGER SPACING</u>	<u>DIAMETER</u>
Inches	Feet	Inches
1/2 to 1-1/4	6.5	3/8
1-1/2 to 2	10	3/8
2-1/2 to 3	10	1/2
4 to 6	10	5/8

**END OF SECTION**

**SECTION 23 0548**  
**VIBRATION AND SEISMIC CONTROL FOR HVAC SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Includes furnishing and installing vibration and seismic components for HVAC piping, ductwork and equipment

**1.02 RELATED SECTIONS**

- A. Painting - Section 09 9000.
- B. Hydronic Piping – Section 23 2113.
- C. Common Work Results for HVAC – Section 23 0500.
- D. Division 23 – All Sections.

**1.03 SUBMITTALS**

- A. See Section 01 3323 – Submittals, for Submittals Procedures.
- B. The manufacturer of vibration isolation and seismic restraints shall provide submittals for products as follows:
  - 1. Descriptive Data:
    - a. Catalog cuts or data sheets on vibration isolators and specific restraints detailing compliance with the specification.
    - b. Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and seismic restraints by referencing numbered descriptive drawings.
  - 2. Shop Drawings:
    - a. Submit fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
    - b. Provide all details of suspension and support for ceiling suspended equipment.
    - c. Where walls, floors, slabs or supplementary steel work are used for seismic restraint locations, details of acceptable attachment methods for ducts, conduit and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturers' submittals must include spacing, static loads and seismic loads at all attachment and support points.
    - d. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.
  - 3. Seismic Certification and Analysis:
    - a. Seismic restraint calculations must be provided for all connections of equipment to the structure. Calculations must be stamped by a registered professional engineer with at least five years of seismic design experience, licensed in the state of the job location.
    - b. All restraining devices shall have a preapproval number from California OSHPD or some other recognized government agency showing maximum restraint ratings. Preapprovals based on independent testing

are preferred to preapprovals based on calculations. Where preapproved devices are not available, submittals based on independent testing are preferred. Calculations (including the combining of tensile and shear loadings) to support seismic restraint designs must be stamped by a registered professional engineer with at least five years of seismic design experience and licensed in the state of the job location. Testing and calculations must include both shear and tensile loads as well as one test or analysis at 45° to the weakest mode.

- c. Analysis must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and/or welded length. All seismic restraint devices shall be designed to accept, without failure, the forces detailed in section 1.06 acting through the equipment center of gravity. Overturning moments may exceed forces at ground level.

C. Typical Applicable Codes and Standards

- 1. The seismic protection shall be provided as required by chapter 16 of the Arkansas Fire Code (International Building Code) Volume II. This building shall meet design classification "C" requirements.

#### 1.04 QUALITY ASSURANCE

- A. The vibration and seismic control system shall be designed and fabricated by a firm which is regularly engaged, for a minimum of five years, in designing of piping systems similar to that required for this project.
- B. All system designers, supervisors and installers shall have five (5) years experience.
  - 1. Prior to installation, submit data showing that Contractor has successfully installed systems of the same type and design as specified herein, or that Contractor has a firm contractual agreement with a subcontractor having such required experience. Data shall include names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months.
  - 2. Qualifications of System Technician: Installation drawings, shop drawings and as-built drawings shall be prepared, by or under the supervision of an individual who is experienced with the types of works specified herein.
- C. The entire installation shall be guaranteed for a period of one (1) year from the building acceptance date.

#### 1.05 SEISMIC FORCE LEVELS

- A. The following force levels will be used on this project.

MINIMUM  $F_p$  (G's) FORCES EQUAL TO OR EXCEEDING BUILDING CODE LIST IN 1.03.

IBC-2000 TI-809-04	IBC-2003 NFPA-5000	"G" Forces for High Deformability Pipe, Bus Ducts, & Conduits	"G" Forces for Rigidly Mounted Equipment & Limited Deformability	"G" Forces for Vibration Isolated Equipment & Pipe Pressure Vessels	"G" Forces for Low Deformability Pipe
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		Cabletrays $a_p^*=1.0$ , $R_p^*=3.5$	Pipe $a_p^*=1.0$ , $R_p^*=2.5$	$a_p^*=2.5$ , $R_p^*=2.5$	$a_p^*=1.0$ , $R_p^*=1.25$
$S_s = 0.616$		Horiz. Vert.	Horiz. Vert.	Horiz. Vert.	Horiz. Vert.
Lower Levels and Ground Level	0.22      0.15	0.22      0.15	0.29      0.15	0.23      0.15	
Above Ground Level up to 1/4 of the Height of the Building	0.22      0.15	0.22      0.15	0.44      0.15	0.35      0.15	
Above 1/4 up to 1/2 of the Height of the Building	0.22      0.15	0.23      0.15	0.58      0.15	0.47      0.15	
Above 1/2 up to 3/4 of the Height of the Building	0.22      0.15	0.29      0.15	0.73      0.15	0.58      0.15	
Above 3/4 of the Height of the Building up to the Roof	0.25      0.15	0.35      0.15	0.88      0.15	0.7      0.15	

## PART 2 PRODUCTS

### 2.01 INTENT

- A. All vibration isolators and seismic restraints described in this section shall be the product of a single manufacturer. Mason Industries' products are the basis of these specifications; products of other manufacturers are acceptable provided their systems strictly comply with the specification and have the approval of the specifying engineer. Submittals and certification sheets shall be in accordance with section 1.03.
- B. For the purposes of this project, failure is defined as the discontinuance of any attachment point between equipment or structure, vertical permanent deformation greater than 1/8" (3mm) and/or horizontal permanent deformation greater than 1/4" (6mm).

### 2.02 PRODUCT DESCRIPTIONS

- A. Vibration Isolators and Seismic Restraints.

#### SPECIFICATION:

- Two layers of 3/4" (19mm) thick neoprene pad consisting of 2" (50mm) square waffle modules separated horizontally by a 16 (1.5mm) gauge galvanized shim. Load distribution plates shall be used as required. Pads shall be type Super W as manufactured by Mason Industries, Inc.
- Bridge-bearing neoprene mountings shall have a minimum static deflection of 0.2" (5mm) and all directional seismic capability. The mount shall consist of a ductile iron casting containing two separated and opposing molded neoprene elements. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation. The shock absorbing neoprene materials shall be compounded to bridge-bearing specifications. Mountings shall have an Anchorage Preapproval "R" Number from

OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Mountings shall be type BR as manufactured by Mason Industries, Inc.

3. Sheet metal panels shall be bolted to the walls or supporting structure by assemblies consisting of a neoprene bushing cushioned between 2 steel sleeves. The outer sleeve prevents the sheet metal from cutting into the neoprene. Enlarge panel holes as required. Neoprene elements pass over the bushing to cushion the back panel horizontally. A steel disc covers the inside neoprene element and the inner steel sleeve is elongated to act as a stop so tightening the anchor bolts does not interfere with panel isolation in 3 planes. Bushing assemblies can be applied to the ends of steel cross members where applicable. All neoprene shall be bridge bearing quality. Bushing assemblies shall be type PB as manufactured by Mason Industries, Inc.
4. A one-piece molded bridge bearing neoprene washer/bushing. The bushing shall surround the anchor bolt and have a flat washer face to avoid metal-to-metal contact. Neoprene bushings shall be type HG as manufactured by Mason Industries, Inc.
5. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or 1/4" (6mm) neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height. Mountings shall be type SLF as manufactured by Mason Industries, Inc.
6. Restrained spring mountings shall have an SLF mounting as described in Specification 5, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. Installed and operating heights are equal. A minimum clearance of 1/2" (12mm) shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Restraining Bolts shall have a neoprene bushing between the bolt and the housing. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position there must be an internal isolation pad. Housing shall be designed to resist all seismic forces. Mountings shall have Anchorage Preapproval "R" Number from OSHPD in the state of California certifying the maximum certified horizontal and vertical load ratings. Mountings shall be type SLR or SLRS as manufactured by Mason Industries, Inc.
7. Spring mountings as in specification 5 built into a ductile iron or steel housing to provide all directional seismic snubbing. The snubber shall be adjustable vertically and allow a maximum of 1/4" (6mm) travel in all directions before contacting the resilient snubbing collars. Mountings shall have an Anchorage Preapproval "R" number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Mountings shall be type SSLFH as manufactured by Mason Industries, Inc.
8. Air Springs shall be manufactured with upper and lower steel sections connected by a replaceable flexible nylon reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air Springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. All air spring systems shall be connected to either the building control air or a supplementary air supply and equipped with three leveling valves to maintain leveling within plus or minus

- 1/8" (3mm). Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician. Air Springs shall be type MT and leveling valves type LV as manufactured by Mason Industries, Inc.
9. Restrained air spring mountings shall have an MT air spring as described in Specification 8, within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2" (12mm) shall be maintained around restraining bolts and between the housing and the air spring so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Housing shall be designed to resist all seismic forces. Mountings shall be type SLR-MT as manufactured by Mason Industries, Inc.
  10. Hangers shall consist of rigid steel frames containing minimum 1 1/4" (32mm) thick neoprene elements at the top and a steel spring with general characteristics as in specification 5 seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. To maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30deg. arc from side to side before contacting the rod bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30-deg. capability. Hangers shall be type 30N as manufactured by Mason Industries, Inc.
  11. Hangers shall be as described in 10, but they shall be supplied with a combination rubber and steel rebound washer as the seismic upstop for suspended piping, ductwork, equipment and electrical cable trays. Rubber thickness shall be a minimum of 1/4" (6mm). Submittals shall include a drawing of the hanger showing the installation of the rebound washer. Hangers shall be type RW30N as manufactured by Mason Industries, Inc.
  12. Hangers shall be as described in 10, but they shall be pre-compressed and locked at the rated deflection by means of a resilient seismic upstop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30-deg. capability. Hangers shall be type PC30N as manufactured by Mason Industries, Inc.
  13. Seismic Cable Restraints shall consist of galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Cables must be pre-stretched to achieve a certified minimum modulus of elasticity. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement. Cables must not be allowed to bend across sharp edges. Cable assemblies shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California verifying the maximum certified load ratings. Cable assemblies shall be type SCB at the ceiling and at the clevis bolt, SCBH between the hanger rod nut and the clevis or SCBV if clamped to a beam, all as manufactured by Mason Industries, Inc.
  14. Seismic solid braces shall consist of steel angles or channels to resist seismic loads with a minimum safety factor of 2 and arranged to provide all directional restraint. Seismic solid brace end connectors shall be steel assemblies that swivel to the final installation angle and utilize two through bolts to provide proper



attachment. Seismic solid brace assembly shall have anchorage preapproval "R" number from OSHPD in the state of California verifying the maximum certified load ratings. Solid seismic brace assemblies shall be type SSB, SSBS or SSRF as manufactured by Mason Industries, Inc.

Note: Specifications 12 - 14 apply to trapeze as well as clevis hanger locations. At trapeze anchor locations piping must be shackled to the trapeze. Specifications apply to hanging equipment as well.

15. Steel angles, sized to prevent buckling, shall be clamped to pipe or equipment rods utilizing a minimum of three ductile iron clamps at each restraint location when required. Welding of support rods is not acceptable. Rod clamp assemblies shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California. Rod clamp assemblies shall be type SRC or UC as manufactured by Mason Industries, Inc.
16. Pipe clevis cross bolt braces are required in all restraint locations. They shall be special purpose preformed channels deep enough to be held in place by bolts passing over the cross bolt. Clevis cross braces shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California. Clevis cross brace shall be type CCB as manufactured by Mason Industries, Inc.
17. All-directional seismic snubbers shall consist of interlocking steel members restrained by a one-piece molded neoprene bushing of bridge bearing neoprene. Bushing shall be replaceable and a minimum of 1/4" (6mm) thick. Rated loadings shall not exceed 1000 psi (.7kg/mm<sup>2</sup>). A minimum air gap of 1/8" (3mm) shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Snubber end caps shall be removable to allow inspection of internal clearances. Neoprene bushings shall be rotated to ensure no short circuits exist before systems are activated. Snubbers shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Snubber shall be type Z-1225 as manufactured by Mason Industries, Inc.  
All directional seismic snubbers shall consist of interlocking steel members restrained by shock absorbent rubber materials compounded to bridge bearing specifications. Elastomeric materials shall be replaceable and a minimum of 3/4" (19mm) thick. Rated loadings shall not exceed 1000 psi (.7kg/mm<sup>2</sup>). Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8" (3mm) nor more than 1/4" (6mm). Snubbers shall be installed with factory set clearances. The capacity of the seismic snubber at 3/8" (9mm) deflection shall be equal or greater than the load assigned to the mounting grouping controlled by the snubber multiplied by the applicable "G" force. Submittals shall include the load deflection curves up to 1/2" (12mm) deflection in the x, y and z planes. Snubbers shall have an anchorage preapproval "R" number from OSHPD in the state of California verifying the maximum certified horizontal and vertical load ratings. Snubbers shall be type Z-1011 as manufactured by Mason Industries, Inc.
18. Stud wedge anchors shall be manufactured from full diameter wire, not from undersized wire that is "rolled up" to create the thread. The stud anchor shall also have a safety shoulder which fully supports the wedge ring under load. The stud anchors shall have an evaluation report number from the I.C.B.O Evaluation Service, Inc. verifying its allowable loads. Drill-in stud wedge anchors shall be type SAS as manufactured by Mason Industries, Inc.
19. Female wedge anchors are preferred in floor locations so isolators or equipment can be slid into place after the anchors are installed. Anchors shall be manufactured from full diameter wire, and shall have a safety shoulder to fully support the wedge ring under load. Female wedge anchors shall have an

- evaluation report number from the I.C.B.O. Evaluation Service, Inc. verifying to its allowable loads. Drill-in female wedge anchors shall be type SAB as manufactured by Mason Industries, Inc.
20. Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split case pump shall include supports for suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14" (350mm) provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1" (25mm). Bases shall be type WF as manufactured by Mason Industries, Inc.
21. Vibration isolation manufacturer shall furnish rectangular steel concrete pouring forms for floating and inertia foundations. Bases for split case pumps shall be large enough to provide for suction and discharge elbows. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6" (150mm). The base depth need not exceed 12" (300mm) unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2" (12mm) bars welded in place on 6" (150mm) centers running both ways in a layer 1 1/2" (38mm) above the bottom. Forms shall be furnished with steel templates to hold the anchor bolts sleeves and anchors while concrete is being poured. Height saving brackets shall be employed in all mounting locations to maintain a 1" (25mm) clearance below the base. Wooden formed bases leaving a concrete rather than a steel finish are not acceptable. Base shall be type BMK or K as manufactured by Mason Industries, Inc.
22. Flexible spherical expansion joints shall employ peroxide cured EPDM in the covers, liners and Kevlar® tire cord frictioning. Any substitutions must have equal or superior physical and chemical characteristics. Solid steel rings shall be used within the raised face rubber flanged ends to prevent pullout. Flexible cable bead wire is not acceptable. Sizes 2" (50mm) and larger shall have two spheres reinforced with a ductile iron external ring between spheres. Flanges shall be split ductile iron or steel with hooked or similar interlocks. Sizes 16" (400mm) to 24" (600mm) may be single sphere. Sizes 3/4" (19mm) to 1 1/2" (38mm) may have threaded two-piece bolted flange assemblies, one sphere and cable retention. Connectors shall be rated at 250 psi up to 170deg.F with a uniform drop in allowable pressure to 215 psi at 250deg F° in sizes through 14" (350mm). 16" (400mm) through 24" (600mm) single sphere minimum ratings are 180 psi at 170deg F and 150 psi at 250deg. F. Higher rated connectors may be used to accommodate service conditions. All expansion joints must be factory tested to 150% of rated pressure for 12 minutes before shipment. Safety factors to burst and flange pullout shall be a minimum of 3/1. Concentric reducers to the above ratings may be substituted for equal ended expansion joints. Expansion joints shall be installed in piping gaps equal to the length of the expansion joints under pressure. Control rods need only be used in unanchored piping locations where the manufacturer determines the installation exceeds the pressure requirement without control rods. If control rods are used, they must have 1/2" (12mm) thick Neoprene washer bushings large enough in diameter to take the thrust at 1000 psi (.7 kg/mm<sup>2</sup>) maximum on the washer area. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer. All

expansion joints shall be installed on the equipment side of the shut off valves. Expansion joints shall be type SAFEFLEX SFDEJ, SFEJ, SFDCR or SFU and Control Rods CR as manufactured by Mason Industries, Inc.

23. Flexible stainless-steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3" (75mm) and larger shall be flanged. Smaller sizes shall have male nipples. Minimum lengths shall be as tabulated:

Flanged

3" x 14" (75 x 350mm)    6" x 20" (150 x 500mm) 12" x 28" (300 x 700mm)  
 4" x 15" (100 x 375mm) 8" x 22" (200 x 550mm) 14" x 30" (350 x 750mm)  
 5" x 19" (125 x 475mm) 10" x 26" (250 x 650mm)    16" x 32" (400 x 800mm)

Male Nipples

1/2" x 9" (12 x 225mm)    1 1/4" x 12" (32 x 300mm)    2" x 14" (50 x 350mm)  
 3/4" x 10" (19 x 250mm) 1 1/2" x 13" (38 x 325mm) 2 1/2" x 18" (64 x 450mm)  
 1" x 11" (25 x 275mm)

Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible. Hoses shall be type BSS as manufactured by Mason Industries, Inc.

24. All-directional acoustical pipe anchor, consisting of two sizes of steel tubing separated by a minimum 1/2" (12mm) thick 60 durometer neoprene. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction. Allowable loads on the isolation material should not exceed 500 psi (.35 kg/mm<sup>2</sup>) and the design shall be balanced for equal resistance in any direction. All-directional anchors shall be type ADA as manufactured by Mason Industries, Inc.
25. Split Wall Seals consist of two bolted pipe halves with minimum 3/4" (19mm) thick neoprene sponge bonded to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete may be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of 1" (25mm) past either face of the wall. Where temperatures exceed 240deg. F, 10# (4.5kg) density fiberglass may be used in lieu of the sponge. Seals shall be type SWS as manufactured by Mason Industries, Inc.
26. The horizontal thrust restraint shall consist of a spring element in series with a neoprene molded cup as described in specification 5 with the same deflection as specified for the mountings or hangers. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4" (6mm) movement at start and stop. The assembly shall be furnished with 1 rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit. Horizontal thrust restraints shall be type WBI/WBD as manufactured by Mason Industries, Inc.
27. Housekeeping pad anchors shall consist of a ductile iron casting that is tapered and hexagonal, smaller at its base than at its top. The upper portion shall have holes for rebar to pass through. The anchor shall be continuously threaded from top to bottom for the attachment of soleplates. Housekeeping pad anchors shall be attached to the structural slab using a stud wedge anchor. Housekeeping pad anchors shall be type HPA and stud wedge anchor shall be type SAS both as manufactured by Mason Industries, Inc.

## PART 3 EXECUTION

### 3.01 GENERAL

- A. All vibration isolators and seismic restraint systems must be installed in strict accordance with the manufacturers written instructions and all certified submittal data.
- B. Installation of vibration isolators and seismic restraints must not cause any change of position of equipment, piping or ductwork resulting in stresses or misalignment.
- C. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified.
- D. The contractor shall not install any equipment or piping, which makes rigid connections with the building unless isolation is not specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls.
- E. Coordinate work with other trades to avoid rigid contact with the building.
- F. Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architects/engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractors expense.
- G. Bring to the architects/engineers attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractors expense.
- H. Correct, at no additional cost, all installations which are deemed defective in workmanship and materials at the contractors expense.
- I. Overstressing of the building structure must not occur because of overhead support of equipment. Contractor must submit loads to the structural engineer of record for approval. Generally bracing may occur from:
  - 1. Flanges of structural beams.
  - 2. Upper truss cords in bar joist construction.
  - 3. Cast in place inserts or wedge type drill-in concrete anchors.
- J. Specification 12 cable restraints shall be installed slightly slack to avoid short circuiting the isolated suspended equipment, piping or conduit.
- K. Specification 12 cable assemblies are installed taut on non-isolated systems. Specification 13 seismic solid braces may be used in place of cables on rigidly attached systems only.
- L. At locations where specification 12 or 13 restraints are located, the support rods must be braced when necessary to accept compressive loads with specification 4 braces.
- M. At locations where specification 12 cable restraints are installed on support rods with spring isolators, the spring isolation hangers must be specification type 1.

- N. At all locations where specification 12 or 13 restraints are attached to pipe clevis, the clevis cross bolt must be reinforced with specification type 5 braces.
- O. Drill-in concrete anchors for ceiling and wall installation shall be specification type 18, and specification type 9 female wedge type for floor mounted equipment.
- P. Vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not permitted on this project.
- Q. Hand built elastomeric expansion joints may be used when pipe sizes exceed 24" or specified movements exceed specification 23 capabilities.
- R. Where piping passes through walls, floors or ceilings the vibration isolation manufacturer shall provide specification 12 wall seals.
- S. Air handling equipment and centrifugal fans shall be protected against excessive displacement which results from high air thrust in relation to the equipment weight. Horizontal thrust restraint shall be specification type 28 (see selection guide).
- T. Locate isolation hangers as near to the overhead support structure as possible.
- U. All mechanical equipment shall be vibration isolated and seismically restrained as per the schedules in Part 4 of this specification.

### **3.02 VIBRATION ISOLATION OF PIPING**

- A. Horizontal pipe isolation: The first four pipe hangers in the main lines near the mechanical equipment shall be as described in specification 11. Brace hanger rods with SRC clamps specification 14. Horizontal runs in all other locations throughout the building shall be isolated by hangers as described in specification 10 & 10A. Floor supported piping shall rest on isolators as described in specification 6. Heat exchangers and expansion tanks are considered part of the piping run. The first three isolators from the isolated equipment will have the same static deflection as specified for the mountings under the connected equipment. If piping is connected to equipment located in basements and hangs from ceilings under occupied spaces the first three hangers shall have 0.75" (19mm) deflection for pipe sizes up to and including 3" (75mm), 1 1/2" (38mm) deflection for pipe sizes up to and including 6" (150mm), and 2 1/2" (64mm) deflection thereafter. Hangers shall be located as close to the overhead structure as practical. Hanger locations that also have seismic restraints attached must have type RW Rebound Washers to limit uplift. Where piping connects to mechanical equipment install specification 23 expansion joints or specification 24 stainless hoses if 23 is not suitable for the service.
- B. Riser isolation: Risers shall be suspended from specification 10A hangers or supported by specification 5 mountings, anchored with specification 10 anchors, and guided with specification 11 sliding guides. Steel springs shall be a minimum of 0.75" (19mm) except in those expansion locations where additional deflection is required to limit load changes to +/- 25% of the initial load. Submittals must include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on the building structure, spring deflection changes and seismic loads. Submittal data shall include certification that the riser system has been examined for excessive stresses and that none will exist in the proposed design.

- C. Seismic Restraint of Piping
1. Seismically restrain all piping listed as a, b or c below. Use specification 2 cables if isolated. Specification 2 or 3 restraints may be used on un-isolated piping.
    - a. Piping located in boiler rooms, mechanical equipment rooms, and refrigeration equipment rooms that is 1 1/4" (32mm) I.D. and larger.
    - b. All other piping 2 1/2" (64mm) diameter and larger.
  2. Transverse piping restraints shall be at 40' (12m) maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
  3. Longitudinal restraints shall be at 80' (24m) maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
  4. Where thermal expansion is a consideration, guides and anchors may be used as transverse and longitudinal restraints provided they have a capacity equal to or greater than the restraint loads in addition to the loads induced by expansion or contraction.
  5. Transverse restraint for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24" (600mm) of the elbow or TEE or combined stresses are within allowable limits at longer distances.
  6. Hold down clamps must be used to attach pipe to all trapeze members before applying restraints in a manner similar to clevis supports.
  7. Branch lines may not be used to restrain main lines.
  8. Connection to the structure must be made with a non-friction connection (i.e. no "C" clamps)
  9. Hanger locations that also have seismic restraints attached must have Specification 10A type RW Rebound Washers.
- D. Pipe Exclusions
1. Gas piping less than 1" (25mm) inside diameter.
  2. Piping in boiler and mechanical rooms less than 1 1/4" (32mm) inside diameter.
  3. All other piping less than 2 1/2" (64mm) inside diameter.
  4.
    - a. All piping suspended by clevis hangers where the distance from the top of the pipe to the suspension point is 12" or less.
    - b. All trapezed piping where the distance from the suspension point to the trapeze member is 12" or less.
    - c. If any suspension location in the run exceeds the above, the entire run must be braced.

### **3.03 VIBRATION ISOLATION AND SEISMIC RESTRAINT OF DUCTWORK**

- A. Vibration isolation of ductwork
1. All discharge runs for a distance of 50' (15m) from the connected equipment shall be isolated from the building structure by means of specification 10 hangers or specification 5 floor isolators. Spring deflection shall be a minimum of 0.75" (19mm).
  2. All duct runs having air velocity of 1000 fpm (5 m/s) or more shall be isolated from the building structure by specification 11 hangers or 5 floor supports. Spring deflection shall be a minimum of 0.75" (19mm).
- B. Seismic restraint of ductwork
1. Seismically restrain all ductwork with specification 12 or 13 restraints as listed below:
    - a. Restrain rectangular ducts with cross sectional area of 6 sq.ft. (.5 m<sup>2</sup>) or larger.

- b. Restrain round ducts with diameters of 28" (700mm) or larger.
    - c. Restrain flat oval ducts the same as rectangular ducts of the same nominal size.
  - 2. Transverse restraints shall occur at 30' (9mm) intervals or at both ends of the duct run if less than the specified interval. Transverse restraints shall be installed at each duct turn and at each end of a duct run.
  - 3. Longitudinal restraints shall occur at 60' (18m) intervals with at least one restraint per duct run. Transverse restraints for one duct section may also act as a longitudinal restraint for a duct section connected perpendicular to it if the restraints are installed within 4' (1.2m) of the intersection of the ducts and if the restraints are sized for the larger duct. Duct joints shall conform to SMACNA duct construction standards.
  - 4. The ductwork must be reinforced at the restraint locations. Reinforcement shall consist of an additional angle on top of the ductwork that is attached to the support hanger rods. Ductwork is to be attached to both upper angle and lower trapeze.
  - 5. A group of ducts may be combined in a larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.
  - 6. Walls, including gypsum board non bearing partitions, which have ducts running through them may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame.
  - 7. Connection to the structure must be made with a non-friction connection (i.e. no "C" clamps)
  - 8. Hanger locations that also have seismic restraints attached must have Specification 10A type RW Rebound Washers.
- C. Ductwork Exclusions
- 1. Rectangular and square and ducts that are less than 6 square feet in cross sectional area.
  - 2. Oval ducts that are less than 6 square feet (.5m<sup>2</sup>) in cross sectional area based on nominal size.
  - 3. Round duct less than 28" (.5m<sup>2</sup>) in diameter.
  - 4.
    - a. All trapezed ductwork where the distance from the suspension point to the trapeze member is 12" or less.
    - b. Ductwork hung with straps where the top of the duct is 12" or less from the suspension point and the strap has 2 #10 sheet metal screws within 2" of the top of the duct.
    - c. If any suspension location in the run exceeds the above, the entire run must be braced.

## PART 4 SCHEDULES

### 4.01 EQUIPMENT ISOLATOR AND SEISMIC RESTRAINT SCHEDULE

	Vibration Isolation and/or Seismic Restraint	
Equipment Schedule	Specification	Static Deflection
Air Terminals	12, 14	None
Air Handling Units – Floor Mounted	4,19	By Manufacturer
Air Handling Units- Roof Mounted	22A	By Manufacturer
Unit Heaters	12, 14	None
Fans – Roof Mounted	22A	None

Fans – Wall Mounted		None
Ductwork	12, 14	None
Piping	12, 14, 15	None
Water Heaters – (Domestic) Boilers	4, 19	None

\*If static deflection isn't listed, then the product does not require resilient mounts, or spring hangers.

\*Equipment listed above with no specification # listed will be provided with restraint calculations and installation details. Mounting hardware will be by others.

#### **4.02 EXCLUSIONS:**

- A. VAV boxes, fan powered terminal equipment, and other equipment connected to the duct system shall be restrained if the equipment weighs more than 50 lbs. Equipment weighing more than 20 lbs., and is connected flexibly to the ductwork, shall be seismically restrained. Any equipment weighing less than 20 lbs. is exempt.

**END OF SECTION**



**SECTION 23 0553**  
**IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Extent of mechanical identification work required by this section is indicated on drawings and/or specified in other Division-23 sections.
- B. Type of identification devices specified in this section include the following:
  - Plastic Pipe Markers.
  - Valve Tags.
  - Valve Schedule Frames.
  - Engraved Plastic-Laminate Signs.
  - Ceiling Tacks.
- C. Mechanical identification furnished as part of factory-fabricated equipment, is specified as part of the equipment assembly in other Division-23 sections.

**1.02 RELATED SECTIONS**

- A. Section 23 2113 – Hydronic Piping.

**1.03 QUALITY ASSURANCE**

- A. Manufacturers: Firms regularly engaged in manufacture of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.
- B. ANSI Standards: Comply with ANSI A13.1 for lettering size, colors, and viewing angles of identification devices.

**1.04 SUBMITTALS**

- A. Product Data: Submit product specifications and installation instructions for each identification material and device desired.
- B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.
- C. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 1.

**PART 2 PRODUCTS**

**2.01 MECHANICAL IDENTIFICATION MATERIALS**

- A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division-21 sections. Where more than single type

is specified for application, selection is Installer's option, but provide single selection for each product category.

B. Plastic Pipe Markers:

1. General: Provide manufacturer's standard pre-printed, flexible or semi-rigid, permanent, color-coded, plastic-sheet pipe markers, complying with ANSI A13.1.
  - a. Small Pipes: For external diameters less than 6 inches (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
    - (1) Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
    - (2) Adhesive lap joint in pipe marker overlap.
  - b. Large Pipes: For external diameters of 6 inches and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:
    - (1) Laminated or bonded application of pipe marker to pipe (or insulation)
    - (2) Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless-steel bands.
  - c. Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by Architect/Engineer in cases of variance with names as shown or specified.
  - d. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.
  - e. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

C. Valve Tags:

1. At the Contractor's option, provide one of the following:
  - a. Brass Valve Tags: provide 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4-inch-high letters and sequenced valve numbers 1/2 inch high, and with 5/32-inch hole for fastener. Provide 1-1/2-inch diameter tags, except as otherwise indicated.
  - b. Plastic Laminate Valve Tags: Provide manufacturer's standard 3/32-inch-thick engraved plastic laminate valve tags, with piping system abbreviation in 1/4-inch-high letters and sequenced valve numbers 1/2 inch high, and with 5/32-inch hole for fastener. Provide 1-1/2-inch square black tags with white lettering, except as otherwise indicated.
2. Valve Tag Fasteners: Manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

D. Valve Schedule Frames:

1. General: For each page of the valve schedule, provide a glazed display frame, with screws for removable mounting on walls. Provide frames of rigid plastic or metal, with plastic glazing.

E. Engraved Plastic-Laminate Signs:

1. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color)

- except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
2. Thickness: 1/16 inch for units up to 20 square inches or 8-inch length; 1/8 inch for larger units.
  3. Fasteners: Self-tapping stainless-steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
- F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering plastic pipe markers which may be incorporated in the work include, but are not limited to, the following:  
Seton Name Plate Company  
EMED Co., Inc.  
Approved equal.

## **2.02 LETTERING AND GRAPHICS**

- A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturer or as required for proper identification and operation/ maintenance of mechanical systems and equipment.
- B. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service.

## **PART 3 EXECUTION**

### **3.01 APPLICATION AND INSTALLATION**

- A. General Installation Requirements:
1. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.
- B. Ductwork Identification:
1. General: Identify air supply, return, exhaust, intake and relief ductwork with plastic signs and arrows, showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork color).
  2. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50' spacing along exposed areas.
  3. Access Doors: Provide plastic-laminate type signs on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.
  4. Concealed Doors: Where access doors are concealed above acoustical ceilings or similar concealment, plasticized tags may be installed for identification in lieu of specified signs, at Installer's option.
- C. Piping System Identification:
1. Locate pipe markers and color bands as follows wherever piping is exposed to view

in occupied spaces, machine rooms, accessible maintenance spaces, (shafts, tunnels, plenums), exterior non-concealed locations and above removable acoustical ceilings.

- a. Near each valve and control device.
- b. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
- c. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
- d. At access doors, manholes and similar access points which permit view of concealed piping.
- e. Near major equipment items and other points of origination and termination.
- f. Spaced intermittently at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
- g. On piping above removable acoustical ceilings.

D. Valve Identification:

1. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibbs, and shut-off valves at plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.
2. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect/Engineer.
  - a. Where more than one major machine room is shown for project, install mounted valve schedule in each major machine room, and repeat only main valves which are to be operated in conjunction with operations of more than signet machine room.

E. Mechanical Equipment Identification:

1. General: Install engraved plastic laminate sign on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
  - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
  - b. Pumps and similar motor-driven units.
  - c. Fans, blowers, primary balancing dampers and mixing boxes.
  - d. Central-station units.
  - e. Tanks and pressure vessels.
  - f. Motor starters and other control equipment.

F. Refer to Division-15 sections for identification requirements at central-station mechanical control center; not work of this section.

G. Refer to Division-16 sections for identification requirements of electrical work; not work of this section.

H. Lettering Size: Minimum 3/8-inch-high lettering for name of unit where viewing distance is less than 2'-0"; 3/4 inch high for distances up to 6'-0"; and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 the size of principal lettering.

I. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, and warn of hazards and improper operations.

- J. Operational valves and similar minor equipment items located in non-occupied spaces (including machine rooms) may, at installer's option, be identified by installation of plasticized tags in lieu of engraved plastic signs.

**END OF SECTION**

**SECTION 23 05 66**  
**UVC EMITTER ULTRAVIOLET DISINFECTION FOR IAQ: HVAC MOLD,**  
**BACTERIA & ODOR CONTROL**

**PART 1 GENERAL**

**1.01 RELATED WORK SPECIFIED IN OTHER SECTIONS:**

- A. Motor starters, disconnects, power wiring of HVAC equipment, variable frequency drives and UVC Emitters: Division 26.

**1.02 QUALITY ASSURANCE:**

- A. UL Compliance: Comply with UL Standard 1995 as applicable to usage of UVC Emitters in HVAC Equipment.
- B. ISO Certification: Fixtures must be manufactured in an ISO 9001:2000 registered facility.

**1.03 DELIVERY, STORAGE AND HANDLING:**

- A. Store UVC Emitters in a clean dry place and protect from weather and construction traffic. Handle UVC Emitters carefully to avoid damage to components, enclosures and finish. Leave factory-shipping covers in place until installation and only when called for in the installation instructions. Do not install damaged components; replace and return damaged components to equipment manufacturer.
- B. Comply with manufacturer's installation instructions placement, wiring and testing.

**PART 2 PRODUCTS**

**2.01 UVC EMITTERS**

- A. GENERAL
  - 1. Acceptable Manufacturers:
    - a. Steril-Aire, Inc. Model RIK Series as shown on Schedule or Drawings.
    - b. Architect approved equal and provide documentation by a recognized Industry Independent Testing Lab on substitute UVC Emitter performances. Performance results must meet or exceed the performance for Emitters specified in an HVAC environment.
  - 2. Quality Assurance:
    - a. Qualifications: Each component and product are to be inbound and outbound tested before shipment in accordance with ISO 9001:2000 test procedures and shall be produced in an ISO 140001 approved facility.
    - b. Output Verification: Independent certified testing shall indicate that when the RIK Emitter first installed total output per one inch arc length shall not be less than 7.8  $\mu\text{W}/\text{cm}^2$  at one meter, in a 400-fpm airstream of 50 °F.
  - 3. Warranty:
    - a. Fixture and Emitter shall be 100% warranted to be free from factory defects for a period of one year. The Power Supplies and Fixtures shall be warranted for 5 years.
    - b. The Coil shall be substantially free of Mold at the end of the manufacturer's Emitter warrantee period, or 9000 hours, whichever is longer.

B. DESIGN REQUIREMENT

1. Irradiation – UVC Emitters and fixtures are to be installed downstream of the coil horizontally across the full face of the coil in sufficient quantity and in such an arrangement so as to provide an equal distribution of UVC energy on the coil and in the drain pan. UVC Emitter lamps shall be installed horizontally across the full width of the face of the coil (i.e., perpendicular to the coil fins) to minimize the shadowing effect of the coil fins.
2. Intensity- Intensity shall be measured by a UVC Radiometer that is accurate to  $\pm 3\%$  radiometric and photometric for NIST transfer standards in the monochromatic irradiance at 254nm. The Radiometer shall have a full cosine response filter.

C. EQUIPMENT

1. The Rapid Install Kit (RIK) System
  - a. The Rapid Install Kit shall be factory assembled and tested. It shall consist of the following components: factory pre-wired power supplies with m12 connector cables and IP67 compliant female Emitter sockets, spring clips for each Emitter, foot bracket assembly, ceiling "H" bracket, adjustable aluminum columns, and all fasteners. All RIK's include SJO cable between housings.
  - b. The adjustable column shall be constructed of aluminum channel. It shall be designed for mounting inside the plenum.
  - c. The column brackets (2) shall be constructed of galvanized steel. The "H" bracket shall be used with self-drilling, self-tapping screws to attach the column to the plenum ceiling. The foot bracket assembly shall be placed at the base of the column for height adjustment and non-slip footing in the drain pan.
  - d. The housing shall be constructed of galvanized steel to withstand HVAC environments and shall be factory installed with 2 pre-wired 110-277 V power supplies. The Emitter shall be held in place and supported in the airstream by Steril-Aire Mounting options.
  - e. The power supply shall be a UL-935, Class P and Type 1 outdoor. The power supply design shall include RF and EMI suppression per FCC part 18. The power supply shall be designed to maximize photon production, irradiance supplies and reliability in cold airstreams of 0-140 °F, 100% RH. The power supply shall be available in a universal 110-277 V, 50/60 Hz, single phase. The power supply shall also have end of life protection.
  - f. The Emitter shall be a very high output, hot cathode, T5 diameter, that produces germicidal UVC of 253.7 nm. The single-ended Emitter shall operate in air velocities of up to 2000 fpm and air temperatures of 35-140°F. It shall produce no ozone or other secondary contaminants.
  - g. The socket shall be a 4-pin stepped type design constructed of UV Stabilized, Flame Retardant Polycarbonate with Silicone Rubber seals to achieve IP-67 protection at -40° to 125 °C.
2. Unitary System
  - a. The Unitary Kit for Smaller Air Handlers shall be factory assembled and tested. The Kit shall consist of a power supply and a mounting solution. The single-ended Emitter shall be ordered separately.
  - b. The power supply shall be a 25Watt unit with connector for Emitter. It shall be suitable for single-phase input power of either 120 volts or 230 volts (+/- 10%), 50 Hertz. The design shall include RF and EMI suppression. The power supply input wire length shall be 10". The Emitter to power supply sleeved wire length shall be 14".
  - c. The socket shall be a Circline® 4 pin type to facilitate connection to the Emitter for ease of installation and service.

- d. The Emitter shall be a high output, hot cathode, T5 diameter, Circline cell-base type that produces a germicidal UVC band of 253.7 nm. The single-ended UVC Emitter shall be designed to maximize photon production, irradiance and reliability in cold air streams of 35-140 °F, 99% RH and up to 2000 fpm. It shall produce no ozone or other secondary contaminants. Optional Emitter extension cords in 11" and 32" lengths (with connectors) shall be available.
  - e. The Mounting Solution: Steril-Aire provides a variety of mounting brackets for UVC Emitters. The Unitary Kit for Smaller Air Handlers includes one of the following mounting options: Short Hooks, Spring Clips, Flat Plate Lamp Holder (for metal), Flat Plate Lamp Holder (for plastic), Insert Lamp Holder, U Bracket – each packaged with mounting screws (as required) to facilitate installation in most major brands. The power supply shall comply with ANSI/UL Standards 153, 1598 and 1995 and CSA standards. The manufacturer shall be an ISO. The supplier of the UVC system(s) shall provide documentation demonstrating the calculations for the specified minimum and average intensities for each UVC system as listed in the UVC Emitter Germicidal Lamp Disinfection Schedule during the submittal process.
- D. System Design Performance:  
The supplier of the UVC system(s) shall provide documentation demonstrating the calculations for the specified minimum and average intensities for each UVC system as listed in the UVC Emitter Germicidal Lamp Disinfection Schedule during the submittal process.
- E. System Commissioning:
  - 1. UVC system shall be commissioned by manufacturer field representative.
  - 2. Commissioning shall verify system intensity level for each UVC system demonstrating that it has met or exceeded the minimum and average UVC intensities as specified. The commissioning shall be performed upon installation of UVC system for each AHU or RTU during operating conditions.
  - 3. Points of measurements for UVC system minimum intensity shall be demonstrated by measuring at the four extreme corners (extreme position is defined as one square centimeter of coil at one corner of the area covered by the lamp) of the coil surface in the same plane as the irradiated surface. Additionally, points of measurements shall be taken every four (4) square feet across the face of the coil.
  - 4. The average intensities shall be calculated by averaging the four (4) corner measurements with those measurements taken every four (4) square feet.
  - 5. Intensity shall be measured by a UVC Radiometer that is accurate to  $\pm 3\%$  radiometric and photometric for NIST transfer standards in the monochromatic irradiance at 254nm. The Radiometer shall have a full cosine response filter. This measurement shall be used to verify compliance
  - 6. Upon completion of the commissioning report demonstrating and verifying design intensity levels, actual recorded levels, and measurement locations all data shall be presented upon submission of an Operation and Maintenance Manual.

## **PART 3 INSTALLATION**

### **3.01 INSTALLATION OF UVC EMITTERS**

- A. Coordinate with installation of HVAC equipment and install Emitters as indicated after such equipment is properly installed.



- B. Provide an interlock switch on the access to the UVC Emitters to turn the lights off when the access is opened.
- C. Provide a view port to enable the maintenance technician to view Emitters to determine that they are operating.
- D. If specified to include a Steril-Aire stationary radiometer, install the radiometer and adjust and set in accordance with manufacturer recommendations.
- E. Install an on/off indicator capable of informing BMS if there is an Emitter failure.
- F. Install provided Caution Labels on all accesses to the Emitters.

**END OF SECTION**

**SECTION 23 0593**  
**TESTING, ADJUSTING AND BALANCING FOR HEATING,**  
**VENTILATING AND AIR CONDITIONING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Basic Requirements for Testing, Balancing and Adjusting Heating, Ventilating, and Air Conditioning Systems.

**1.02 RELATED SECTIONS**

- A. Section 23 0500 – Common Work Results for HVAC.
- B. Section 23 0548 – Vibration and Seismic controls for HVAC Piping and Equipment.
- C. Section 23 2113 – Hydronic Piping.
- D. Section 23 3100 – HVAC Ducts and Casings.
- E. Section 23 0923 – DDC System for HVAC.

**1.03 REFERENCES**

- A. AABC - National Standards for Field Measurement and Instrumentation, Total System Balance.
- B. ASHRAE - 2007 Systems Handbook: Chapter 37, Testing, Adjusting and Balancing.
- C. NEBB - Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

**1.04 SUBMITTALS**

- A. Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.
- B. Submit test reports as a submittal under provisions of Section 01 3000 and Section 23 0500.
- C. Prior to commencing work, submit draft reports indicating adjusting, balancing, and equipment data required.
- D. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.
- E. Provide reports in hard back, letter size manuals, complete with index page and indexing tabs, with cover identification at front and side.
- F. Include detailed procedures, agenda, sample report forms prior to commencing system balance.

**1.05 QUALITY ASSURANCE**

- A. Mechanical contractor may at his option perform hydrostatic pressure test and hydronic balancing of the HVAC piping systems.
- B. Air Balance Subcontractor shall be a qualified representative of the Air Distribution Manufacturer whose devices are used on the project, or a qualified Independent Balancing Contractor. Air Balance Subcontractor may not be the Mechanical Contractor or the Sheet Metal Contractor on the project.
- C. In order to be considered qualified, the Air Distribution Manufacturer shall include with air device shop drawings evidence of qualifications as follows:
  - 1. Resume of Air Balance Technician(s) to be used on the project including list of major air balance projects within the last five (5) years. Minimum acceptable experience shall be three (3) years as Air Balance Technician and five (5) projects similar in size and complexity.
  - 2. Resume of firm's experience in air balance and list of air balance projects within last five (5) years.
  - 3. Evidence of certification of calibration of equipment.
- D. In order to be considered to be qualified, Independent Air Balance Contractor shall submit evidence of qualifications as follows:
  - 1. Resume of firm's experience in air balance representing a minimum of two (2) years as an Air Balance Contractor. Resume shall include a list of air balance projects within the last five (5) years.
  - 2. Resume of Air Balance Technicians(s) to be used on the project, including list of major air balance projects within last five (5) years. Minimum acceptable experience shall be three (3) years as Air Balance Technician and five (5) projects similar in size and complexity.
  - 3. Evidence of certification of calibration or equipment.

## **1.06 SEQUENCING AND SCHEDULING**

- A. Sequence work under the provisions of Division 01.
- B. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.
- C. Schedule and provide assistance in final adjustment and test of life safety, smoke evacuation and/or smoke control system with Fire Authority.

## **PART 2 PRODUCTS**

### **2.01 EQUIPMENT**

- A. All measurements during air balance operations shall be made by means of the "Velometer" or "Anemometer" method. Instruments used for check of air quantities shall have recent certification of calibration.
- B. The Air Balance Subcontractor shall furnish balance forms for all air systems. Forms shall list air distribution devices by location, system, size, pattern, CFM flow factor and required velocity.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Before commencing work, verify that systems are complete and operable. Ensure the following:
  - 1. Equipment is operable and in a safe and normal condition.
  - 2. Temperature control systems are installed complete and operable.
  - 3. Proper thermal overload protection is in place for electrical equipment.
  - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
  - 5. Duct systems are clean of debris.
  - 6. Correct fan rotation.
  - 7. Fire and volume dampers are in place and open.
  - 8. Coil fins have been cleaned and combed.
  - 9. Access doors are closed and duct end caps are in place.
  - 10. Air outlets are installed and connected.
  - 11. Duct system leakage has been minimized.
  - 12. Hydronic systems have been flushed, filled, and vented.
  - 13. Correct pump rotation.
  - 14. Proper strainer baskets are clean and in place.
  - 15. Service and balance valves are open.
- B. Report any defects or deficiencies noted during performance of services to Architect/Engineer.
- C. Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.
- D. If, for design reasons, system cannot be properly balanced, report as soon as observed.

### **3.02 PREPARATION**

- A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.
- B. Provide additional balancing devices as required.

### **3.03 INSTALLATION TOLERANCES**

- A. Adjust air handling systems to plus or minus 5 percent for supply systems and plus or minus 10 percent for return and exhaust systems from figures indicated.
- B. Adjust hydronic systems to plus or minus 10 percent of design conditions indicated.

### **3.04 ADJUSTING**

- A. Recorded data shall represent actually measured, or observed condition.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

- E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

### **3.05 HYDROSTATIC TEST**

- A. After completion of the installation, all piping shall be tested under 100 psi hydrostatic pressure, which shall be maintained for one hour without loss of pressure; after the system is proven tight and put in service, the contractor shall perform the equipment start-up and operating tests. All equipment shall be placed in complete operating condition subject to the approval of the Architect.

### **3.06 AIR BALANCE PROCEDURE**

- A. All air quantities shall, after completion of the job, be adjusted to provide air quantities shown on plans. After complete adjustment, additional re-adjustment shall be performed if necessary to satisfy desired temperature.
- B. The balance procedure shall include the checking of each supply, return and exhaust fan. As a minimum, CFM, RPM and ampere readings shall be taken. Pulley adjustments, etc., shall be performed to obtain the required CFM readings.
- C. Air Balance Subcontractor shall also furnish all balancing instruments required. Air Balance Subcontractor shall provide one experienced technician to team with Contractor's technician to balance system. The Air Balance Subcontractor's Technician and the Contractor's Technician shall perform as a team during the entire field balancing operation.
- D. After all adjustments and corrections have been performed to balance system as designed and required, the Air Balance Subcontractor shall prepare and submit three (3) copies of completed balance form to Architect/Engineer for approval.
- E. At the time of balancing, the Air Balance Contractor's Technician shall verify that each device is the size and pattern submitted and includes accessories such as volume controls and deflection where specified.
- F. Where project includes controlled Air Terminal Units, the Terminal Unit Manufacturer's Supplier shall be responsible for testing the automatic control devices on the Terminal.

### **3.07 WATER BALANCE PROCEDURE**

- A. With all manual valves in fully open position and all control valves full flow to coil, adjust pump discharge valves to design flow on pumping systems.
- B. Automatic flow control valves will balance flow to coils.
- C. Balance flow through pumps at chillers, towers and boilers.

### **3.08 SYSTEM OPERATING TEST**

- A. After the successful completion of all equipment start-up and individual item test requirements, formal tests shall be performed on the complete Mechanical systems, measurements shall be made and reports prepared as specified below. Provide all instruments, materials and labor to perform the tests and to obtain and record the measurements specified herein, including the furnishing of all required record forms. Submit

for the Architect's approval the form on which the measurements specified herein. Furnish all required record forms. Submit for the Architect's approval, complete shop drawings or catalog data for all instruments to be used for the 3-day operating test, and obtain approval at least two weeks before the forms and instruments will be required. Sample forms can be provided by the Architect if the Contractor requests.

- B. First operating test by Contractor: Prove the operation of the Mechanical systems and of each individual item in the systems. At least 10 days' notice shall be given the Architect of such tests. Should any item of the systems fail to perform in an approved manner, this test shall be repeated until the operating test is approved by the Architect. During this test, balance circulation of steam, condensate, heating and chilled water, air and all other fluids conveyed to provide proper quantities to all items of equipment. Adjust and set all balancing cocks, valves, dampers and similar items to ensure that the systems perform as intended.
- C. Checking by Owner and Architect: Following the successful completion of first operating tests by the Contractor, the Owner and Architect shall have the privilege of making such tests as they may desire during a period of three weeks to ascertain if any corrections are to be made to the system. At the end of the testing by the Owner and Architect, the Architect shall direct the Contractor in writing to make such corrections to the systems as are within the Scope of the contract.
- D. Contractor's corrections to systems: Make all required corrections to the systems and notify the Architect in writing that the corrections outlined have been completed and give at least seven days' notice of a final 3-day operating test.
- E. Three-day operating test: An operating test shall then be performed by the Contractor to the satisfaction of the Architect for a period of three days. Should any element of the systems not perform properly, the Contractor shall make all required corrections, and the test shall be repeated until successfully performed.
- F. Measurements: Make the following measurements at two-hour intervals (5 measurements per 8-hour day) during the 3-day operating test.
  - 1. Electrical: Running ampere and voltage of each motor 3/4HP or larger.
  - 2. Air pressures at entrance and exit of each electronic air cleaner, filter, coil, fan and damper.
  - 3. Air temperatures in each heated or air-conditioned space, at the entrance and exit of each coil, downstream from each pair of dampers where air of two different temperatures is mixed and outside the structure.
  - 4. Relative humidity at location of each humidity sensor.
  - 5. Water pressures at each pump suction and discharge and at entrance and exit of each convertor, and each heating and cooling coil.
  - 6. Water temperature at entrance and exit of each convertor and each heating and cooling coil.
  - 7. Domestic hot water supply temperature at the fixtures closest to and farthest away from the domestic hot water heater on each system (only once during 3-day test).
  - 8. Running ampere and voltage on re-circulating pumps.
  - 9. Static pressure of cold water line at building service connection (only once during 3-day test).
- G. Report: Four copies of a written report of the 3-day operating test, on the approved form of record, shall be submitted to the Architect for approval and subsequent transmittal to the Owner.

#### **END OF SECTION**

**SECTION 23 0713**  
**DUCT INSULATION FOR HEATING, VENTILATING AND AIR CONDITIONING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Basic Requirements for Duct Insulation for HVAC Systems.

**1.02 RELATED SECTIONS**

- A. Section 23 3100 – HVAC Ducts and Casings.

**1.03 REFERENCES**

- A. ASTM C553 - Mineral Fiber Blanket and Felt Insulation.
- B. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.
- C. ASTM E96 - Water Vapor Transmission of Materials.
- D. NFPA 255 - Surface Burning Characteristics of Building Materials.
- E. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- F. Test standards and procedures for evaluating and rating performance of fire resistive and zero-inch clearance duct wrap systems.
  - 1. Underwriters' laboratories Inc., (UL):
    - a. UL 723, Surface Burning Characteristics per ASTM E 84.
    - b. UL 1978, First Edition of the Standard for Grease Ducts.
    - c. UL 1479, Through-Penetration Firestop Test.
  - 2. American Society for Testing and Materials (ASTM):
    - a. E119, Standard Method of Fire Test of Building Construction and Materials; 2-hour External Total Engulfment Test.
    - b. E814, Standard Method of Fire Tests of Through-Penetration Fire Stops.
  - 3. NFPA 96, 1994 Edition, Ventilation Control and Fire Protection of Commercial Cooking Operations.

**1.04 SUBMITTALS**

- A. Submit under provisions of Division 01 and Section 23 0500.
- B. Product Data: Provide product description, list of materials and thickness for each service, and locations.
- C. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

**1.05 QUALITY ASSURANCE**

- A. Materials: Flame spread/smoke developed rating of 25/100 in accordance with NFPA 255.

**1.06 QUALIFICATIONS**

- A. Applicator: Company specializing in performing the work of this section with minimum three

years experience.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect and handle products to site under provisions of Section 23 0500.
- B. Deliver materials to site in original factory packaging, labeled with manufacturer's density and thickness.
- C. Store insulation in original wrapping and protect from weather and construction traffic.
- D. Protect insulation against dirt, water, chemical, and mechanical damage.

#### **1.08 ENVIRONMENTAL REQUIREMENTS**

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

### **PART 2 PRODUCTS**

#### **2.01 GLASS FIBER, FLEXIBLE**

- A. Insulation: ASTM C553 and C612; flexible, noncombustible blanket.
  - 1. "K" value: 0.27 at 75 degrees F.
  - 2. Maximum service temperature: 250 degrees F.
  - 3. Maximum moisture absorption: 0.20 percent by volume.
  - 4. Density: 1.0 lb/cu ft.
- B. Vapor Barrier Jacket:
  - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
  - 2. Moisture vapor transmission: 0.04 perm.
  - 3. Secure with adhesive and tape.
- C. Vapor Barrier Tape
  - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber-based adhesive.

#### **2.02 GLASS FIBER, RIGID**

- A. Insulation: ASTM C612; rigid, noncombustible blanket.
  - 1. "K" value: 0.24 at 75 degrees F.
  - 2. Maximum service temperature: 350 degrees F.
  - 3. Maximum moisture absorption: 0.20 percent by volume.
  - 4. Density: 4.2 lb/cu ft.
- B. Vapor Barrier Jacket:
  - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
  - 2. Moisture vapor transmission: 0.04 perm.
  - 3. Secure with adhesive tape.
- C. Vapor Barrier Tape:
  - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber-based adhesive.



## 2.03 GLASS FIBER DUCT LINER, FLEXIBLE

- A. Insulation: ASTM C553; flexible, bonded fibers, noncombustible blanket with edge coating.
  - 1. "K" value: 0.26 at 75 degrees F.
  - 2. Maximum service temperature: 250 degrees F.
  - 3. Density: 1.5 lb/cu ft.
- B. Adhesive:
  - 1. Waterproof, fire-retardant type.
- C. Liner Fasteners: Galvanized steel, impact applied or welded with press on head conforming to Mechanical Fastener Standard MF-19/1.

## 2.04 FIRE-RATED DUCT INSULATION

- A. A lightweight, non-asbestos, high-temperature inorganic foil encapsulated insulation blanket. Duct wrap system is used on commercial grease hood duct systems allowing a zero-inch clearance to combustible construction and as a 2-hour fire resistive rated enclosure system (shaft enclosure) when used with a listed or approved through-penetration system.
- B. Performance Requirements:
  - 1. Two-hour rated fire resistive enclosure assembly, ASTM E119; Total Engulfment Test.
  - 2. Class 1 interior finish materials, ASTM E84
  - 3. Zero-inch clearance to combustibles, maximum allowable surface temperatures on unexposed side, UL 1978.
  - 4. Three-hour through-penetration protection systems for grease duct, ASTM E814 and UL 1479.
- C. Materials
  - 1. FlameChek™ Duct Insulation.
  - 2. Tapes:
    - a. High Performance Filament Tape: one-inch wide.
    - b. Aluminum Foil Tape: to seal cut edges of blankets.
  - 3. Banding Material:
    - a. Minimum 1/2 inch wide, .015 inch thick, type 304 stainless steel.
  - 4. Insulation Pins: 12 gage, minimum 4-1/2 inches long, Type 300 series stainless steel, with 1-1/2-inch square or round speed clips.
  - 5. Firestopping materials:
    - a. Mesh: 304 stainless steel, .011 inch thick, 12 inches wide
    - b. FlameChek™ Fiber Blanket
    - c. Unifrax FryePutty
  - 6. Grease Duct Access Door, by duct fabricator:
    - a. Door Enclosure:
      - 1) Steel angle opening frame.
      - 2) Access door cover, no less than 16 gauge.
      - 3) Insulation Pins.
      - 4) Speed Clips.
    - b. Hardware:
      - 1) Threaded rods: Minimum 4-1/2 inches long, 1/4-inch diameter galvanized steel with wing nuts and metal washers.
      - 2) Steel tubing to fit over threaded rods, optional.

- 3) Wing nuts.

## **2.05 APPROVED MANUFACTURERS**

- A. Glass Fiber, Flexible:
  1. Owens Corning Fiberglass, Type 100.
  2. Architect Approved.
- B. Glass Fiber, Rigid:
  1. Owens Corning Fiberglass, Type 704.
  2. Architect Approved.
- C. Glass Fiber Duct Liner, Adjustable:
  1. Certainteed Toughgard 150.
  2. Architect Approved.
- D. Grease Duct Insulation
  1. Flamechek Duct Insulation, Certainteed Corporation.
  2. Architect Approved.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that ductwork has been tested and joints and seams sealed, before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

### **3.02 INSTALLATION**

- A. Install materials in accordance with manufacturer's instructions.
- B. Insulated ductwork conveying air below or above ambient temperature:
  1. Provide insulation with vapor barrier jackets.
  2. Finish with tape and vapor barrier jacket.
  3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
  4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- C. Grease Duct
  1. Apply two layers of FlameChek insulation with all seams and joints over lapped by 3 inches.
  2. Off-set the longitudinal joint on the second layer by 10.5" from the first layer.
  3. Secure the insulation to the duct using tape, SS bands, and insulation pins.
  4. Follow all manufactures installation requirements for the installation of the insulation, transitions, hangers, access doors, and thru-penetrations.
- D. Ducts external to the building shall be externally insulated with 2" thick rigid glass fiber insulation, cover with minimum .016" thick aluminum jacketing with waterproof seams. Crown jacketing as required to shed water and seal. A covering equal to "Alumaguard" may be used in lieu of aluminum jacket.

### **3.03 TOLERANCE**

- A. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

**3.04 FLEXIBLE GLASS FIBER DUCTWORK INSULATION SCHEDULE**

**DUCTWORK**

All supply, return and outside air ducts inside the building,  
unless noted otherwise.

**THICKNESS**

2 inches

Dishwasher exhaust ductwork above ceiling.

2 inches

**3.05 RIGID GLASS FIBER DUCTWORK INSULATION SCHEDULE**

**DUCTWORK**

All ductwork external to the building  
(See Section 3.02, Paragraph D)

**THICKNESS**

2 inches

All rectangular ductwork in Mechanical Rooms  
Provide canvas jacket.

2 inches

**3.06 FLEXIBLE GLASS FIBER DUCT LINER INSULATION SCHEDULE**

**DUCTWORK**

All supply and return ductwork shown  
Crosshatched or with dashed lines on the Drawings

**THICKNESS**

1 inch

**3.07 FIRE RATED DUCT INSULATION**

**THICKNESS**

Range hood exhaust ductwork

(2) 1½" layers

**END OF SECTION**

**SECTION 23 0716  
HVAC EQUIPMENT INSULATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Equipment insulation.
- B. Covering.

**1.02 RELATED SECTIONS**

- A. Painting: Painting Insulation Covering - Section 09 9000.
- B. Identification for HVAC Piping and Equipment - Section 23 0553.
- C. HVAC Piping Insulation - Section 23 0719.

**1.03 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00 and Section 23 0500.

**1.04 QUALIFICATIONS**

- A. Applicator: Company specializing in performing the work of this section with minimum three years experience.

**PART 2 PRODUCTS**

**2.01 GLASS FIBER, FLEXIBLE**

- A. Insulation: ASTM C553; flexible, noncombustible.
  - 1. ASTM C335, 0.24 at 75 degrees F.
  - 2. Maximum service temperature: 850 degrees F.
  - 3. Maximum moisture absorption: 0.2 percent by volume.
  - 4. Density: 2.0 lb/cu ft. density.
- B. Vapor Barrier Jacket
  - 1. ASTM C921, kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
  - 2. Moisture vapor transmission: ASTM E96; 0.02 perm.
- C. Vapor Barrier Lap Adhesive
  - 1. Compatible with insulation.

**2.02 GLASS FIBER, RIGID**

- A. Insulation: ASTM C612; rigid, noncombustible.
  - 1. K value: ASTM C335, 0.24 at 75 degrees F.
  - 2. Maximum service temperature: 850 degrees F.
  - 3. Maximum moisture absorption: 0.1 percent by volume.
  - 4. Density: 3.0 lb/cu ft density.

- B. Vapor Barrier Jacket:
  - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
  - 2. Moisture vapor transmission: ASTM E96; 0.02 perm.
- C. Vapor Barrier Lap Adhesive:
  - 1. Compatible with insulation.

## **2.03 JACKETS**

- A. Canvas Jacket: UL listed
  - 1. Fabric: ASTM C921, 6 oz/sq yd, plain weave cotton treated with dilute fire-retardant lagging adhesive.
  - 2. Lagging Adhesive:
    - a. Compatible with insulation.

## **2.04 APPROVED MANUFACTURERS**

- A. Glass Fiber, Flexible:
  - 1. Owens Corning.
  - 2. Architect Approved.
- B. Glass Fiber, Rigid:
  - 1. Owens Corning.
  - 2. Architect Approved.
- C. Vapor Barrier Lap Adhesive:
  - 1. Foster.
  - 2. Architect Approved.
- D. Lagging Adhesive:
  - 1. Thixotropic.
  - 2. Architect Approved.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that equipment has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

### **3.02 INSTALLATION**

- A. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.
- B. Install insulation for equipment requiring access for maintenance, repair, or cleaning, in such a manner that it can be easily removed and replaced without damage.
- C. Insulate air separators and expansion tanks with 1½" thick fiberglass insulation. Finish with brush coat of white canvas or a spiral wrap of stretchable glass tape and a second coat of cement or lagging adhesive.
- D. Insulate pipe connectors and expansion joints by filling linear voids with continuous wrappings of fiberglass insulation secured in place with copper wires. Complete

assembly shall then be covered by a continuous wrap of two layers of ½" thick insulation to lap adjoining pipe insulation. The entire exposed surface shall then be continuous spiral wrapped with two separate and opposite wound layers of fiberglass fabric and sized with non-hardening vapor proof sealant.

- E. Insulate chilled water pump impeller casing with a job-built insulation box which shall sit on the pump base plate and have openings for suction and discharge piping and the pump shaft. The insulation box shall be removable for pump servicing and shall have metal clips attached with sheet metal screws to attach it rigidly to the pump base. The insulation box shall be dual wall constructed of 16-gage sheet metal with a layer of one-inch-thick fiberglass insulation board with foil reinforced Kraft facing sandwiched between the sheet metal. Seal all seams and ends of insulation. Outside sheet metal panel and mating edges of top and bottom halves of insulation shall have finish layer of 8-ounce canvas applied with lagging adhesive.

**END OF SECTION**

**SECTION 23 0719  
HVAC PIPING INSULATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Basic Requirements for Piping Insulation for Heating, Ventilating, and Air Conditioning systems.

**1.02 RELATED SECTIONS**

- A. Section 23 2113 – Hydronic Piping.

**1.03 REFERENCES**

- A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- B. ASTM C195 - Mineral Fiber Thermal Insulation Cement.
- C. ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
- D. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.
- E. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- F. ASTM C547 - Mineral Fiber Preformed Pipe Insulation.
- G. ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
- H. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
- I. ASTM D2842 - Water Absorption of Rigid Cellular Plastics.
- J. ASTM E96 - Water Vapor Transmission of Materials.

**1.04 SUBMITTALS**

- A. Submit under provisions of Division 01 and Section 23 0500.
- B. Product Data: Provide product description, list of materials and thickness for each service, and locations.
- C. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

**1.05 QUALITY ASSURANCE**

- A. Materials: Flame spread/smoke developed rating of 25/100 or less in accordance with ASTM E84, NFPA 255, and UL 723.

**1.06 QUALIFICATIONS**

- A. Applicator: Company specializing in performing the work of this section with minimum three years experience.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect, and handle products to site under provisions of Section 23 05 00.
- B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Store insulation in original wrapping and protect from weather and construction traffic.
- D. Protect insulation against dirt, water, chemical, and mechanical damage.

#### **1.08 ENVIRONMENTAL REQUIREMENTS**

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

### **PART 2 PRODUCTS**

#### **2.01 GLASS FIBER**

- A. Insulation: ASTM C547; rigid molded, noncombustible.
  - 1. "K" value: ASTM C335, 0.24 at 75 degrees F.
  - 2. Minimum Service Temperature: -20 degrees F.
  - 3. Maximum Service Temperature: 850 degrees F.
  - 4. Maximum Moisture Absorption: 0.2 percent by volume.
- B. Vapor Barrier Jacket:
  - 1. ASTM C921, white kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
  - 2. Moisture Vapor Transmission: ASTM E96; 0.02 perm inches.
  - 3. Secure with adhesive applied to longitudinal laps and butt strips.
  - 4. Secure with vapor barrier mastic.
  - 5. Self-sealing laps may be used provided lap seal is additionally sealed with vapor barrier masters.

#### **2.02 CELLULAR GLASS**

- A. Insulation: ASTM C552.
  - 1. "K" value: 0.40 at 75 degrees F.
  - 2. Maximum Water Vapor Transmission: 0.1 perm.

#### **2.03 CELLULAR FOAM**

- A. Insulation: SASTM C534; flexible, cellular elastomeric, tubing.
  - 1. "K" Value: ASTM C177 C518; 0.27 at 75 degrees F.
  - 2. Minimum Service Temperature: -40 degrees F.
  - 3. Maximum Service Temperature: 220 degrees F.
  - 4. Maximum Moisture Absorption: ASTM D1056; 1.0 percent pipe by volume, .0 percent sheet by volume.
  - 5. Moisture Vapor Transmission: ASTM E96, 0.20 perm inches.
  - 6. Maximum Flame Spread: ASTM E84; 25.



7. Maximum Smoke Developed: ASTM E84; 25
8. Connection: Waterproof vapor barrier adhesive.

## **2.04 APPROVED MANUFACTURERS**

- A. Glass Fiber:
  1. Owens/Corning Fiberglass.
  2. Architect Approved - Other acceptable manufacturers offering equivalent products.
- B. Vapor Barrier Jacket Lap Adhesive - Compatible with insulation:
  1. Foster 25.
  2. Architect Approved.
- C. Cellular Foam:
  1. Armstrong Armaflex - FR.
  2. K-Flex USA.
  3. Architect Approved.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

### **3.02 INSTALLATION**

- A. Install materials in accordance with manufacturer's instructions.
- B. On exposed piping, locate insulation and cover seams in least visible locations.
- C. Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:
  1. Provide vapor barrier jackets, factory applied or field applied.
  2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe.
  3. Finish with glass cloth and vapor barrier adhesive.
  4. PVC fitting covers may be used.
  5. Continue insulation through walls, sleeves, pipe hangers, and other pipe.
  6. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- D. For insulated pipes conveying fluids above ambient temperature:
  1. Provide standard jackets, with or without vapor barrier, factory applied or field applied.
  2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
  3. Finish with glass cloth and adhesive.
  4. PVC fitting covers may be used.
  5. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
  6. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

- E. Inserts and Shields:
  - 1. Application: Piping 1-1/2 inches diameter or larger.
  - 2. Insert Location: Between support shield and piping and under the finish jacket.
  - 3. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
- F. Finish insulation at supports, protrusions, and interruptions.
- G. For exterior applications, provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum or stainless-steel jacket with seams located on bottom side of horizontal piping.
- H. For buried piping, provide factory fabricated assembly with inner all-purpose service jacket with self sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.
- I. For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- J. Valves and fittings insulated with block insulation shall be finished with insulating cement and troweled to a smooth and uniform finish.

### 3.03 TOLERANCE

- A. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

### 3.04 GLASS FIBER INSULATION SCHEDULE

	PIPING SYSTEMS	THICKNESS
A.	Heating Systems	
	Heating Water Supply and Return	
	Pipes 2" and larger	2 inches
	Pipes 1½" and smaller	1 inch
B.	Cooling Systems	
	Chilled Water (Conditioned Spaces)	
	Pipes 2" and larger	2 inches
	Pipes 1½" and smaller	1 inch
	Chilled Water (Unconditioned Spaces)	2 inches
	Humidity Drain Piping	½ inch

Note: Provide PVC jacket on all piping exposed in mechanical rooms.

### END OF SECTION

**SECTION 23 0923**  
**DIRECT DIGITAL CONTROL SYSTEM FOR HVAC**

**PART 1 GENERAL**

**1.01 RELATED SECTIONS**

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of these Specifications and will be used in conjunction with this Section as a part of the Contract Documents.

**1.02 DESCRIPTION**

- A. General: The control system will be as indicated on the drawings and described in the specifications. The campus automation system shall connect to BACnet interfaces to perform monitoring and start/stop functions as outlined in control drawings.
- B. The Direct Digital Control System (DDCS) will be designed such that each mechanical system will be able to operate under stand-alone control. In the event of a network communication failure, or the loss of any other controller, the control system will continue to independently operate under control.

**1.03 QUALITY ASSURANCE**

- A. System Installer Qualifications - The Installer shall be Schneider Electric / Wade Company.
- B. Codes and Standards: Meet requirements of all applicable standards and codes, except when more detailed or stringent requirements are indicated by the Contract Documents, including requirements of this Section.
  - 1. Underwriters Laboratories: Products will be UL-916-PAZX listed.
  - 2. National Electrical Code -- NFPA 70.
  - 3. Federal Communications Commission -- Part J.
  - 4. ASHRAE/ANSI 135-1995 (BACnet)

**1.04 SUBMITTALS**

- A. Contractor will provide shop drawings and manufacturers= standard specification data sheets on all hardware and software to be provided.
  - 1. Project Record Drawings - As built version of the submittal shop drawings.
  - 2. Testing and Commissioning Reports and Checklists.
  - 3. Operating and Maintenance (O & M) Manual - These will be as-built versions of the submittal product data.

**1.05 WARRANTY**

- A. Labor & materials for control system specified will be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. Control System failures during the warranty period will be adjusted, repaired, or replaced at no charge or reduction in service to the Owner.

**PART 2 PRODUCTS**

**2.01 BUILDING CONTROLLERS**

- A. General - The Building Automation System will be composed of one or more independent, stand-alone, microprocessor-based Building Controllers to manage the global strategies described in System software section. Data will be shared between networked Building Controllers.
  - 1. The controller will provide a communications port for connection to existing network.
  - 2. The Building Controller will be an Apogee Mechanical Equipment Controller of a TX10 Controller.
  - 3. The building controller shall include an operator interface for access to all functions defined in section 2.03.
- B. Memory. The Building Controller will maintain all BIOS and programming information in the event of a power loss for at least 72 hours.

## **2.02 CUSTOM APPLICATION CONTROLLERS**

- A. General - The Building Automation System will be composed of one or more independent, stand-alone, microprocessor-based Building Controllers to manage the local strategies described in System software section. Data will be shared between networked Controllers. The operating system of the Controller will manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
  - 1. Controller hardware will be suitable for the anticipated ambient conditions. Controllers used outdoors and/or in wet ambient will be mounted within NEMA Type 4 waterproof enclosures, and will be rated for operation at -40 F to 150 F. Controller used in conditioned ambient will be mounted in dust-proof enclosures, and will be rated for operation at 32 F to 120 F.
  - 2. Provide RS-232 connection for access to handler controller. Configure database so that HVAC technician may scroll through current status of all inputs and outputs and access local control of outputs for trouble shooting purposes. Provide password protection for all command procedures.

## **2.03 APPLICATION SPECIFIC CONTROLLERS**

- A. General – Terminal Equipment Controllers (TEC) are microprocessor-based DDC controllers which through hardware or firmware design are dedicated to control a specific piece of equipment. They are not fully user programmable, but are customized for operation within the confines of the equipment they are designed to serve. Each TEC will be capable of stand-alone operation and will continue to provide control functions without being connected to the network.
- B. Environment - Controllers used outdoors and/or in wet ambient will be mounted within NEMA Type 4 waterproof enclosures, and will be rated for operation at -40 F to 150 F. Controller used in conditioned ambient will be mounted in dust-proof enclosures, and will be rated for operation at 32 F to 120 F.

## **2.04 COMMUNICATIONS**

- A. The design of the BMS shall support networking of operator workstations and Building Controllers. The network architecture shall consist of two levels, an Ethernet based primary network for all operator workstations, servers, and primary DDC controllers along with secondary Floor Level Networks (FLN) for terminal equipment application specific controllers.

- B. Access to system data shall not be restricted by the hardware configuration of the building management system. The hardware configuration of the BMS network shall be totally transparent to the user when accessing data or developing control programs.
- C. Remote operator interface via a 9600 or faster baud modem will allow for communication with any and all controllers on this network. Communications services over the internetwork will result in operator interface and value passing that is transparent to the internetwork architecture.
- D. The time clocks in all controllers will be automatically synchronized daily.

## **2.05 AUXILIARY CONTROL DEVICES**

- A. Motorized dampers, unless otherwise specified elsewhere, will be as follows:
  - 1. Damper frames will be 16-gauge galvanized sheet metal or 1/8-inch extruded aluminum with reinforced corner bracing.
  - 2. Damper blades will not exceed 8 inches in width or 48 inches in length. Blades are to be suitable for medium velocity performance (2,000 fpm). Blades will be not less than 16 gauge.
  - 3. Damper shaft bearings will be as recommended by manufacturer for application.
  - 4. All blade edges and top and bottom of the frame will be provided with compressible seals. Side seals will be compressible stainless steel. The blade seals will provide for a maximum leakage rate of 10 CFM per square foot at 2.5" w.c. differential pressure.
  - 5. All leakage testing and pressure ratings will be based on AMCA Publication 500.
  - 6. Individual damper sections will not be larger than 48" x 60". Provide a minimum of one damper actuator per section.
- B. Control dampers will be parallel or opposed blade type as scheduled on drawings.
- C. Electronic damper actuators.
  - 1. The actuator will have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.
  - 2. Where indicated on the drawings or in the Sequence of Operations, for power-failure/safety applications, an internal mechanical, spring return mechanism will be built into the actuator housing.
  - 3. All rotary spring return actuators will be capable of both clockwise or counter clockwise spring return operation. Linear actuators will spring return to the retracted position.
  - 4. Proportional actuators will accept a 0-10 VDC or 0-20 ma control signal and provide a 2-10 VDC or 4-20 ma operating range.
  - 5. All 24 VAC/DC actuators will operate on Class 2 wiring and will not require more than 10 VA for AC or more than 8 W for DC applications. Actuators operating on 120 VAC or 230 VAC will not require more than 11 VA.
  - 6. All field installed non-spring return actuators will have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity will have a manual crank for this purpose.
  - 7. All field installed modulating actuators will have an external, built-in switch to allow the reversing of direction of rotation.
  - 8. All field installed actuators will be provided with a conduit fitting and a minimum 1m electrical cable and will be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
  - 9. All field installed actuators will be Underwriters Laboratories Standard 873 listed.

10. Actuators will be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque.
- D. Temperature Sensors:
1. Temperature sensors will be Resistance Temperature Device (RTD) or Thermistor.
  2. Duct sensors in supply and return air will be rigid. Mixing sensors will be an averaging type with a minimum of 22 feet of length.
  3. Immersion sensors will be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.
  4. Space sensors will be equipped with set-point adjustment, and override switch as indicated in the sequence of operation.
- E. Humidity Sensors:
1. Duct and room sensors will have a sensing range of 20% to 80% with accuracy of "5% RH
  2. Duct sensors will be provided with a sampling chamber.
  3. Outdoor air humidity sensors will have a sensing range of 20% to 95% RH It will be suitable for ambient conditions of -40 F to 170 F.
  4. Humidity sensor's drift will not exceed 1% of full scale per year.
- F. Static Pressure Sensors:
1. Sensor will have linear output signal. Zero and span will be field-adjustable.
  2. Sensor sensing elements will withstand continuous operating conditions plus or minus 50% greater than calibrated span without damage.
- G. Low Limit Thermostats:
1. Safety low limit thermostats will be vapor pressure type with an element 20 ft minimum length. Element will respond to the lowest temperature sensed by any one-foot section.
  2. Low limit will be manual reset only. Low Limit will shut down unit through starter regardless of position of hand-off-auto switch. Low limit will also provide indication to the air handler controller for alarming through the DDCS.
- H. Relays:
1. Control relays will be UL listed plug-in type with dust cover unless mounted in an enclosure. Contact rating, configuration, and coil voltage suitable for application.
  2. Time delay relays will be UL listed solid-state plug-in type with adjustable time delay. Delay will be adjustable plus or minus 200% (minimum) from set-point shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA 1 Type enclosure when not installed in local control panel.
- I. Transformers and Power Supplies:
1. Control transformers will be UL listed, Class 2 current-limiting type, or will be furnished with over-current protection in both primary and secondary circuits for Class 2 service.
  2. Unit output will match the required output current and voltage requirements. Current output will allow for a 50% safety factor. Output ripple will be 3.0 mV maximum Peak-to-Peak. Regulation will be 0.10% line and load combined, with 50 microsecond response time for 50% load changes. Unit will have built-in over-voltage protection.
- J. Current Switches:

1. Current-operated switches will be self-powered, solid state with adjustable trip current. The switches will be selected to match the current of the application and output requirements of the DDC system.
- K. Local Control Panels:
1. All indoor control cabinets will be fully enclosed NEMA 1 Type construction with key-lock latch, removable sub-panels.
  2. Interconnections between internal and face-mounted devices pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections will be UL listed for 600-volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection will be individually identified per control drawings.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION REQUIREMENTS**

- A. All electrical work, including but not limited to installation of conduit, performed in the installation of the DDCS/ATC system as described in this specification will be per the National Electrical Code (NEC) and per applicable state and local codes. Where exposed, conduit will be run parallel to building lines properly supported and sized at a maximum of 40% fill.
- B. In no cases will field installed conduit smaller than ¾" trade size be allowed. Where conductors are concealed (tenant spaces), cable rated for use in return air plenums will be used and properly supported from J-hooks. All conduit shall be installed per Division 26.
- C. Follow manufacturer's instructions for interlocking unit controls to campus automation system.

#### **3.02 SEQUENCE OF OPERATIONS – REFER TO DRAWINGS**

**END OF SECTION**

**SECTION 23 2113  
HYDRONIC PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Basic Requirements for Hydronic Piping and Valves for the Heating, Ventilating, and Air Conditioning Controls.

**1.02 RELATED SECTIONS**

- A. Section 23 0500 - Common Work Results for Heating, Ventilating, and Air Conditioning.
- B. Section 23 0548 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- C. Division 22 - All Sections.

**1.03 REFERENCES**

- A. ANSI/ASME - Boiler and Pressure Vessel Code.
- B. ANSI/ASME Sec 9 - Welding and Brazing Qualifications.
- C. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.
- D. ANSI/ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.
- E. ANSI/ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
- F. ANSI/ASME B31.9 - Building Services Piping.
- G. ANSI/AWS A5.8 - Brazing Filler Metal.
- H. ANSI/AWS D1.1 - Structural Welding Code.
- I. ANSI/AWWA C110 - Ductile - Iron and Gray - Iron Fittings 3 in. through 48 in., for Water and Other Liquids.
- J. ANSI/AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings.
- K. ANSI/AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- L. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- M. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- N. ASTM B32 - Solder Metal.
- O. ASTM B88 - Seamless Copper Water Tube.



#### **1.04 REGULATORY REQUIREMENTS**

- A. Conform to ANSI/ASME B31.9.

#### **1.05 QUALITY ASSURANCE**

- A. Welding Materials and Procedures: Conform to ANSI/ASME SEC 9 and applicable state labor regulations.
- B. Welders Certification: In accordance with ANSI/ASME SEC 9 and ANSI/AWS D1.1.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to site under provisions of Section 23 0500.
- B. Store and protect products under provisions of Section 23 0500.
- C. Deliver and store valves in shipping containers with labeling in place.

### **PART 2 PRODUCTS**

#### **2.01 PIPING**

- A. HEATING WATER PIPING
  - 1. Steel Pipe: ASTM A53 or A120, Schedule 40, for sizes 2-1/2 inches and over, black. Provide factory applied Epoxy protective coating for all buried piping.
    - a. Fittings: ANSI/ASTM B16.3, malleable iron or ASTM A234, forged steel welding type
    - b. Joints: Screwed, or ANSI/AWS D1.1, welded.
  - 2. Copper Tubing: ASTM B88, Type L, hard drawn, for sizes 2 inches and under.
    - a. Fittings: ANSI/ASME B16.23 cast brass or ANSI/ASME B16.29 solder wrought copper.
    - b. Joints: ASTM B32, solder, Grade 95TA.
- B. CHILLED WATER PIPING, ABOVE GRADE
  - 1. Steel Pipe: ASTM A53 or A120, Schedule 40, for sizes 2-1/2 inches and over, black.
    - a. Fittings: ANSI/ASTM B16.3, malleable iron or ASTM A234, forged steel welding type. Joints: Screwed for pipe 2 inch and under; ANSI/AWS D1.1 welded for pipe over 2 inch.
  - 2. Copper Tubing: ASTM B88, Type L, hard drawn for sizes 2 inches and smaller.
    - a. Fittings: ANSI/ASME B16.23 cast brass or ANSI/ASME B16.29 solder wrought copper.
    - b. Joints: ASTM B32, solder, Grade 95TA.
- C. CONDENSING WATER PIPING
  - 1. Steel Pipe: ASTM A53 or A120, Schedule 40, for sizes 2-1/2 inches and over, black.
    - a. Fittings: ANSI/ASTM B16.3, malleable iron or ASTM A234, forged steel welding type. Joints: Screwed for pipe 2 inch and under; ANSI/AWS D1.1 welded for pipe over 2 inch.
- D. EQUIPMENT DRAINS AND OVERFLOWS
  - 1. Copper Tubing: ASTM B88, Type M, hard drawn.

- a. Fittings: ANSI/ASME B16.23 cast brass, or ANSI/ASME B16.29 solder wrought copper.
  - b. Joints: ASTM B32, solder, Grade 95TA.
- E. FLANGES, UNIONS, AND COUPLINGS
  - 1. Pipe Size 2-Inches and Smaller: Bronze for copper or brass pipe soldered joints.
  - 2. Pipe sizes 2-1/2 Inches through 3-Inches: Cast brass flange type with gasket.
  - 3. Pipe Sizes 4 Inches and Larger: Forged steel, weld neck, flanged unions with gasket.
  - 4. Provide dielectric unions for connections joining dissimilar metals.

## 2.02 PIPING SPECIALTIES

- A. MANUFACTURED PIPING SPECIALTIES
  - 1. General: Provide factory-fabricated piping specialties recommended by manufacturer for use in service indicated. Provide piping specialties of types and pressure ratings indicated for each service, or if not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's option.
  - 2. Pipe Escutcheons:
    - a. General: Provide pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings, and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.
    - b. Pipe Escutcheons for Moist and Wet Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.
    - c. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.
  - 3. Low Pressure Y-Type Pipeline Strainers:
    - a. General: Comply with FCI 73-1. Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 125 psi working pressure, with Type 304 stainless steel screens, with 3/64-inch perforations at 233 sq. in. Mechanical grooved type strainer may be used in grooved piping system.
    - b. Threaded ends, 2 Inches and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.
    - c. Flanged Ends, 2-1/2 Inches and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.
    - d. Available Manufacturers: Subject to compliance with requirements, manufacturers offering low pressure Y-type strainers which may be incorporated in the work include, but are not limited to, the following:  
 American Air Filter, an Allis-Chalmers Co.  
 Armstrong Machine Works.  
 Hoffman Specialty, ITT Fluid Handling Div.  
 Metraflex Co.  
 Sarco Co., Div. of White Consolidated.  
 Trerice (H.O.) Co.  
 Victaulic Co. of America

4. High Pressure Y-Type Pipeline Strainers:
  - a. General: Comply with FCI 73-1. Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 250 psi working pressure, with Type 304 stainless steel screens, with 3/64" perforations at 233 sq. in. Mechanical grooved type strainer may be used in grooved piping systems.
  - b. Threaded Ends, 2 Inches and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.
  - c. Flanged Ends, 2-1/2 Inches and Larger: Cast-iron body, bolted steel retainer with off-center blowdown fitted with pipe plug.
  - d. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high pressure Y-type strainers which may be incorporated in the work include, but are not limited to, the following:  
 American Air Filter, an Allis-Chalmers Co.  
 Armstrong Machine Works.  
 Hoffman Specialty, ITT Fluid Handling Div.  
 Metraflex Co.  
 Sarco Co., Div. of White Consolidated.  
 Trerice (H.O.) Co.  
 Victaulic Co. of America
5. Dielectric Unions:
  - a. General: Provide standard products recommended by manufacturer for use in service indicated, which effectively isolates ferrous from non-ferrous piping (electrical conductance), prevent galvanic action, and stop corrosion.
  - b. Available Manufacturers: Subject to compliance with requirements, manufacturers offering dielectric unions which may be incorporated in the work include, but are not limited to, the following:  
 Atlas Products Co.  
 Capital Mfg. Co., Div. of Harsco Corp.  
 Eclipse, Inc.  
 Epco Sales, Inc.  
 FMC Corp.  
 McNally, Inc.  
 PSI Industries.  
 Stockham Valves and Fittings.

**B. FABRICATED PIPING SPECIALTIES**

1. Drip Pans: Provide drip pans fabricated from not less than 18-gauge corrosion-resistant sheet metal with watertight joints, and with edges turned up 2-1/2 inches. Reinforce top, either by structural angles or by rolling top over 1/4-inch steel rod. Provide hole, gasket, and flange at low point for watertight joint and 1" drain line connection.
2. Pipe Sleeves: Provide pipe sleeves of one of the following:
  - a. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gauges: 3 inches and smaller, 20-gauge; 4 inches to 6 inches, 16-gauge; over 6 inches, 14-gauge.
  - b. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.
  - c. Iron-Pipe: Fabricate from cast-iron or ductile-iron pipe, remove burrs.
3. Sleeve Seals: Provide sleeve seals for sleeves located in foundation walls below grade, or in exterior walls, of one of the following:
  - a. Lead and Oakum: Caulked between sleeve and pipe.

- b. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
- 4. Available Manufacturers: Subject to compliance with requirements, manufacturers offering mechanical sleeve seals which may be incorporated in the work include, but are not limited to following:  
Thunderline Corp.

## **2.03 VALVES**

- A. General: Provide factory-fabricated valves recommended by manufacturer for use in service indicated. Provide valves of types and pressure ratings indicated; provide proper selection as determined by Installer to comply with installation requirements. Provide sizes as indicated, and connections which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's option.

## **2.04 GATE VALVES**

- A. Packing: Select valves designed for repacking under pressure when fully opened, equipped with packing suitable for intended service. Select valves designed so back seating protects packing and stem threads from fluid when valve is fully opened, and equipped with gland follower.
- B. Comply with the following standards.
  - 1. Cast-Iron Valves: MSS SP-70.
  - 2. Bronze Valves: MSS SP-80.
  - 3. Steel Valves: ANSI B16.34.
- C. For HVAC Hot and Chilled Water Service:
  - 1. Threaded Ends 2 inches and smaller: Class 150, bronze body, union bonnet, rising stem, solid wedge, Milwaukee 1151.
  - 2. Flanged Ends 2-1/2 inches and larger: Class 125, iron body bronze mounted, bolted bonnet, rising stem, OS&Y, solid wedge, Milwaukee F-2886M.
- D. Available Manufacturers: Subject to compliance with requirements, manufacturers offering gate valves which may be incorporated in the work include, but are not limited to, the following:
  - 1. Milwaukee Valve Company.
  - 2. Powell (Wm.) Co.
  - 3. Stockham Valves and Fittings, Inc.

## **2.05 GLOBE VALVES**

- A. Packing: Select valves designed for repacking under pressure when fully opened, equipped with packing suitable for intended service. Select valves designed so back seating protects packing and stem threads from fluid when valve is fully opened, and equipped with gland follower.
- B. Composition Discs: Where required, provide suitable material for intended service. For stem throttling service, fit composition disc valve with throttling nut. For metal-seated globe valves, provide hardened stainless-steel disc and seat ring.

- C. Comply with the following standard:
  - 1. Cast-Iron Valves: MSS SP-85.
  - 2. Bronze Valves: MSS SP-80.
  - 3. Steel Valves: ANSI B16.34.
- D. For HVAC Hot and Chilled Water Service:
  - 1. Threaded Ends 2 inches and smaller: Class 150, bronze body, union bonnet, rising stem, composition disc.
  - 2. Flanged Ends 2-1/2 inches and larger: Class 125, iron body, bolted bonnet, rising stem, OS&Y, renewable seat, and disc.
- E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering globe valves which may be incorporated in the work include, but are not limited to, the following:
  - 1. Milwaukee Valve Company.
  - 2. Powell (Wm.) Co.
  - 3. Stockham Valves and Fittings, Inc.

## **2.06 DRAIN VALVES**

- A. For Low Pressure Drainage Service:
  - 1. Threaded Ends 2 Inches and Smaller: Class 125, bronze body, screwed bonnet, rising stem, composition disc, 3/4-inch hose outlet connection, Milwaukee 1152M.
  - 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering drain valves which may be incorporated in the work include, but are not limited to, the following:
    - a. Milwaukee Valve Company.
    - b. Powell (Wm.) Co.
    - c. Stockham Valves and Fittings, Inc.

## **2.07 BALL VALVES**

- A. General: Select with port area equal to or greater than connecting pipe area, include seat ring designed to hold sealing material.
- B. Comply with the following standards:
  - 1. Steel Valves: ANSI B16.34.
- C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering ball valves which may be incorporated in the work include, but are not limited to the, the following:
  - 1. Milwaukee Valve Company.
  - 2. Powell (Wm.) Co.
  - 3. Stockham Valves and Fittings, Inc.

## **2.08 SWING CHECK VALVES**

- A. General: Construct pressure containing parts of valves as follows:
  - 1. Bronze Valves, 125 or 150 psi: ANSI/ASTM B62.
  - 2. Metallic Seated Bronze Valves, 200 or 300 psi: ANSI/ASTM B61.
  - 3. Iron Body Valves: ANSI/ASTM A126, Grade B.
- B. Comply with MSS SP-71 for design, workmanship, material, and testing.

- C. Construct valves of pressure castings free of any impregnating materials.
- D. Construct valves of bronze, regrinding, with seating angle 40 degrees to 45 degrees, unless composition disc is specified.
- E. Provide stop plug as renewable stop for disc hanger, unless otherwise specified.
- F. Construct disc and hanger as separate parts, with disc free to rotate.
- G. Support hanger pins on both ends by removable side plugs.
- H. Install spring loaded check valves on discharge of all pumps.
- I. For HVAC Hot and Chilled Water Service:
  - 1. Threaded Ends 2 inches and smaller: Class 125, bronze body, screwed cap, horizontal switch, bronze disc, Milwaukee 509.
  - 2. Flanged Ends 2-1/2 inches and larger: Class 125, iron body bronze mounted, bolted cap, horizontal swing, cast-bronze disc, Milwaukee 2974.
- J. Available Manufacturers: Subject to compliance with requirements, manufacturers offering swing check valves which may be incorporated in the work include, but are not limited to, the following:
  - 1. Milwaukee Valve Company
  - 2. Powel Co (The Wm.)
  - 3. Stockham Valves and Fittings, Inc.

## **2.09 BUTTERFLY VALVES**

- A. Butterfly valves in chilled water supply and return piping, where shown on plans, shall be Demco Series NE, Milwaukee "M" Series, or approved equal. Ductile iron lug type body drilled and tapped for cap screws. Aluminum bronze disc; 416 stainless steel stems; Buna-N stem seals; Buna-N seat, field renewable type. Neck to provide handles or actuator clearance over 2 inches thick line insulation. Furnish set of ASA 150 Weld-Neck flanges and cap-screws for each valve. Valves shall have gear type handle.

## **2.10 VALVE FEATURES**

- A. General: Provide valves with features indicated and, where not otherwise indicated, provide proper valve features as determined by Installer for installation requirements. Comply with ANSI B31.1.
- B. Bypass: Comply with MSS SP-45, and except as otherwise indicated provide manufacturer's standard bypass piping and valving.
- C. Drain: Comply with MSS SP-45, and provide threaded pipe plug complying with Division-15 "Pipe, Tube, and Fittings" section.
- D. Flanged: Valve flanges complying with ANSI B16.5 (steel) or ANSI B16.24 (bronze).
- E. Threaded: Valve ends complying with ANSI B2.1.
- F. Butt-Welding: Valve ends complying with ANSI B16.25.

- G. Flangeless: Valve bodies manufactured to fit between flanges complying with ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).
- H. Wafer: Flangeless valves.
- I. Trim: Fabricate pressure-containing components of valve, including stems (shafts) and seats from brass or bronze materials, of standard alloy recognized in valve manufacturing industry.
- J. Non-Metallic Disc: Non-metallic material selected for service indicated in accordance with manufacturer's published literature.
- K. Renewable Seat: Design seat of valve with removable disc, and assembly valve so disc can be replaced when worn.
- L. Extended Stem: Increase stem length by 2 inches minimum, to accommodate insulation applied over valve.
- M. Mechanical Actuator: Factory-fabricated gears, gear enclosure, external chain attachment, and chain designed to provide mechanical advantage in operating valve.
- N. Bonnet: Part of gate or globe valve through which stem passes to valve body, and attached to valve body by screws, bolts, union, or welding.
- O. Solid Wedge: One-piece tapered disc in gate valve, designed for contact on both sides.
- P. Outside Screw and Yoke: Stem and handwheel designed to rise out of bonnet or yoke as valve is operated from closed to open position.

## **2.11 PLUG VALVES (COCKS)**

- A. Valve body shall be screw pattern, iron, except that sizes 1-1/4 inches through 2 inches shall be semi-steel, rated for 125 psig, non-shock W.O.G. operating pressure.
- B. Plug shall be tapered, lubricated brass with square head operator.
- C. APPROVED MANUFACTURERS
  - 1. 1-inch and smaller - A. Y. McDonnell Manufacturing Company #10686.
  - 2. 1-1/4 inches through 1-1/2 inches - Nordstrom #114.
  - 3. 2-1/2 inches and larger - Nordstrom #115.
  - 4. Architect Approved.

## **2.12 PRESSURE RELIEF VALVES**

- A. Body: Bronze or iron with testing lever.
- B. Trim: Bronze or stainless steel.
- C. Construction: Comply with ASME Code for Pressure Vessels, Section VIII and shall bear ASME stamp.
- D. Maximum Permissible over Pressure: 25 percent (water).
- E. APPROVED MANUFACTURERS

1. Bell and Gossett.
2. McDonnell Miller.
3. Kunkle Valve Company.

## **2.13 PRESSURE REDUCING VALVES**

- A. Body: Cast iron.
- B. Trim: Bronze.
- C. Rating: 125 psig working pressure at 200 degrees F.
- D. Operator: Spring loaded diaphragm with adjustable range.
- E. Diaphragms and Disc: Nitrile.
- F. Pressure Reducing Valves - Water Service:
  1. Spence Regulators - Type D 34.
  2. Watts Regulators.
  3. Architect Approved.

## **2.14 BACK FLOW PREVENTERS**

- A. Reduced pressure type. Rated 175 psig at 140 degrees F, manufactured in the United States of America.
- B. Body:
  1. Bronze construction.
  2. Bronze body test cocks.
  3. NPT body connections.
  4. Non-rising stem gate valves.
- C. Check Valve:
  1. Celcon seats.
  2. Rubber check valve.
- D. Relief Valve:
  1. Stainless steel seat.
  2. Stainless steel shaft and flange bolts.

## **2.15 APPROVED MANUFACTURERS**

- A. Watts Regulator Series 909-SAG.
- B. Wilkins Regulators.
- C. Febco.

## **2.16 HORIZONTAL-PIPING HANGERS AND SUPPORTS**

- A. General: Except as otherwise indicated, provide factory-fabricated horizontal-piping hangers and supports complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one



manufacturer for each piping service. Select size of hangers and supports to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.

- B. Adjustable Steel Clevises: MSS Type 1.
- C. Steel Double Bolt Pipe Clamps: MSS Type 3.
- D. Adjustable Swivel Pipe Rings: MSS Type 6.
- E. Split Pipe Rings: MSS Type 11.
- F. Extension Split Pipe Clamps: MSS Type 12.
- G. Pipe Saddle Supports: MSS Type 36, including steel pipe base support and cast-iron floor flange.
- H. Pipe Stanchion Saddle: MSS Type 37, including steel pipe base support and cast-iron floor flange.
- I. Adjustable Pipe Saddle Supports: MSS Type 38 including steel pipe base support and cast-iron floor flange.
- J. Single Pipe Rolls: MSS Type 41.
- K. Adjustable Roller Hangers: MSS Type 43.

## **2.17 VERTICAL-PIPING CLAMPS**

- A. General: Except as otherwise indicated, provide factory-fabricated vertical-piping clamps complying with ANSI/MSS SP-58, of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.
- B. Two-Bolt Riser Clamps: MSS Type 8.
- C. Four-Bolt Riser Clamps: MSS Type 42.

## **2.18 HANGER-ROD ATTACHMENTS**

- A. General: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.
- B. Steel Turnbuckles: MSS Type 13.
- C. Swivel Turnbuckles: MSS Type 15.

- D. Malleable Iron Sockets: MSS Type 16.
- E. Steel Weldless Eye Nuts: MSS Type 17.

## **2.19 BUILDING ATTACHMENTS**

- A. General: Except as otherwise indicated, provide factory-fabricated building attachments complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.
- B. Concrete Inserts: MSS Type 18.
- C. Top Beam C-Clamps: MSS Type 19.
- D. Side Beam or Channel Clamps: MSS Type 20.
- E. Center Beam Clamps: MSS Type 21.
- F. C-Clamps: MSS Type 23.
- G. Top I-Beam Clamps: MSS Type 25.
- H. Side I-Beam Clamps: MSS Type 27.
- I. Steel I-Beam Clamps with Eye Nut: MSS Type 28.
- J. Steel WF-Beam Clamps with Eye Nut: MSS Type 29.
- K. Malleable Beam Clamps: MSS Type 30.
- L. Steel Brackets: One of the following for indicated loading:
  - Light Duty: MSS Type 31.
  - Medium Duty: MSS Type 32.
  - Heavy Duty: MSS Type 33.

## **2.20 SADDLES AND SHIELDS**

- A. General: Except as otherwise indicated, provide saddles or shields for piping hangers and supports, factory-fabricated, for all insulated piping. Side saddles and shields for exact fit to mate with pipe insulation.
- B. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.
- C. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.

## **2.21 MANUFACTURERS OF HANGERS AND SUPPORTS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering hangers and supports which may be incorporated in the work include, but are not limited to the following:

C & S Mfg. Corp.  
Carpenter and Patterson, Inc.  
Elcen Metal Products Co.  
F & S Central Mfg. Corp.  
ITT Grinnell Corp.

## **2.22 MISCELLANEOUS MATERIALS**

- A. Metal Framing: Provide products complying with NEMA Std. ML 1.
- B. Steel Plates, Shapes and Bars: Provide products complying with ANSI/ASTM A36.
- C. Cement Grout: Portland cement (ANSI/ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ANSI/ASTM C404, Size No. 2). Mix at a ratio of 1.0-part cement to 3 parts sand, by volume, with minimum amount of water required for placement and hydration.
- D. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for load required; weld steel in accordance with AWS standards.
- E. Pipe Guides: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of a bolted two-section outer cylinder and base with a two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), by cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. After completion, fill, clean, and treat systems. Refer to Section 23 0500.

### **3.02 INSTALLATION**

- A. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.
- B. Install piping to conserve building space, and not interfere with use of space and other work.
- C. Group piping whenever practical at common elevations.
- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 0500.
- E. Provide clearance for installation of insulation, and access to valves and fittings.

- F. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors.
- G. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- I. Prepare pipe, fittings, supports, and accessories for finish painting. Refer to Section 09 9000.
- J. Install valves with stems upright or horizontal, not inverted.

### **3.03 APPLICATION**

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
- C. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- D. Install spring loaded check valves on discharge of all pumps.
- E. Use plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.
- F. Use lug end butterfly valves as indicated.
- G. Provide 3/4-inch gate drain valves at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest drain.
- H. The Contractor may at his option use copper pipe hydronic piping systems up through 3 inches, provided it conforms to this specification.

### **3.04 COPPER PIPE CONNECTIONS**

- A. Form hot brazed joints in copper, brass, or bronze fittings with lead-free solder.
- B. Make connections to equipment and branch mains with unions.
- C. Provide adapters in lines for valves and equipment. Bushings are not acceptable.
- D. Provide water seal trap in drain near equipment. Pipe drain to nearest floor drain.

### **3.05 WELDED PIPE**

- A. Bevel pipe ends at a 37.5-degree angle where possible, smooth rough cuts, and clean to remove slag, metal particles and dirt.
- B. Install welding rings and backing for each welded joint. Ring shall be as manufactured by Tube Turn, Inc., or approved equal.

- C. Use pipe clamps or tack-weld joints with 1-inch-long welds; 4 welds for pipe sizes to 10 inches, 8 welds for pipe sizes 12 inches to 30 inches.
- D. Build up welds with stringer-bead pass, followed by hot pass, followed by cover or filler pass. Eliminate valleys at center and edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow-holes and non-metallic inclusions.
- E. Do not weld-out piping system imperfections by tack-welding procedures; re-fabricate to comply with requirements.
- F. Tees may be formed with Weld-O-Lets into mains or risers where branches are one-half or less than one-half the diameter of main or riser. Factory made fittings must be used for all larger branches.

### **3.06 FLANGED JOINTS**

- A. Match flanges within piping system, and at connections with valves and equipment.
- B. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.

### **3.07 INSTALLATION OF MANUFACTURED PIPING SPECIALTIES**

- A. Pipe Escutcheons: Install pipe escutcheons on each pipe penetration through floors, walls, partitions, and ceilings where penetration is exposed to view; and on exterior of building. Secure escutcheon to pipe or insulation so escutcheon covers penetration hole, and is flush with adjoining surface.
- B. Y-Type Strainers: Install Y-type strainers full size of pipeline, in accordance with manufacturer's installation instructions. Install pipe nipple and shutoff valve in strainer blow down connection, full size of connection, except for strainers 2 inches and smaller installed ahead of control valves feeding individual terminals. Where indicated, provide drain line from shutoff valve to plumbing drain, full size of blow down connection.
  - 1. Locate Y-type strainers in supply line ahead of the following equipment, and elsewhere as indicated, if integral strainer is not included in equipment.
    - Pumps.
    - Steam traps serving steam main drips.
    - Temperature control valves.
    - Pressure reducing valves.
    - Temperature or pressure regulating valves.
- C. Dielectric Unions: Install at each piping joint between ferrous and non-ferrous piping. Comply with manufacturer's installation instructions.

### **3.08 INSTALLATION OF FABRICATED PIPING SPECIALTIES**

- A. Drip Pans: Locate drip pans under piping passing over or within 3' horizontally of electrical equipment, and elsewhere as indicated. Hang from structure with rods and building attachments, weld rods to sides of drip pan. Brace to prevent sagging or swaying. Connect 1 inch drain line to drain connection, and run to nearest plumbing drain or elsewhere as indicated.

- B. Sleeves: Install pipe sleeves of types indicated where piping passes through walls, floors, ceilings, and roofs. Do not install sleeves through structural members of work, except as detailed on drawings, or as reviewed by Architect/Engineer. Install sleeves accurately centered on pipe runs. Size sleeves so that piping and insulation (if any) will have free movement in sleeve, including allowance for thermal expansion; but not less than 2 pipe sizes larger than piping run. Where insulation includes vapor-barrier jacket, provide sleeve with sufficient clearance for installation. Install length of sleeve equal to thickness of construction penetrated, and finish flush to surface except floor sleeve. Extend floor sleeves 1/4 inch above level floor finish, and 3/4 inch above floor finish sloped to drain. Provide temporary support of sleeves during placement of concrete and other work around sleeves, and provide temporary closure to prevent concrete and other materials from entering sleeves.
1. Install sheet-metal sleeves at interior partitions and ceilings other than suspended ceilings.
  2. Install iron-pipe sleeves at exterior penetrations, both above and below grade.
  3. Install steel-pipe sleeves except as otherwise indicated.
- C. Sleeve Seals: Install in accordance with the following:
1. Mechanical Sleeve Seals: Loosely assemble rubber links around pipe with bolts and pressure plates located under each bolt head and nut. Push into sleeve and center. Tighten bolts until links have expanded to form watertight seal.

### **3.09 VALVE INSTALLATION**

- A. General: Except as otherwise indicated, comply with the following requirements.
1. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.
  2. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward for horizontal plane unless unavoidable. Install valve drains with hose-end adapter for each valve that must be installed with stem below horizontal plane.
- B. Insulation: Where insulation is indicated, install extended-stem valves, arranged in proper manner to receive insulation.
- C. Applications Subject to Shock: Install valves with bodies of metal other than cast iron where thermal or mechanical shock is indicated or can be expected to occur.
- D. Applications Subject to Corrosion: Do not install bronze valves and valve components in direct contact with steel, unless bronze and steel are separated by dielectric insulator. Install bronze valves in steam and condensate service and in other services where corrosion is indicated or can be expected to occur.
- E. Mechanical Actuators: Install mechanical actuator with chain operators where indicated, and where valves 4" and larger are mounted more than 7'-0" above floor in mechanical rooms, boiler rooms; and where recommended by valve manufacturer because of valve size, pressure differential or other operating condition making manual operation difficult.
- F. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select and install valves with the following ends or types of pipe/tube connections.
1. Pipe Size 2 inches and smaller: One of the following, at Installer's option:
    - a. Threaded valves.

- b. Grooved-end valves (Fire Protection Only).
    - c. Flanged valves.
  - 2. Pipe Size 2-1/2 inches and larger: One of the following, at Installer's option:
    - a. Grooved-end valves (Fire Protection Only).
    - b. Flanged valves.
- G. Valve System: Select and install valves with outside screw and yoke stems, except provide inside screw non-rising stem valves where headroom prevents full opening of OS&Y valves.
- H. Non-Metallic Disc: Limit selection and installation of valves with non-metallic discs to locations indicated and where foreign material in piping system can be expected to prevent tight shutoff of metal seated valves.
- I. Renewable Seats: Select and install valves with renewable seats except where otherwise indicated.
- J. Fluid Control: Except as otherwise indicated, install, gate, ball, globe and butterfly valves to comply with ANSI B31.1. Where throttling is indicated or recognized as principal reason for valve, install globe or butterfly valve.
- K. Installation of Check Valves:
  - 1. Swing Check Valves: Install in horizontal position with hinge pin horizontally perpendicular to center line of pipe. Install for proper direction of flow.
  - 2. Horizontal Lift Check Valve: Install in horizontal piping line with stem vertically upward, position for proper direction of flow.
  - 3. Vertical Lift Check Valve: Install in vertical piping line with upward flow with stem vertically upward.
  - 4. Spring Loaded Horizontal Lift Check Valve: Install in horizontal piping line with stem vertically upward, position for proper direction of flow.

### **3.10 BACKFLOW PREVENTER INSTALLATION**

- A. Install backflow preventers where shown on the plans with elbow and air gap, and as may be required to prevent cross contamination of potable water systems.
- B. Pipe discharge drain to nearest floor drain.

### **3.11 PREPARATION**

- A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.
- B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Architect/Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

### **3.12 INSTALLATION OF BUILDING ATTACHMENTS**

- A. Install building attachments at required locations, within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-59. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.

### **3.13 INSTALLATION OF HANGERS AND SUPPORTS**

- A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping, ductwork or other supported mechanical or electrical items.
  - 1. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.
  - 2. Support fire-water piping independently of other piping.
  - 3. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.
- B. Provisions for Movement:
  - 1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion bends and similar units.
  - 2. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
  - 3. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 are not exceeded.
- C. Insulated Piping: Comply with the following installation requirements.
  - 1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
  - 2. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold or chilled water piping, install galvanized coated protective shields. Install Foam-Glas insulation saddles.
  - 3. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.

### **3.14 INSTALLATION OF ANCHORS**

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.



- C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximum recommended by manufacturer for each unit.
- D. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

### **3.15 ADJUSTMENT OF HANGERS AND SUPPORTS**

- A. Adjust hangers and supports and place grout as required under supports to bring piping to proper levels and elevations.

### **3.16 EQUIPMENT BASES**

- A. Concrete housekeeping bases will be provided as work of Division 3. Furnish to Contractor, scaled layouts of all required bases with dimensions of bases, and location to column center lines. Furnish templates, anchor bolts, and accessories, necessary for base construction.
- B. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks mounted on steel stands. Structural steel stands to be supported from housekeeping pad bases. Steel supports shall not be allowed to be in direct contact with slab floors.

**END OF SECTION**

**SECTION 23 2114  
HYDRONIC SPECIALTIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Basic Requirements for Hydronic Specialties for Heating, Ventilating, and Air Conditioning System.

**1.02 RELATED SECTIONS**

- A. Section 23 0500 – Common Work Results for Heating, Ventilating, and Air Conditioning Controls.
- B. Section 23 0548 – Vibration and Seismic Controls for HVAC Piping and Equipment.
- C. Section 23 2113 – Hydronic Piping.

**1.03 QUALITY ASSURANCE**

- A. Manufacturers: Firms regularly engaged in manufacturer of hydronic specialties of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. ASTM Code: Comply with all ASTM codes pertaining to valves and tanks.
- C. MSS Standards: Valves and Fittings to comply with the Manufacturer's Standardization Society of the Valve and Fittings Industry.
- D. U.S.A.S.I. - Equipment provided under this section to comply with all applicable codes of the United States of America Standards Institute.
- E. ASME Code - Comply with requirements of the American Society of Mechanical Engineers "Boiler Construction and Unfired Pressure Vessel Code".

**1.04 SUBMITTALS**

- A. Product Data: Submit catalog cuts, specifications, installation instructions, and dimensioned drawings for each type of manufactured hydronic specialty. Include pressure drop curve or chart for each type and size of hydronic specialty. Submit schedule showing capacities, and features for each required hydronic specialty.
- B. Maintenance Data: Submit maintenance data and spare parts lists for each type of manufactured hydronic specialty. Include this data in Maintenance Manual.
- C. Hydronic Specialty Types: Provide hydronic specialties of same type by same manufacturer.

**PART 2 PRODUCTS**

**2.01 MANUFACTURED HYDRONIC SPECIALTIES**

- A. General: Provide factory-fabricated hydronic specialties recommended by manufacturer

for use in service indicated. Provide hydronic specialties of types, capacities, and pressure ratings indicated for each service, or if not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube, and equipment connections. Where more than one type cannot be used on project.

B. Balance Valves:

1. General: Provide balance valves as indicated, of one of the following types.
  - a. Threaded Ends 2 Inches and Smaller: Class 125, bronze body, ball type with memory stop, straight pattern.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering balance valves which may be incorporated in the work include, but are not limited to, the following:  
Bell & Gossett.  
ITT Fluid Handling Div.  
Hammond Valve Corp., Div. of Convall Corp.  
Illinois Products, American Air Filter Co., Inc.  
Milwaukee Valve Co., Inc.  
Sarco Co., Div. of White Consolidated.  
Taco, Inc.

C. Vent Valves:

1. Manual Vent Valves: Provide manual vent valves designed to be operated manually with screwdriver or thumbscrew, 1/8-inch N.P.T. connection; 1/4-inch NPT connection for vent valves remote from point of venting.
2. Automatic Vent Valves: Provide automatic vent valves designed to vent automatically with float principle, stainless steel float and mechanisms, cast-iron body, pressure rated for 125 psi, 1/2-inch N.P.T. inlet and outlet connections.
3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering vent valves which may be incorporated in the work include, but are not limited to, the following:  
Armstrong Machine Works.  
Bell & Gossett, ITT Fluid Handling Div.  
Hoffman Specialty, ITT Fluid Handling Div.  
Sarco Co., Div. of White Consolidated.  
Wheatley.

D. Air Separators:

1. Furnish and install as shown on the drawings a Spirovent coalescing type or approved equal centrifugal type air separator on the hot and chilled water systems. Pipe size is not a factor in selecting air separators and appropriate reducers shall be furnished to connect to piping as shown on the drawing. All separators shall be fabricated steel, rated for 150 psig design pressure and be selected at their point of peak efficiency in accordance with manufacturer's published catalog data. Entering velocity at the pipe connections shall not exceed 2 feet per second at specified GPM for centrifugal type separators and 4 feet per second for coalescing type. Spirovent "HV" separators specifically designed for high velocity systems may have an entering velocity of up to 10 feet per second. Coalescing type separators shall include internal copper coalescing medium to reduce velocity, facilitate maximum air elimination and suppress turbulence. Centrifugal type shall have a 3:1 vessel diameter to pipe connection ratio to reduce velocity and be furnished with galvanized steel strainer and stainless-steel collector tube for air separation and collection. Provide integral high-capacity float actuated air vent at top fitting of tank. Alternates to integral

vent shall include cast iron float actuated air vent rated at 150 psig, which shall be threaded to the top of the separator. Unit shall have bottom blow down connection.

Spirovent.

Thrush

Taco, Inc.

Architect Approved Equal.

E. Diaphragm-Type Compression Tanks:

1. Construction: Welded steel, tested and stamped in accordance with Section 8D of ANSI/ASME Code; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles. Bladder shall be replaceable. Tank sized for partial acceptance.
2. Accessories: Pressure gage and air-charging fitting, tank drain; precharge to 12 psig.
3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering compression tanks and tank fittings which may be incorporated in the work include, but are not limited to, the following:  
Wheatley  
Armstrong Pumps, Inc.  
Bell & Gossett, ITT Fluid Handling Div.  
Taco, Inc.  
Thrush Div.,

F. Shot Feeders:

1. General: Provide shot feeders of 5 gal. capacity or otherwise as indicated, constructed of cast iron or steel, for introducing chemicals in hydronic system. Provide funnel and valve on top for loading, drain valve in bottom, and recirculating valves on side. Construct for pressure rating of 125 psi.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering shop feeders which may be incorporated in the work include, but are not limited to, the following:  
Culligan USA.  
Vulcan Laboratories, Subsidiary of Clow Corp.  
Mogul

G. Water Relief Valves:

1. General: Provide water relief valves as indicated, of size and capacity as selected by Installer for proper relieving capacity, in accordance with ASME Boiler and Pressure Vessel Code.
  - a. Pressure Relief Valves: Bronze body, test lever, A.S.M.E. rated. Provide pressure relief at 30 psi, or as noted on flow diagrams.
2. Available Manufacturers: Subject to Compliance with requirements, manufacturers offering water relief valves which may be incorporated in the work include, but are not limited to, the following:  
Wheatley  
Bell & Gossett, ITT Fluid Handling Div.  
Sarco Co., Div. of White Consolidated.  
Watts Regulator Co.

H. Pressure Reducing Valves:

1. General: Provide pressure reducing valves as indicated, of size and capacity as selected by Installer to maintain operating pressure on boiler system.
2. Construction: Cast iron or brass body, low inlet pressure check valve, inlet

strainer removable without system shut-down, non-corrosive valve seat and stem, factory set at operating pressure.

3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering pressure reducing valves which may be incorporated in the work include, but are not limited to, the following:

Wheatley

Armstrong Pumps, Inc.

Bell & Gossett, ITT Fluid Handling Div.

Taco, Inc.

I. Flow Limiting Valves:

1. The automatic flow control valve shall be factory set to limit the flow rate as specified, regardless of system pressure fluctuation. The valve must be accurate within plus or minus 5 percent of the factory calibrated flow rate.
2. All internal working parts shall be passivated stainless steel. Plated internal parts are not acceptable. Body pressure tapings suitable for pressure and temperature gage installation and verification of pressure differential across valve orifice shall be provided.
3. The safe maximum working pressure and temperature of valve shall be 200 psi and 250 degrees F.
4. Available Manufacturers: Subject to compliance with requirements, manufacturers offering flow limiting valves which may be incorporated in the work include the following:  
Griswold.  
Architect approved equal.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION OF MANUFACTURED HYDRONIC SPECIALTIES**

A. Balance valves:

1. General: Install on each hydronic terminal and elsewhere as indicated. After hydronic system balancing has been completed, mark each balance valve with stripe or yellow lacquer across body and stop plate to permanently mark final balanced position.

B. Vent Valves:

1. Manual Vent Valves: Install manual vent valves on each hydronic terminal at highest point, and on each hydronic piping drop in direction of flow for mains, branches, and runouts, and elsewhere as indicated. Locate manual vent valves remote from vent point where indicated.
2. Automatic Vent Valves: Install automatic vent valves at top of each hydronic riser and elsewhere as indicated. Install shutoff valve between riser and vent valve, pipe outlet to suitable plumbing drain, or as indicated.

C. Air Separators:

1. Combination Separator/Strainer: Install external combination /strainers in pump suction lines. Connect inlet and outlet piping. Run piping to compression tank pitched towards tank at 1 inch rise in 5-foot run (1.7%). Install blowdown valve and piping. Remove and clean strainer after 25 hours and again after 30 days of system operation.

D. Compression Tanks:

1. General: Install compression tanks on housekeeping pad for tank fully loaded, or

otherwise as indicated. Install cocks on end of tank.

E. Shot Feeders:

1. General: Install shot feeders on each hydronic system at pump discharge and elsewhere as indicated. Install in upright position with top of funnel not more than 48 inches above floor. Install globe valve in pump discharge line between recirculating lines. Pipe drain to nearest plumbing drain or as indicated.

F. Water Relief Valves:

1. General: Install on hot water generators, and elsewhere as indicated. Pipe discharge to floor. Comply with ASME Boiler and Pressure Vessel Code.

G. Pressure Reducing Valves:

1. General: Install for each hot water boiler or heat exchanger as indicated, and in accordance with manufacturer's installation instructions.

H. Flow Limiting Valves:

1. Install where indicated on the drawings. Valve shall be tamperproof upon installation. Ensure valves are installed in proper direction of airflow.

**END OF SECTION**

**SECTION 23 2123  
HYDRONIC PUMPS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Basic Requirements for Hydronic Pumps for HVAC Systems.

**1.02 RELATED SECTIONS**

- A. Section 23 0500 – Common Work Results for Heating, Ventilating and Air Conditioning.
- B. Section 23 0548 – Vibration and Seismic Controls for HVAC Piping and Equipment.
- C. Section 23 2113 – Hydronic Piping.
- D. Division 23 – All Sections.

**1.03 REFERENCES**

- A. ANSI/UL 778 - Motor Operated Water Pumps.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer: Company specializing in manufacture, assembly and field performance of pumps, whose products have been in satisfactory use in similar service.
- B. Alignment: Base mounted pumps shall be aligned by qualified millwright and alignment certified.

**1.05 SUBMITTALS**

- A. Submit shop drawings and product data under provisions of 01 33 23 and Section 23 05 00.
- B. Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
- C. Submit manufacturer's installation instructions under provisions of Division 01.

**1.06 OPERATION AND MAINTENANCE DATA**

- A. Submit operation and maintenance data under provisions of Section 23 05 00.
- B. Include installation instructions, assembly views, lubrication instructions and replacement parts list.

**1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to site under provisions of Section 23 05 00.
- B. Store and protect products under provisions of Section 23 05 00.

**1.08 EXTRA PARTS**

- A. Provide one extra set of mechanical seals for each pump.

## **PART 2 PRODUCTS**

### **2.01 GENERAL CONSTRUCTION REQUIREMENTS**

- A. Balance: Rotating parts, statically and dynamically.
- B. Pump Motors: Operate at 1750 rpm unless specified otherwise.
- C. Pump Connections: Flanged.

### **2.02 SPLIT COUPLED BASE-MOUNTED END SUCTION PUMPS**

- A. The pump shall be single, end suction type with radically split, top center-line discharge, self-venting casing. The casing-to-cover gasket shall be confined on the atmospheric side to prevent blow-out possibility.
- B. Pump construction shall be cast iron, bronze fitted and shall be fitted with a long- life, product lubricated, drip-tight mechanical seal, with O-ring seat retainer, designed for the specified maximum temperature and pressure.
- C. The casing suction and discharge connections shall be the same size and shall be provided with drilled and tapped seal vent and pressure gauge connections.
- D. Pump impeller shall be stainless steel or bronze, fully enclosed type. Impeller shall be dynamically balanced.
- E. The shaft shall be fitted with a Stainless-Steel shaft sleeve and be supported by two heavy duty ball bearings. The design shall allow Back Pull-Out servicing, enabling the complete rotating assembly to be removed without disturbing the casing piping connections.
- F. The pump shall be mounted on a rigid, single piece baseplate, with grouting hole, and connected by flexible coupling with guard, to a 460U, 3 phase, inverter duty motor of Federal approved premium, efficiency level and suitable for across-the-line starting.
- G. The housing shall be hydrostatically tested to 150% maximum working pressure.
- H. The unit shall be suitable for the conditions shown on the pump schedule.

### **2.04 SPLIT COUPLED VERTICAL IN-LINE PUMPS**

- A. Pump casing shall be cast iron, suitable for 175 psi (1206 kPa) working pressure at 140°F (60°C). Ductile iron pump casings are suitable for pressures to 250 psi (1724 kPa). The casing shall be hydrostatically tested to 150% maximum working pressure. The pump internals shall be capable of being serviced without disturbing the pipe connections. The casing suction and discharge connections shall be the same size and shall be provided with drilled and tapped seal vent and pressure gauge connections.
- B. Pump impeller shall be stainless steel or bronze, fully enclosed type. Impeller shall be dynamically balanced.



- C. A bronze shaft sleeve, extending the full length of the mechanical seal area, shall be provided.
- D. Mechanical Seal shall be single spring inside type with carbon against Ceramic faces. EPDM elastomer with stainless steel spring and hardware shall be provided. Seal vent line shall be factory installed and shall be piped from the seal area to the pump suction connection.

## **2.05 BOILER CIRCULATION PUMPS**

- A. Pump casing shall be cast iron, suitable for 125 psi (862 kPa) working pressure at 210°F (99°C). The casing shall be hydrostatically tested to 150% maximum working pressure. The pump internals shall be capable of being serviced without disturbing the pipe connections. The flanged casing suction and discharge connections shall be the same size and shall be provided with drilled and tapped seal vent and pressure gauge connections where available.
- B. Pump impeller shall be non-metallic, as part of a self-lubricating replaceable cartridge design. Impeller shall be dynamically balanced. Entire cartridge shall be able to be replaced without removing the pump body from the piping connections.
- C. A ceramic shaft bearing shall be provided.

## **2.06 APPROVED MANUFACTURERS**

- A. Armstrong
- B. Bell & Gossett
- C. Taco
- D. Engineer Approved

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install pumps in accordance with manufacturer's instructions.
- B. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.
- C. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- D. Provide drains for bases and seals, piped to and discharging into floor drains.
- E. Lubricate pumps before start-up.
- F. Install base mounted pumps on concrete inertia base, with anchor bolts, set and level.
- G. Qualified millwright shall check, align, and certify base mounted pumps prior to start-up.

**END OF SECTION**



**SECTION 23 2500  
HVAC WATER TREATMENT**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. Chilled, condensing and heating water systems cleanout and preparation.
- B. Chilled, condensing and heating water systems treatment.

**1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Basic Mechanical Requirements - Section 23 0500.
- B. Testing, Adjusting and Balancing - Section 23 0593.

**1.03 COORDINATION**

- A. All power, motor and interlock wiring required for solution pumps, timers, monitors, etc., shall be furnished, whether shown or not, at no additional cost.
- B. Coordinate exact locations and power requirements with the electrical contractor and other trades as required to avoid omissions or conflicts.
- C. Mechanical contractor shall install all equipment. Water treatment contractor shall supervise the cleaning of hydronic and steam piping systems. Provide certification for each system when cleanout is completed.

**1.04 QUALITY ASSURANCE**

- A. Chemicals, service and equipment shall be supplied by a single water treatment company for undivided responsibility.
- B. The bid for chemicals, service and equipment shall be as recommended and furnished by the water treatment company based upon a complete analysis of the water from the site.
- C. The water treatment chemical and service supplier shall be a recognized specialist, active in the field of industrial water treatment for at least five (5) years, whose major business is in the field of water treatment, and shall have regional water analysis laboratories, development facilities and service department.
- D. The necessary chemical formulations and testing shall be as directed by the supplier.
- E. Water treatment supplier shall provide cleanout of new piping and equipment and treatment of new water back to acceptable levels for conformation of existing treatment program.

**PART 2 PRODUCTS**

**2.01 CHEMICAL SHOT FEEDERS**

- A. Equal to 5-gallon, one-shot feeder, complete with isolation valves and inlet fill funnel if required.

## **2.02 IN PLANT TESTING**

- A. Provide all necessary chemical testing equipment and reagents for in-plant testing. Equipment and reagents shall be provided for each system and shall be furnished in a sturdy case labeled with system name (i.e. "CHILLED WATER").
- B. Supply all log sheets for recording of test results and treatment used. Furnish a Vinyl covered, hardback, 3-ring binder with label on spine "WATER TREATMENT TEST LOG". Include printed instructions for each type of test and tab dividers for each section.

## **2.03 APPROVED MANUFACTURERS**

- A. Coordinate with Owner's existing programs. Chem-Aqua.

## **PART 3 EXECUTION**

- 3.01** Provide all necessary chemical testing equipment and reagents for in plant testing. Supply all log sheets for recording of test results of treatment used.

## **3.02 CHILLED, CONDENSING, AND HEATING WATER SYSTEM - TREATMENT**

- A. Install a one-shot feeder, if required, that meets the pressure requirements of the specified system.
- B. Provide automatic feed and monitoring systems as may be required based upon initial water analysis.
- C. Provide the chemical formulations required to inhibit scale and corrosion, together with written instructions for dosages, application procedures and testing.

**END OF SECTION**

**SECTION 23 3100**  
**HVAC DUCTS AND CASINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Basic Requirements for HVAC Ducts and Casings.

**1.02 RELATED SECTIONS**

- A. Section 23 0500 – Common Work Results for Heating, Ventilating, and Air Conditioning System.
- B. Section 23 0548 – Vibration and Seismic Controls for HVAC Piping and Equipment.
- C. Section 23 0593 – Testing, Adjusting and Balancing.
- D. Section 23 0713 – Duct Insulation.

**1.03 QUALITY ASSURANCE**

- A. Installer: A firm with at least 3 years of successful installation experience on projects with low pressure ductwork systems work similar to that required for project.
- B. SMACNA Standards: Comply with SMACNA HVAC Duct Construction Standards for fabrication and installation of low-pressure ductwork.
- C. NFPA Compliance: Comply with ANSI/NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems" and ANSI/NFPA 90B "Standard for the Installation of Warm Air Heating and Air-Conditioning Systems" and ANSI/NFPA96 "Standard for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment".
- D. Field Reference Manual: Have available at project field office, copy of "SMACNA HVAC Duct Construction Standards", latest Edition.

**1.04 SUBMITTALS**

- A. Product Data: Submit manufacturer's specifications on manufactured products and factory-fabricated ductwork, used for work of this section.
- B. Record Drawings: At project closeout, submit record drawings of installed ductwork, duct accessories, and outlets and inlets, in accordance with requirements of Division 01.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.
- B. Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

## PART 2 PRODUCTS

### 2.01 LOW PRESSURE DUCTS

#### A. Ductwork Materials

1. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, oil canning, stains and discolorations, and other imperfections, including those which would impair painting.
2. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ANSI/ASTM A 527, lock forming quality, with ANSI/ASTM A 525, G90 zinc coating; mill phosphatized for exposed locations.

#### B. Miscellaneous Ductwork Materials

1. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.
2. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant (type applicable for fabrication/installation detail) as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork. Hardcast tape or approved equal.
3. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.
  - a. Except where space is indicated as "High Humidity" area, interior support materials of not less than 1/4" diameter or 3/16" thickness may be plain (not galvanized).

#### C. Flexible Duct

1. Flexible duct may be used in lengths not over 3'-0" to connect terminal units. Flexible duct shall not be used to turn elbows in excess of 45 degrees.
2. Flexible duct shall meet U.L. 181 and conform to NFPA 90A and 90B and be installed in accordance with the conditions of their listing by U.L. as a flexible duct.
3. Installation shall conform to SMACNA "HVAC Duct Construction Standards", Section III, latest edition.

#### D. Fabrication

1. Shop fabricate ductwork in 4, 8, 10 or 12-foot lengths, unless otherwise indicated or required to complete runs. Pre-assemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.
2. Shop fabricated ductwork if gages and reinforcement complying with SMACNA "HVAC Duct Construction Standards", First Edition, 1985.
3. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with centerline radius equal to associated duct width; and fabricate to including turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers. The contractor may use square 90-degree elbows with turning vanes in lieu of centerline radius turns.
4. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division-15 section "Duct Accessories" for accessory

requirements.

E. Factory-Fabricated Ductwork

1. General: As installer's option, provide factory- fabricated duct and fittings, in lieu of shop-fabricated duct and fittings.
2. Material: Galvanized sheet steel complying with ANSI/ASTM A 527, lock-forming quality, with ANSI/ASTM A 525, G90 zinc coating, mill phosphatized.
3. Gauge: 26 ga. minimum for round ducts and fittings, 4-inch through 24-inch diameter.
4. Elbows: One piece construction for 90 degree and 45-degree elbows 14 inches and smaller. Provide multiple gore construction for larger diameters with standing seam circumferential joint.
5. Divided Flow Fittings: 90-degree tees, constructed with saddle tap spot welded and bonded to duct fitting body.
6. Available Manufacturers: Subject to compliance with requirements, manufacturers offering factory-fabricated ductwork which may be incorporated in the work include, but are not limited to, the following:  
United Sheet Metal Div., United McGill Corp.  
Semco Manufacturing, Inc.  
Sheet Metal Products, Inc.

## 2.02 HIGH PRESSURE DUCTWORK

A. Ductwork Materials

1. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, oil canning, stains and discolorations, and other imperfections, including those which would impair painting.
2. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ANSI/ASTM A 527, lock forming quality, with ANSI/ASTM A 525, G90 zinc coating; mill phosphatized for exposed locations.

B. Miscellaneous Ductwork Materials

1. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.
2. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15-degree change of direction per section. Unless specifically detailed otherwise, use 45-degree laterals and 45-degree elbows for branch take-off connections. Where 90-degree branches are indicated, provide conical type tees.
3. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant (type applicable for fabrication/installation detail) as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork.
4. Duct Cement: Non-hardening migrating mastic or liquid neoprene-based cement (type applicable for fabrication/installation detail) as compounded by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork.

C. Fabrication

1. Shop fabricate ductwork in 4, 8, 10 or 12-foot lengths, unless otherwise indicated or required to complete runs. Pre-assemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.

2. Shop fabricates ductwork of gauges and reinforcement complying with SMACNA HVAC Duct Construction Standards for 4" pressure class ductwork.
3. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers.
4. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division-15 section "Duct Accessories" for accessory requirements.

D. Factory-Fabricated Ductwork

1. General: At installer's option, provide factory-fabricated duct and fittings, in lieu of shop-fabricated duct and fittings.
2. Round Ductwork: Construct of galvanized sheet steel complying with ANSI/ASTM A 527 by the

Diameter	Minimum Gauge	Method of Manufacturer
3" to 14"	26 ga.	Spiral Lock seam
15" to 26"	24 ga.	Spiral Lock seam
27" to 36"	22 ga.	Spiral Lock seam
37" to 50"	20 ga.	Spiral Lock seam

- a. Provide locked seams for spiral duct; fusion-welded butt seam for longitudinal seam duct.
- b. Fittings and Couplings: Construct of minimum gauges listed. Provide continuous welds along seam.

Diameter	Minimum Gauge
3" to 36"	20
38" to 50"	18
Over 50"	16

3. Flat-Oval Ductwork: Construct of galvanized sheet steel complying with ANSI/ASTM A 527, of spiral lock-seam construction, in minimum gauges listed.

Maximum Width	Minimum Gauge
Under 25"	24
25" to 48"	22
49" to 70"	20
Over 70"	18

- a. Fittings and Couplings: Construct of minimum gauges listed. Provide continuous weld along seams.

Maximum Width	Minimum Gauge
Under 37"	20
37" to 50"	18
Over 50"	16

4. Available Manufacturers: Subject to compliance with requirements, manufacturers



offering factory-fabricated ductwork which may be incorporated in the work include, but are not limited to, the following:

United Sheet Metal Div, United McGill Corp.  
Semco Manufacturing, Inc.  
Sheet Metal Products Co.

### **2.03 DUAL WALL DUCT AND FITTINGS**

- A. Dual wall duct shall be comprised of an airtight outer pressure shell, a 2-inch insulation layer, and perforated metal inner liner. Liner shall be supported from the steel by welded spacers. Where indicated on the drawings, ductwork shall have 3 inches of insulation for sound attenuation.
- B. Insulation shall completely fill the space between the liner and outer shell and have the following UL ratings:

Flame Spread	10-20
Fuel Contributed	10-15
Smoke Developed	0-20
- C. Outer shell of duct shall be minimum 20-gage galvanized steel. Inner liner of duct shall be minimum 28-gage galvanized steel.
- D. Manufactured end fittings shall be installed at all connections of dual wall and single wall duct.
- E. All round and oval ductwork shall be spiral lock seam pipe. The spiral pipe shall have been laboratory tested for leakage rate, friction loss, bursting and collapsing strength.
- F. Fitting shall be of the standard machine-formed fittings as manufactured by the duct manufacturer. Fittings shall match those shown on the drawings as closely as possible. All fittings shall have a turning radius of 1-1/2 times the diameter of the duct where possible.
- G. Provide "paint grip" finish where indicated on drawings.

### **2.04 RANGE HOOD AND DISHWASHER HOOD EXHAUST DUCTS**

- A. Range hood exhaust ducts shall be 14-gauge welded steel. Duct construction, joints, cleanouts and installation shall comply with Chapter 5 of the Arkansas Mechanical Code.
- B. Dishwasher hood exhaust ductwork shall be 16-gauge aluminum with all joints and seams welded.
- C. Insulate range hood exhaust ducts per Section 23 0713.
- D. Insulate dishwasher hood exhaust ducts with 2" wrap-on insulation as specified in Section 23 0713.

### **2.05 DRYER VENTS**

- A. Dryer vent duct shall have smooth interior finish with joints running in direction of airflow.
- B. Dryer vents shall not be assembled with sheet metal screws or other means which

extend into the duct. Seal each joint with non-combustible material.

- C. Provide vent cap with back draft damper and no screen. See detail on plans.
- D. Provide Complete UL listed kit with everything needed to connect dryer to wall vent
  - Close fit for 4-in wall clearance.
  - 6-ft of flexible pipe.
  - 2 close elbows resist crushing and maintain airflow.
  - Swivel cuffs on close elbows allow moving dryer without disconnecting.
  - Conforms to UL safety requirements.

## **2.06 FUME HOOD EXHAUST DUCTS**

- A. Furnish and install all exhaust ducts from laboratory fume hoods as indicated on the Drawings.
- B. All rectangular or round pipe fume hood ductwork and fittings shall be constructed of Type 316 stainless steel with heliarc welded seams.

## **PART 3 EXECUTION**

### **3.01 LOW PRESSURE DUCTWORK**

- A. Installation of Ductwork
  - 1. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight (1% leakage) and noiseless (no objectional noise) systems, capable for performing each indicated service. Install each run with minimum of joints. Align ductwork accurately at connections, within 1/8 inch misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling.
  - 2. Seal ductwork, to class recommended, and method prescribed in SMACNA "HVAC Duct Construction Standards", latest edition.
  - 3. Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.
  - 4. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details, and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct unusable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent- enclosure elements of building. Limit clearances to 1/2 inch where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1 inch clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work. Do not locate ductwork over (parallel to) position indicated to extend to deck.
  - 5. Electrical Equipment Spaces: Do not run ductwork through transformer vaults and their electrical equipment spaces and enclosures.
  - 6. Where ducts pass through interior partitions and exterior walls, conceal space between construction opening and duct or duct-plus-insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2 inches.

7. Provide insulated blank-off plates as indicated on the drawings where ducts connect to vents or louvers.
  8. Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.
  9. Support ductwork in manner complying with SMACNA "HVAC Duct Construction Standards", latest Edition.
  10. Do not reroute or shorten branch ductwork to terminal or inline air devices without direct approval of design Engineer. Routings and offsets are designed to be in compliance with cross sectional area and distance from penetration through fire rated wall. Any changes must be in direct compliance with Section 510 of the Standard Mechanical Code, 1991 Edition.
- B. Cleaning and Protection
1. Clean ductwork internally, unit-by-unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.
  2. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

### 3.02 HIGH PRESSURE DUCTWORK

- A. Installation of Ductwork
1. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight (1% leakage) and noiseless (no objectional noise) systems, capable for performing each indicated service. Install each run with minimum of joints. Align ductwork accurately at connections, within 1/8 inch misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling.
  2. Seal ductwork, in accordance with recommendations of SMACNA "HVAC Duct Construction Standards - First Edition", 1985.
  3. Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.
  4. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent-enclosure elements of building. Limit clearances to 1/2 inch where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1 inch clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
  5. Electrical Equipment Space: Do not run ductwork through transformer vaults and their electrical equipment spaces and enclosures.
  6. Where ducts pass through interior partitions and exterior walls, conceal space between construction opening and duct or duct-plus-insulation with sheet metal flanges of same gauge as duct. Overlap opening on 4 sides by at least 1-1/2 inch.

7. Provide insulated blank-off plates as indicated on the drawings where ducts connect to vents or louvers.
  8. Refer to Division 15 - Duct Accessories Section for accessories required in conjunction with high-pressure ductwork. Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.
  9. Support ductwork in manner complying with SMACNA "High Pressure Duct Standards - Latest Edition" hanging and supporting systems chapter.
- B. Cleaning and Protection
1. Clean ductwork internally, unit-by-unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.
  2. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.
- C. Testing for Leakage
1. General: After each duct system is completed, test for duct leakage in accordance with SMACNA "High Pressure Duct Standards - Latest Edition, Chapter 10 - Testing and Leakage". Repair leaks and repeat tests until total leakage is less than 1% of system design air flow.
- D. Balancing
1. Seal any leaks in ductwork that become apparent in balancing process.

**END OF SECTION**

**SECTION 23 3300  
AIR DUCT ACCESSORIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Basic Requirements for Air Duct Accessories for complete Heating, Ventilating, and Air Conditioning Systems.

**1.02 RELATED SECTIONS**

- A. Section 23 0500 – Common Work Results for Heating, Ventilating, and Air Conditioning Controls.
- B. Section 23 0548 – Vibration and Seismic controls for HVAC Piping and Equipment.
- C. Section 23 0593 – Testing, Adjusting and Balancing.
- D. Section 23 3100 – HVAC Ducts and Casings.

**1.03 QUALITY ASSURANCE**

- A. Manufacturers: Firms regularly engaged in manufacturer of duct accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. SMACNA Compliance: Comply with applicable portions of Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) high pressure and low-pressure duct construction standards.
- C. Industry Standards: Comply with American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) recommendations pertaining to construction of duct accessories, except as otherwise indicated.
- D. UL Compliance: Construct, test, and label fire dampers in accordance with Underwriters Laboratories (UL) Standard 555 "Fire Dampers and Ceiling Dampers".
- E. NFPA Compliance: Comply with applicable provisions of ANSI/NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of duct accessories.

**1.04 SUBMITTALS**

- A. Product Data: Submit manufacturer's data for each type of duct construction; and installation instructions.
- B. Shop Drawings: Submit assembly-type shop drawings for each type of duct assembly showing interfacing requirements with ductwork, and method of fastening or support.
- C. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory include this data in Maintenance Manual.

**PART 2 PRODUCTS**

**2.01 DAMPERS**

- A. Low Pressure Manual Dampers: Provide dampers of single blade type of multiblade type, constructed in accordance with SMACNA "Low Pressure Duct Standards".
- B. Control Dampers: Refer to Division-23 section "Temperature Control Systems" for control dampers; not work of this section.
- C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering dampers which may be incorporated in the work include, but are not limited to, the following:  
 Air Balance, Inc.  
 Airguide Corp.  
 Airstream Products Div., Penn Ventilator Co., Inc.  
 American Warming & Ventilating, Inc.  
 Arrow Louver and Damper Corp.  
 Elgo Shutter and Mfg. Co.  
 Imperial Damper and Louver Co., Inc.  
 Louvers & Dampers.  
 Ruskin Mfg. Co.

## **2.02 FIRE AND SMOKE DAMPERS**

- A. Fire Dampers: Provide fire dampers, of types and sizes indicated. Construct casings of 11 ga. galvanized steel with bonded red acrylic enamel finish. Provide fusible link rated at 160-165°F (71-74°C) unless otherwise indicated. Provide damper with positive lock in closed position, and with the following additional features:
  - 1. Damper Blade Assembly: Single-blade type (ducts less than 10 inches deep).
  - 2. Damper Blade Assembly: Curtain type.
  - 3. Blade Material: Steel, match casing.
- B. Motor Driven Smoke Dampers: Provide smoke damper, resettable type linkage of sizes indicated, designed and constructed in accordance with NFPA-90A, motor operated, frame constructed of 10-gauge galvanized steel with provisions for securing to building and attaching to ducts, electric motor operator, casing to have a bonded red acrylic enamel finish, low leakage with friction free metal seals, 32" long wire leads for connecting to smoke detector, and the following additional features:
  - 1. Damper Blade Assembly: Single-blade type (ducts less than 10 inches deep).
  - 2. Damper Blade Assembly: Multi-blade type.
  - 3. Blade Material: Steel, matching casing.
- C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fire and smoke dampers which may be incorporated in the work include, but are not limited to, the following:  
 Air Balance, Inc.  
 Airstream Products Div., Penn Ventilator Co., Inc.  
 American Warming & Ventilating, Inc.  
 Arrow Louver and Damper Corp.  
 Louvers & Dampers.  
 Phillips-Aire.  
 Ruskin Mfg. Co.

## **2.03 TURNING VANES**

- A. Fabricated Turning Vanes: Provide fabricated turning vanes and vane runners, constructed in accordance with SMACNA "Low Pressure Duct Standards".

- B.     Manufactured Turning Vanes: Provide turning vanes constructed of 1-1/2-inch-wide curved blades set at 1-1/2-inch o.c., supported with bars perpendicular to blades set at 2 inches o.c., and set into side strips suitable for mounting in ductwork, per SMACNA Standards for low pressure duct.
- C.     Available Manufacturers: Subject to compliance with requirements, manufacturers offering turning vanes which may be incorporated in the work include, but are not limited to, the following:  
Air Filter Corp.  
Anemostat Products Div., Dynamics Corp. of America  
Duro-Dyne Corp.  
Environmental Elements Corp., Subs. Koppers Co., Inc.  
Tuttle & Bailey Div. of Interpace Corp.

## **2.04     DUCT HARDWARE**

- A.     General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:
  - 1.     Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.
  - 2.     Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12 inches. Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.
- B.     Available Manufacturers: Subject to compliance with requirements, manufacturers offering duct hardware which may be incorporated in the work include, but are not limited to, the following:  
Ventfabrics, Inc.  
Young Regulator Co.

## **2.05     DUCT ACCESS DOORS**

- A.     General: Provide, where indicated and at all fire and smoke dampers, duct access doors of size indicated.
- B.     Construction: Construct of same or greater gage as ductwork served, provide double panel insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one side hinged, other side with 1 handle-type latch for doors 12 inches high and smaller, 2 handle-type latches for larger doors.
- C.     Available Manufacturers: Subject to compliance with requirements, manufacturers offering duct access doors which may be incorporated in the work include, but are not limited to, the following:  
Air Balance Inc.  
Duro Dyne Corp.  
Register & Grille Mfg. Co., Inc.  
Ruskin Mfg. Co.  
Semco  
Ventfabrics, Inc.  
Zurn Industries, Inc., Air Systems Div.

## **2.06 FLEXIBLE CONNECTIONS**

- A. General: Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment.

## **2.07 DUCT ACCESS DOOR/PRESSURE RELIEF DOOR**

- A. General: Provide a duct access door/pressure relief door in all high-pressure duct immediately downstream of all fire dampers, smoke dampers and fire/smoke dampers.
- B. Construction: Factory-fabricated access section, 20-gauge galvanized sheet metal housing welded to round galvanized duct section, gasketed transparent shatterproof cover (inside mounted), pressure sensitive release for manual or emergency vacuum release, pressure " sealed, cover handle and cover retaining chain. Provide double panel pre-insulated if duct is to be insulated.
- C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering duct access doors/pressure relief which may be incorporated in the work include, but are not limited to, the following:  
United McGill Corp., TYPE AR-W Access Section  
Semco

## **PART 3 EXECUTION**

### **3.01 INSPECTION**

- A. Examine areas and conditions under which duct accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

### **3.02 INSTALLATION**

- A. Install duct accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.
- B. Install turning vanes in square or rectangular 90-degree elbows in supply.
- C. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.
- D. Coordinate with other work, including ductwork, as necessary to interface installation of duct accessories properly with other work.
- E. Field Quality Control: Operate installed duct accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories as required to obtain proper operation and leakproof performance.

**END OF SECTION**



**SECTION 23 3423  
HVAC POWER VENTILATORS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Basic Requirements for HVAC Power Ventilators.

**1.02 RELATED SECTIONS**

- A. Section 23 0500 – Common Work Results for Heating, Ventilating, and Air Conditioning Systems.
- B. Section 23 0548 – Vibration and Seismic controls for HVAC Piping and Equipment.
- C. Section 23 3100 – HVAC Ducts and Casings.

**1.03 QUALITY ASSURANCE**

- A. Manufacturers: Firms regularly engaged in manufacturer of power ventilators and exhaust fans, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. AMCA Compliance: Provide power roof ventilators and exhaust fans bearing the Air Movement and Control Association, Inc. (AMCA) Certified Ratings Seal.
- C. UL Compliance: Provide power roof ventilator and exhaust fans electrical components which have been listed and labeled by Underwriters Laboratories (UL).

**1.04 SUBMITTALS**

- A. Product Data: Submit manufacturer's data for power ventilators and exhaust fans, including specifications, capacity ratings, dimensions, weights, materials, accessories furnished, and installation instructions.
- B. Maintenance Data: Submit maintenance instructions, including lubrication instructions, motor and drive replacement, and spare parts lists. Include this data in maintenance manuals.

**PART 2 PRODUCTS**

**2.01 ROOF-MOUNTED FANS**

- A. Uni-Dome exhauster shall be belt drive, centrifugal fan of the size, capacity and electrical characteristics as scheduled on the Drawings.
- B. Fan housing and wheel shall be of all aluminum construction. Fan shaft shall be steel.
- C. Wheels shall be statically and dynamically balanced.
- D. Motor and drive shall be located in an enclosed weatherproof compartment separate from the air stream. Motor and drive shall have permanently lubricated ball bearings rated for 200,000 hours operating life. Drives shall be variable pitch and sized for 165 percent of

scheduled motor horsepower.

- E. Fan shall be equipped with birdscreen, disconnect switch, internal wiring using "Sealtite" flexible conduit from switch to motor, and gravity backdraft damper.
- F. Entire housing shall be factory primed coated to accept field applied finish coat.
- G. Provide pre-fabricated roof curb with prime coat finish suitable for field painting, compatible with roof pitch to provide level top.

## **2.02 APPROVED MANUFACTURERS**

- A. Roof-Mounted - Exhaust Fan:
  - 1. Greenheck.
  - 2. Cook.
  - 3. Engineer Approved.

## **PART 3 EXECUTION**

### **3.01 GENERAL**

- A. Examine areas and conditions under which power ventilators and exhaust fans are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

### **3.02 INSTALLATION OF POWER VENTILATORS**

- A. General: Except as otherwise indicated or specified, install ventilators and exhaust fans in accordance with manufacturer's installation instructions and recognized industry practices to ensure that ventilators serve their intended function.
- B. Coordinate ventilator and exhaust fan work with work of roofing, walls, and ceilings, as necessary for proper interfacing.
- C. Ensure that power ventilators and exhaust fans are wired properly, with correct motor rotation, and positive electrical motor grounding.
- D. Remove shipping bolts and temporary supports within ventilators and exhaust fans. Adjust dampers for free operation.

### **3.03 TESTING**

- A. General: After installation of ventilators and exhaust fans has been completed, test each to demonstrate proper operation of units at performance requirements specified. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.

### **3.04 SPARE PARTS**

- A. General: Furnish to Owner, with receipt, 1 spare set of belts for each belt drive power ventilator and exhaust fans.

## **END OF SECTION**

**SECTION 23 3616**  
**AIR TERMINAL UNITS - VARIABLE VOLUME**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Single duct terminal units.
  - 1. Variable volume.
  - 2. Constant volume.
- B. Integral heating coils.
  - 1. Hot water.
- C. Sound attenuator.

**1.02 RELATED SECTIONS**

- A. Section 23 0923 - Controls and Instrumentation.
- B. Section 23 2113 - Hydronic Piping: Connections to heating coils.
- C. Section 23 2114 - Hydronic Specialties: Connections to heating coils.
- D. Section 23 3100 - Ductwork.
- E. Section 23 3300 - Ductwork Accessories.
- F. Section 23 3700 - Air Outlets and Inlets.

**1.04 REFERENCES**

- A. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- B. UL 181 - Factory-Made Air Ducts and Connectors.
- C. UL 1995, Heating and Cooling Equipment.
- D. CUL C22.2 No. 236, Heating and Cooling Equipment.
- E. ASTM A 527 (Steel Sheet, Zinc Coated Galvanized).
- F. A-A-1419 or F-F-310 Federal specification (filter element, Air conditioning, Viscous-impingement or Dry type, replaceable), Tested per UL 900.

**1.05 SUBMITTALS**

- A. Submit shop drawings and product data sheets indicating configuration, general assembly, and materials used in fabrication.
- B. Submit product performance data indicating design air flow, minimum static pressure drop, fan operating condition.
- C. Submit installation, operation and maintenance documentation.

## **1.06 QUALIFICATIONS**

- A. Manufacturer: The company manufacturing the products specified in this section shall have a minimum of ten years experience producing products of this type.

## **1.07 SYSTEM RESPONSIBILITY**

- A. The contractor shall be responsible for any and all costs associated with any and all changes resulting from the use of a supplier other than the one used as "basis of design".

## **1.08 WARRANTY**

- A. Provide manufacturer's parts warranty for one year from substantial completion.

# **PART 2 PRODUCT**

## **2.01 MANUFACTURERS**

- A. Specified Manufacturers
  - 1. Price.
  - 2. Titus.
  - 3. Trane.
  - 4. Engineer approved.

## **2.02 MANUFACTURED UNITS**

- A. Identify each terminal unit with clearly marked identification label and airflow indicator. Label shall include unit nominal air flow, maximum factory-set air flow, minimum factory-set air flow, and coil type.

## **2.03 FABRICATION**

- A. Casings: Units shall be completely factory-assembled, manufactured of corrosion protected steel, and fabricated with a minimum of 18-gauge metal on the high pressure (inlet) side of the terminal unit damper and 22-gauge metal on the low pressure (outlet) side and unit casing.
- B. INSULATION - Foil Faced - The interior surface of unit casing is acoustically and thermally lined with a minimum of 1" foil faced insulation. The interior foil liner shall isolate the fiberglass insulation from the airstream and allow for cleaning of the terminal unit interior surfaces. Insulation shall meet NFPA-90A, UL 181 and bacteriological standard ASTM C 665.
- C. Assembly: Primary air control damper, airflow sensor, fans, controls and optional heating coil in single cabinet.
- D. Rectangular Supply Air Outlet Connections: Rectangular outlet connections for units without optional heating coils on the outlet of the terminal unit shall be flange type. Rectangular outlet connections for units with optional heating coils on the outlet of the terminal unit shall be slip and drive type.

## **2.04 PRIMARY AIR CONTROL DAMPER ASSEMBLY**

- A. Locate primary air control damper assembly inside unit casing. Construct the damper assembly from extruded aluminum and/or a minimum 22-gauge galvanized steel components. Maximum damper leak rate shall not exceed 1% of damper nominal CFM at 4-inch wg. differential.
- B. Provide damper assembly with integral flow sensor. Flow sensor shall be provided regardless of control type. Flow sensor shall be a multi-point, averaging, ring or cross type. Bar or single point sensing type is not acceptable.

## **2.05 HEATING COILS**

- A. Hot Water Heating Coil: Coils shall be factory-installed and shall consist of aluminum plated fins and seamless copper tubes. Fins shall have full fin collars to provide accurate fin spacing and maximum fin-to-tube contact. Tubes shall be mechanically expanded into the fin collars. Coils shall be leak tested under water to 450 psig pressure. Supply and return water connections shall be on the same side of the coil.
- B. Capacity: Provide coils in capacities as scheduled on the drawings.

## **2.06 WIRING**

- A. Factory install and wire power line fusing, a disconnect switch and a 24 VAC transformer for control voltage on units. Provide terminal strip in control box for field wiring of thermostat and power source.
- B. Factory install and wire all terminal unit controls. Install electrical components in control box with removable cover. Incorporate single point electrical connection to power source.
- C. Disconnect switch - Provide single duct terminals with a factory installed and wired switch to disconnect power to the unit.
- D. Power Line Fuse - Provide single duct terminal units with integral power line fusing installed in the control box to prevent overcurrent damage to the unit.
- E. Control Transformer - Provide single duct terminal units with a factory installed and wired 24 VAC transformer to provide control voltage power to the unit.

## **2.07 DIRECT DIGITAL VAV CONTROLS**

- A. Direct Digital Controls
  - 1. General. DDC Controls, actuator and costs to mount, calibrate and test the system shall be the responsibility of Section 23 0923 ATC/Building Management System Contractor.
  - 2. Multi-point, multi-axis flow ring or cross sensor to be furnished and mounted by terminal unit manufacturer. Single point or flow bar sensors are not acceptable. Shall be capable of maintaining airflow to within +/- 5 percent of rated unit airflow setpoint with 1.5 duct diameters straight duct upstream from the unit.

## **2.08 TESTING / VERIFICATION**

- A. Maximum Casing Leakage: 1 percent of nominal air flow at 0.5 in wg inlet static pressure.
- B. Maximum Damper Leakage: 1 percent of design air flow at 4 in wg inlet static pressure.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.

### **3.02 ADJUSTING**

- A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design air flow to 25 percent nominal air flow for cooling only units and 30 percent for units with heating coils.

**END OF SECTION**

**SECTION 23 3700  
AIR INLETS AND OUTLETS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Basic Requirements for Air Inlets and Outlets.

**1.02 RELATED SECTIONS**

- A. Section 23 0500 – Common Work Results for Heating, Ventilating, and Air Conditioning System.
- B. Section 23 0548 – Vibration and Seismic Controls for HVAC Piping and Equipment.
- C. Section 23 0593 – Testing, Adjusting and Balancing.
- D. Section 23 3100 – HVAC Ducts and Casings.

**1.03 REFERENCES**

- A. ADC 1062 - Certification, Rating and Test Manual.
- B. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- C. ARI 650 - Air Outlets and Inlets.
- D. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
- E. SMACNA - Low Pressure Duct Construction Standard.

**1.04 QUALITY ASSURANCE**

- A. Test and rate performance of air outlets and inlets in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.
- B. Air distribution devices have been specifically selected based on the specified manufacturer's performance data. If the Contractor submits on devices other than those specified, the submittal must include an item-by-item selection of substitutions listed by space location.
- C. Where compliance with performance requires different dimensions, such as neck or face size, than the specified item, the submittal must note where these dimension changes occur listing both the original and the new dimensions.
- D. Any additional costs by any trade resultant from air device substitution shall be borne by the Contractor.

**1.05 REGULATORY REQUIREMENTS**

- A. Conform to ANSI/NFPA 90A.

**1.06 SUBMITTALS**

- A. Submit product data under provisions of Division 01 and Section 23 05 00.
- B. Submit schedule of air devices indicating type, size, location, and application.
- C. Schedule must include model number, size, air pattern, CFM, pressure drop, throw, NC noise level, finish and mounting method for both the submitted and specified device.
- D. Review requirements of outlets and inlets as to size, finish, and type of mounting prior to submitting product data and schedules of outlets and inlets.
- E. Submit manufacturer's installation instructions.

## **PART 2 PRODUCTS**

### **2.01 AIR DEVICES**

- A. All air devices shall be equal to products scheduled on the Drawings.

### **2.02 APPROVED MANUFACTURERS**

- A. Air Devices
  - 1. Titus.
  - 2. Price.
  - 3. Tuttle & Bailey.
  - 4. Architect Approved.
- B. Hooded Intake/Relief Ventilator
  - 1. Greenheck.
  - 2. Cook.
  - 3. Architect Approved.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION (AIR DEVICES)**

- A. Install air devices in accordance with manufacturers' instructions.
- B. Check location of air devices and make necessary adjustments in position to conform with architectural reflected ceiling plan, symmetry, and lighting arrangement.
- C. Install diffusers to ductwork with airtight connection.
- D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, regardless of whether dampers are specified as part of the diffuser, or grille and register assembly.
- E. Provide mounting frame or additional ceiling grid tees as required to mount air devices. Support devices as required to prevent ceiling sag.

## **END OF SECTION**



**SECTION 23 5100**  
**DOUBLE WALL SPECIAL GAS VENT (CATEGORY IV)**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This section includes specifications for furnishing and installing Positive Pressure Vent Systems.

**1.02 SUBMITTALS**

- A. Submit the following in accordance with Division 23 Specifications:
1. Catalog cuts
  2. Sizing calculations
  3. Installation drawings
  4. Installation instructions
  5. Sample of warranty

**1.03 QUALITY ASSURANCE**

- A. APPLICABLE STANDARDS
1. All products furnished under this Section shall conform to the requirements of the National Fuel Gas Code, NFPA-54, where applicable and shall comply with and be listed to UL1738, Standard for Venting Systems for Gas-Burning Appliances, Category II, III and IV. Components coming in direct contact with products of combustion shall carry the appropriate UL or cUL listing mark or label.
- B. WARRANTY
1. Limited lifetime Warranty  
Warranty to guarantee product is free from defects in material and workmanship in normal use for as long as the original consumer owns the system, provided the system has been designed, installed, maintained and used in accordance with manufacturer's specifications.

**PART 2 PRODUCTS**

**2.01 POSITIVE PRESSURE VENT**

- A. The vent shall be of the double-wall, factory-built type for use on condensing appliances or pressurized venting systems serving Category II, III or IV appliances or as specified by the equipment manufacturer.
- B. Maximum temperature shall not exceed 550 °F (288 °C).
- C. Vent shall be listed for an internal static pressure of 10" w.g. and tested to 25" w.g.
- D. Vent shall be constructed with an inner and outer wall, with a 1" annular insulating airspace. The inner wall (vent) shall be constructed of, 0.015 thick AL29-4C, super ferritic stainless steel. The outer wall (casing) shall be constructed of aluminized steel with .018 of thickness. *Optional: The outer wall shall be constructed of a minimum 0.012 thick Type 430.* Inner and outer walls shall be connected by means of spacer clips that maintain the concentricity of the annular space and allow unobstructed differential

thermal expansion of the inner and outer walls. *All vent parts exposed to the weather shall be stainless steel.*

- E. All supports, roof or wall penetrations, terminations, appliance connectors and drain fittings, required to install the vent system shall be included.
- F. Roof penetration pieces shall be UL listed and provided by the vent manufacturer. Roof curbs shall be required on roofs greater than 12:12 pitch.
- G. Vent shall be secured by sheet metal screws through casings. Joints shall be sealed with factory installed gaskets. Where exposed to weather, the outer closure band shall be sealed to prevent rainwater from entering the space between inner and outer walls.
- H. Vent shall terminate in accordance with Installation Instructions and local codes.

## **2.02 AVAILABLE MANUFACTURERS**

- A. Corr/Guard Model CG as manufactured by Metal-Fab, Inc.
- B. Architect Approved

## **PART 3 EXECUTION**

- 3.01** Store delivered materials inside, out of the weather. Protect material from accidental damage or vandalism.
- 3.02** Installation shall conform to the manufacturer's Installation Instructions, UL listing and state or local codes.
- 3.03** Support vent from building structure using rigid structural shapes for attachment of fixed point supports (plate support assembly). Anchor supports to structure by welding, bolting, steel expansion anchors, or concrete inserts. Size of structural shapes shall be in accordance with manufacturer's recommendations.
- 3.04** Coordinate installation of dampers or fans. Dampers or fans shall be supported independently from the vent sections. Protect vent from twist or movement due to fan torque or vibration.
- 3.05** Protect incomplete vent installations by attaching temporary closures over open ends of sections.
- 3.06** Clean all vent and breechings of dust and debris prior to final connection to appliances.

## **END OF SECTION**

**SECTION 23 5216  
CONDENSING BOILERS**

**PART 1 GENERAL**

**1.01 SCOPE:**

- A. Work Included: Boiler-Burner units, and related accessories as indicated and required for a complete system. Verify delivery pressure of natural gas furnished by Gas Company and provide additional gas pressure regulator if available delivery pressure does not satisfy pressure requirements of equipment furnished for this project.

**1.02 RELATED INFORMATION AND REQUIREMENTS**

- A. Common Work Results for HVAC - Section 23 05 00
- B. Testing and Balancing - Section 23 05 93

**1.03 REVIEW OF MATERIALS: Submittal data is required for the following listed materials**

- A. Boiler-Burner Units
- B. The boiler-burner unit shall be manufactured by:
  - 1. Raypack Xfyre.
  - 2. RBI
  - 3. LochinvarNote: No other alternate manufacturers will be accepted.

**1.04 WARRANTY**

- A. The equipment manufacturer's warranty shall be for a period of one year from the date of substantial completion. The warranty shall include parts and labor costs for the repair or replacement of defects in material or workmanship.

**PART 2 PRODUCTS**

**2.01** The boiler shall have a modulating input rating of 500,000 Btu/Hr, an output of 487,500 Btu/Hr and shall be operated on Natural Gas. The boiler shall be capable of full modulation with a turndown ratio of 7:1.

- A. The boiler shall bear the ASME "H" stamp for 160 psi working pressure and shall be National Board listed. The boiler shall have a fully welded, stainless steel, fire tube heat exchanger. Multiple pressure vessels in a single enclosure are not acceptable. There shall be no banding material, bolts, gaskets or "O" rings in the pressure vessel construction. The heat exchanger shall be designed for a single-pass water flow to limit the water side pressure drop. Pressure drop shall be no greater than 2.2 psi at 75 GPM. The condensate collection basin shall be constructed of welded stainless steel. The complete heat exchanger assembly shall carry a ten (10) year limited warranty.
- B. The boiler shall be certified and listed by C.S.A. International under the latest edition of the harmonized ANSI Z21.13 test standard for the U.S. and Canada. The boiler shall comply with the energy efficiency requirements of the latest edition of ASHRAE 90.1 and the minimum efficiency requirements of the latest edition of the AHRI BTS-2000 Standard

as defined by the Department of Energy in 10 CFR Part 431. The boiler shall operate at a minimum of 97% Combustion and Thermal Efficiency at full fire as registered with AHRI. The boiler shall be certified for indoor installation.

- C. The boiler shall be constructed with a heavy gauge steel jacket assembly, primed and pre-painted on both sides. The combustion chamber shall be sealed and completely enclosed, independent of the outer jacket assembly, so that integrity of the outer jacket does not affect a proper seal. A burner/flame observation port shall be provided for observing the burner flame and combustion chamber. The burner shall be a premix design constructed of high temperature stainless steel with a woven Fecralloy outer covering to provide smooth operation at all modulating firing rates. The boiler shall be supplied with a negative pressure regulation gas valve and be equipped with a pulse width modulation blower system to precisely control the fuel/air mixture to the burner. The boiler shall operate in a safe condition with gas supply pressures as low as 4 inches of water column. The burner flame shall be ignited by direct spark ignition with flame monitoring via a flame sensor.
- D. The boiler shall utilize a 24 VAC control circuit and components. The control system shall have a factory installed display for boiler set-up, boiler status, and boiler diagnostics. All components shall be easily accessed and serviceable from the front and top of the jacket. The boiler shall be equipped with a temperature/pressure gauge; high limit temperature control with manual reset; ASME certified pressure relief valve set for 50 psi (standard); outlet water temperature sensor with a dual thermistor to verify accuracy; system supply water temperature sensor; outdoor air sensor, flue temperature sensor with dual thermistor to verify accuracy; low water cut off with manual reset, blocked drain switch and a condensate trap for the heat exchanger condensate drain.
- E. The boiler shall feature a control system which is standard and factory installed with 128 x 128 resolution display, password security, outdoor air reset, pump delay with freeze protection, pump exercise, ramp delay featuring six steps, domestic hot water prioritization with limiting capabilities, USB drive for simple uploading of parameters and a PC port connection for connection to a local computer for programming and trending. A secondary operating control that is field mounted outside or inside the appliance is not acceptable. The boiler shall have alarm contacts for any failure, runtime contacts and data logging of runtime at given modulation rates, ignition attempts and ignition failures. The boiler shall have a built-in "Cascade" with leader redundancy to sequence and rotate while maintaining modulation of up to eight boilers of different Btu inputs without utilization of an external controller. The internal "Cascade" function shall be capable of lead-lag, efficiency optimization, front-end loading, and rotation of lead boiler every 24 hours. The boiler shall be capable of remote communication via optional Remote Connectivity with the capability of historical trending and sending text message or email alerts to notify the caretaker of a boiler alarm and remote programming of onboard boiler control. The boiler shall be capable of controlling an isolation valve (offered by manufacturer) during heating operation and rotation of open valves in standby operation for full flow applications. The control must have optional capability to communicate via Modbus protocol with a minimum of 46 readable points. The boiler shall have an optional gateway device which will allow integration with LON or BacNet protocols.
- F. The control system shall increase fan speed to boost flame signal when a weak flame signal is detected during normal operation. A 0-10 VDC output signal shall control a variable speed boiler pump (offered by manufacturer) to keep a fixed Delta T across the boiler regardless of the modulation rate. The boiler shall have the capability to receive a 0-10 VDC input signal from a variable speed system pump to anticipate changes in system heat load in order to prevent flow related issues such as erratic temperature cycling.

- G. The Boiler shall be equipped with two terminal strips for electrical connection. A low voltage connection board with 46 connection points for safety and operating controls, i.e., Alarm Contacts, Runtime Contacts, Louver Proving Switch, Tank Thermostat, Domestic Hot Water Building Recirculation Pump Contacts, Domestic Hot Water Building Recirculation Temperature Sensor Contacts, Remote Enable/Disable, System Supply Temperature Sensor, Outdoor Temperature Sensor, Tank Temperature Sensor, Modbus Building Management System Signal and Cascade Control Circuit. A high voltage terminal strip shall be provided for Supply voltage. Supply voltage shall be 120 volt / 60 hertz / single phase on all models. The high voltage terminal strip plus integral relays are provided for independent pump control of the System pump, the Boiler pump and the Domestic Hot Water pump.
- H. The boiler shall be installed and vented with a direct vent system with vertical roof top termination of both the exhaust vent and combustion air. The flue shall be Category IV approved material constructed of PVC and CPVC. A separate pipe shall supply combustion air directly to the boiler from the outside. The boiler's total combined air intake length shall not exceed 100 equivalent feet. The boiler's total combined exhaust venting length shall not exceed 100 equivalent feet. The air inlet must terminate on the rooftop with the exhaust.
- I. The boiler shall have an independent laboratory rating for Oxides of Nitrogen (NOx) to meet the requirements of South Coast Air Quality Management District in Southern California and the requirements of Texas Commission on Environmental Quality. The manufacturer shall verify proper operation of the burner, all controls and the integrity of the heat exchanger by connection to water and venting for a factory fire test prior to shipping.
- J. The boiler shall operate at altitudes up to 4,500 feet above sea level without additional parts or adjustments. The boiler shall be certified for operation at elevations of 4,500 feet, and above, by a 3rd party organization.
- K. The boiler shall be suitable for use with polypropylene glycol up to a 50% concentration. The de-rate associated with the glycol will vary per glycol manufacturer.

## STANDARD CONSTRUCTION

The boiler shall be constructed in accordance with the following code requirements as standard equipment. Manufacturing of special models to meet the below code requirements is not acceptable.

California Code  
Massachusetts Code  
Kentucky Code  
CRN Approval in Canada

Note: Due to the large disparity in CSD-1 interpretation from state to state, please confirm to the factory all controls required in your jurisdiction.

## PART 3 EXECUTION

**3.01 SPACE CONDITIONS:** Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until satisfactory conditions are corrected.

## 3.02 INSTALLATION

- A. Coordinate as necessary with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this section.
- B. Install the work of this section in strict accordance with the approved design drawings and the requirements of the contract.
- C. Follow manufacturer's instructions in the delivery, storage, handling and installation of all equipment, accessories and connections.

### **3.03 TESTING AND ACCEPTANCE**

- A. Upon completion of the installation, provide the services of factory authorized personnel to verify that the installation meets the specifications, the manufacturer's written instructions and all state and local codes and to perform startup and initial adjustment of the boiler, burner and controls in accordance with the manufacturer's written instructions.
- B. Where inspections or tests show materials or workmanship are deficient, replace or repair as necessary, and repeat the inspection or test until the specified standards are achieved.

### **3.04 INSTRUCTIONS AND VERIFICATION**

- A. Furnish of Owners manuals, which include instructions for installation, operation and maintenance of the boiler(s) as specified in 23 05 00.
- B. Document the results of the startup and initial adjustment on the manufacturer's startup record and complete the manufacturer's CSD-1 verification form. Submit the startup record and CSD-1 form to the Engineer.

**END OF SECTION**

**SECTION 23 7313  
CENTRAL STATION AIR HANDLER**

**PART 1 GENERAL**

**1.01 WORK INCLUDED**

- A. Applied Air Handling Units.

**1.02 RELATED SECTIONS**

- A. Section 23 0713 - Duct Work Insulation.
- B. Section 23 0923 - Building Automation and Control Systems

**1.03 REFERENCES**

- A. AMCA Publication 99 - Standards Handbook.
- B. AMCA Publication 611 - Certified Ratings Program - Airflow Measurement Performance
- C. AMCA Standard 500-D - Laboratory Methods of Testing Dampers for Rating.
- D. ANSI/ABMA Standard 9 - Load Ratings and Fatigue Life for Ball Bearings.
- E. ANSI/AMCA Standard 204 - Balance Quality and Vibration Levels for Fans.
- F. ANSI/AMCA Standard 610 - Laboratory Methods of Testing Airflow Measuring Stations for Rating.
- G. ANSI/AHRI Standard 410 - Forced Circulation Air-Cooling and Air-Heating Coils.
- H. ANSI/AHRI Standard 430 - Central Station Air Handling Units.
- I. ANSI/ASHRAE Standard 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- J. ANSI/ASHARE Standard 62.1 - Ventilation for Acceptable Indoor Air Quality.
- K. ANSI/ASHARE Standard 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- L. ANSI/NEMA MG 1 - Motors and Generators.
- M. ANSI/UL 900 - Standard for Safety Air Filter Units.
- N. AHRI Standard 260 - Sound rating of Ducted Air Moving and Conditioning Equipment.
- O. ASHRAE Standard 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems.
- P. ASTM C1071 - Thermal and Acoustic Insulation (Mineral Fiber, Duct Lining Material).
- Q. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation

Material and Facings.

- R. ASTM E477 - Standard Test Method for Measure Acoustical and Airflow Performance of Duct Liner
- S. NFPA 70 - National Electrical Code
- T. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilation Systems.
- U. UL 1995 - Standard for Safety Heating and Cooling Equipment

#### **1.04 QUALITY ASSURANCE**

- A. Air Coils: Certify capacities, pressure drops and selection procedures in accordance with current AHRI Standard 410.
- B. Air handling units with fan sections utilizing single fans shall be rated and certified in accordance with AHRI Standard.
- C. Air handling units with fan sections utilizing multiple fans shall be rated in accordance with AHRI Standard 430 for airflow, static pressure, and fan speed performance.
- D. Airflow monitoring station: Certify airflow measurement station performance in accordance with AMCA 611.

#### **1.05 SUBMITTALS**

- A. No equipment shall be fabricated or delivered until the receipt of approved shop drawings from the Owner or Owner's approved representative.
- B. AHU manufacturer shall provide the following information with each shop drawing/product data submission:
  - 1. All electrical, piping, and ductwork requirements, including sizes, connection locations, and connection method recommendations.
  - 2. Each component of the unit shall be identified and mechanical specifications shall be provided for unit and accessories describing construction, components, and options.
  - 3. All performance data, including capacities and airside and waterside pressure drops, for components.
  - 4. Fan curves shall be provided for fans with the design operating points indicated. Data shall be corrected to actual operating conditions, temperatures, and altitudes.
  - 5. For units utilizing multiple fans in a fan section, a fan curve shall be provided showing the performance of the entire bank of fans at design conditions. In addition, a fan curve shall be provided showing the performance of each individual fan in the bank of fans at design conditions. Also, a fan curve shall be provided showing the performance of the bank of fans, if one fan is down. The percent redundancy of the bank of fans with one fan down shall be noted on the fan curve or in the tabulated fan data.
  - 6. A filter schedule must be provided for each air handling unit supplied by the air handling unit manufacturer. Schedule shall detail unit tag, unit size, corresponding filter section location within the AHU, filter arrangement (e.g., angled/flat), filter depth, filter type (e.g., pleated media), MERV rating, and filter quantity and size.



7. 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.
  8. A coil valve coordination schedule shall be provided for each air handling unit supplied by the air handling unit manufacturer. Schedule shall detail unit tag, coil type and corresponding section location within the AHU, valve style (e.g., global, ball), valve type (e.g., electronic 2-way/3-way), valve position (e.g., normally open/closed), size, flow coefficient (CV), and close-off pressure.
  9. An electrical MCA - MOP schedule shall be provided for each electrical circuit to which field-power must be supplied. Schedule to detail unit tag, circuit description, voltage/phase/hertz, Minimum Circuit Ampacity (MCA), and calculated Maximum Overcurrent Protection (MOP).
  10. 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.
- C. The AHU manufacturer shall provide appropriate sets of submittals as referenced in the General Conditions and shall submit to the Owner electronic copies of the IOM.

#### **1.06 REGULATOR REQUIREMENTS**

- A. Agency Listings/Certifications
1. Unit shall be manufactured to conform to UL 1995 and shall be listed by either UL/CUL or ETL. Units shall be provided with listing agency label affixed to the unit. In the event the unit is not UL/CUL or ETL approved, the contractor shall, at his/her expense, provide for a field inspection by a UL/CUL or ETL representative to verify conformance. If necessary, contractor shall perform modifications to the unit to comply with UL/CUL or ETL as directed by the representative, at no additional expense to the owner.
  2. Certify air handling units in accordance with AHRI Standard 430. Units shall be provided with certification label affixed to the unit. If air handling units are not certified in accordance with AHRI Standard 430, contractor shall be responsible for expenses associated with testing of units after installation to verify performance of fan(s). Any costs incurred to adjust fans to meet scheduled capacities shall be the sole responsibility of the contractor.
  3. Certify air handling coils in accordance with AHRI Standard 410. Units shall be provided with certification label affixed to the unit. If air handling coils are not certified in accordance with AHRI Standard 410, contractor shall be responsible for expenses associated with testing of coils after installation to verify performance of coil(s). Any costs incurred to adjust coils to meet scheduled capacities shall be the sole responsibility of the contractor.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Units shall ship fully assembled up to practical shipping and rigging limitations. Units not shipped fully assembled shall have tags and airflow arrows on each section to indicate location and orientation in direction of airflow. Shipping splits shall be clearly defined on submittal drawings. Cost associated with non-conformance to shop drawings shall be the responsibility of the manufacturer. Each section shall have lifting lugs for field rigging,

lifting and final placement of AHU section(s). AHU's less than 100-inches wide shall allow for forklift transport and maneuverability on the jobsite.

- C. Deliver units to jobsite with fan motor(s), sheave(s), and belt(s) completely assembled and mounted in units.
- D. Unit shall be shipped in a clear shrink-wrap or stretch-wrap to protect unit from in-transit rain and debris per ASHRAE 62.1 recommendations.
- E. Installing contractor shall be responsible for storing AHU in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

#### **1.08 START-UP AND OPERATING REQUIREMENTS**

- A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters in place, bearings lubricated (if applicable), condensate properly trapped, piping connections verified and leak-tested, belts aligned and tensioned, all shipping braces removed, bearing set screws torqued, and fan has been test-run under observation.

#### **1.09 WARRANTY**

- A. AHU manufacturer shall provide, at no additional cost, a standard parts warranty that covers a period of one year date of substantial completion. This warrants that all products are free from defects in material and workmanship and shall meet the capacities and ratings set forth in the equipment manufacturer's catalog and bulletins.

### **PART 2 PRODUCTS**

#### **2.01 ACCEPTABLE MANUFACTURERS**

- A. Manufacturer must clearly define any exceptions made to Plans and Specifications. Any deviations in layout or arrangement shall be submitted to consulting engineer prior to bid date. Acceptance of deviation(s) from specifications shall be in the form of written approval from the consulting engineer. Mechanical Contractor is responsible for expenses that occur due to exceptions made.
- B. Approved Manufacturers:
  - 1. Trane
  - 2. Daikin
  - 3. York/JCINote: No other alternate manufacturers will be accepted.

#### **2.02 GENERAL**

- A. Unit layout and configuration shall be as defined in project plans and schedule.
- B. Manufacturer to provide an integral base frame to support and raise all sections of the unit for proper trapping. Contractor will be responsible for providing a housekeeping pad when unit base frame is not of sufficient height to properly trap unit. Unit base frames not constructed of galvanized steel shall be chemically cleaned and coated with both a rust-inhibiting primer and finished coat of rust-inhibiting enamel. Unit base height to be included in trap

## 2.03 UNIT CASING

- A. Unit manufacturer shall ship unit in segments as specified by the contractor for ease of installation in tight spaces. The entire air handler shall be constructed of galvanized steel. Casing finished to meet ASTM B117 250-hour salt-spray test. The removal of access panels or access doors shall not affect the structural integrity of the unit. All removable panels shall be gasketed. All doors shall have gasketing around full perimeter to prevent air leakage. Contractor shall be responsible to provide connection flanges and all other framework that is needed to properly support the unit.
- B. Casing performance - Casing air leakage shall not exceed leak class 6 ( $CL = 6$ ) per ASHRAE 111 at specified casing pressure, where maximum casing leakage ( $\text{cfm}/100 \text{ ft}^2$  of casing surface area) =  $CL \times P^{0.65}$ .
- C. Air leakage shall be determined at 1.00 times maximum casing static pressure up to 8 inches w.g. Specified air leakage shall be accomplished without the use of caulk. Total estimated air leakage shall be reported for each unit in CFM, as a percentage of supply air, and as an ASHRAE 111 Leakage Class.
- D. Under 55F supply air temperature and design conditions on the exterior of the unit of 81F dry bulb and 73F wet bulb, condensation shall not form on the casing exterior. The AHU manufacturer shall provide tested casing thermal performance for the scheduled supply air temperature plotted on a psychrometric chart. The design condition on the exterior of the unit shall also be plotted on the chart. If tested casing thermal data is not available, AHU manufacturer shall provide, in writing to the Engineer and Owner, a guarantee against condensation forming on the unit exterior at the stated design conditions above. The guarantee shall note that the AHU manufacturer will cover all expenses associated with modifying units in the field should external condensate form on them. In lieu of AHU manufacturer providing a written guarantee, the installing contractor must provide additional external insulation on AHU to prevent condensation.
- E. 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 ( $L/240$ ).
- F. Floor panels shall be double-wall construction and designed to support a 250-lb load during maintenance activities and shall deflect no more than 0.0042 per inch of panel span.
- G. Unit casing panels shall be 2-inch double-wall construction, with solid galvanized exterior and solid galvanized interior, to facilitate cleaning of unit interior.
- H. Unit casing panels (roof, walls, floor) and doors shall be provided with a minimum thermal resistance (R-value) of  $13 \text{ Hr} \cdot \text{Ft}^2 \cdot ^\circ\text{F}/\text{BTU}$ .
- I. Unit casing panels (roof, walls, floor) and external structural frame members shall be completely insulated filling the entire panel cavity in all directions so that no voids exist. Panel insulation shall comply with NFPA 90A.
- J. Casing panel inner liners must not extend to the exterior of the unit or contact the exterior frame. A mid-span, no-through-metal, internal thermal break shall be provided for all unit casing panels.
- K. Access panels and/or access doors shall be provided in all sections to allow easy access

to drain pan, coil(s), motor, drive components and bearings for cleaning, inspection, and maintenance.

- L. Access panels and doors shall be fully removable without the use of specialized tools to allow complete access of interior surfaces.
- M. External surface of unit casing shall be prepared and coated with a minimum 1.5 mil enamel finish or equal. Units supplied with casing exterior factory-painted shall be able to withstand a salt spray test in accordance with ASTM B117 for a minimum of 500 consecutive hours. Unit casing exterior will be provided with manufacturer's standard color, or alternative color when required.
- N. A single layer outer/outdoor roof shall be utilized above the unit's inner roof and shall be sloped at a minimum 0.125 inches per foot either from one side of unit to other, or from center to sides of the unit. The roof assembly shall overhang all walls of units by a 1.5 inch minimum.
- O. Piping cabinets shall be supplied by the manufacturer (factory-assembled) and shall be of the same construction as the main unit casing. Piping cabinet shall be mounted external to the unit and shipped separate to be field installed.

#### **2.04 ACCESS DOORS**

- A. Access doors shall be 2-inch double-wall construction. Interior and exterior shall be of the same construction as the interior and exterior wall panels.
- B. All doors shall be provided with a thermal break construction of door panel and door frame.
- C. Gasketing shall be provided around the full perimeter of the doors to prevent air leakage.
- D. Door hardware shall be surface-mounted to prevent through-cabinet penetrations that could likely weaken the casing leakage and thermal performance.
- E. Handle hardware shall be designed to prevent unintended closure.
- F. Access doors shall be hinged and removable without the use of specialized tools to allow.
- G. Hinges shall be interchangeable with the door handle hardware to allow for alternating door swing in the field to minimize access interference due to unforeseen job site obstructions.
- H. Door handle hardware shall be adjustable and visually indicate locking position of door latch external to the section.
- I. All doors shall be a 60-inch high when sufficient unit height is available, or the maximum height allowed by the unit height.
- J. A single door handle shall be provided for each door linking multiple latching points necessary to maintain the specified air leakage integrity of the unit.
- K. A shatterproof window shall be provided in access doors where indicated on the plans.

#### **2.05 PRIMARY DRAIN PANS**

- A. All coil sections shall be provided with an insulated, double-wall, stainless steel drain pan.
- B. The drain pan shall be designed in accordance with ASHRAE 62.1 being of sufficient size to collect all condensation produced from the coil and sloped in two planes, pitched toward drain connections, promoting positive drainage to eliminate stagnant water conditions when unit is installed level and trapped per manufacturer's requirements. See section 2.07, paragraph F through H for specifications on intermediate drain pans between cooling coils.
- C. The outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.
- D. All drain pan threaded connections shall be visible external to the unit. Threaded connections under the unit floor shall not be accepted.
- E. Drain connections shall be of the same material as the primary drain pan and shall extend a minimum 2-1/2-inch beyond the base to ensure adequate room for field piping of condensate traps.
- F. The installing contractor is responsible to ensure the unit is installed level, trapped in accordance with the manufacturer's requirements, and visually inspected to ensure proper drainage of condensate.
- G. Coil support members inside the drain pan shall be of the same material as the drain pan and coil casing.
- H. If drain pans are required for heating coils, access sections, or mixing sections they will be indicated in the plans.

## **2.06 FANS**

- A. Fan sections shall have a minimum of one hinged and latched access door located on the drive side of the unit to allow inspection and maintenance of the fan, motor, and drive components. Construct door(s) per Section 2.04.
- B. Provide fans of type and class as specified on the schedule. Fan shafts shall be solid steel, coated with a rust-inhibiting coating, and properly designed so that fan shaft does not pass through first critical speed as unit comes up to rated RPM. All fans shall be statically and dynamically tested by the manufacturer for vibration and alignment as an assembly at the operating RPM to meet design specifications. Fans that are selected with inverter balancing shall first be dynamically balanced at design RPM. The fans then will be checked in the factory from 25% to 100% of design RPM to ensure they are operating within vibration tolerance specifications, and that there are no resonant frequency issues throughout this operating range. Inverter balancing that requires lockout frequencies inputted into a variable frequency drive in order to bypass resonant frequencies shall not be acceptable. If supplied in this manner by the unit manufacturer, the contractor will be responsible for rebalancing in the field after unit installation. Fans selected with inverter balancing shall have a maintenance free, circumferential conductive micro fiber shaft grounding ring installed on the fan motor to discharge shaft currents to ground.
- C. Belt-driven fans shall be provided with grease lubricated, self-aligning, anti-friction bearings selected for L-50 200,000-hour average life per ANSI/AFBMA Standard 9. Lubrication lines for both bearings shall be extended to the drive side of the AHU and

rigidly attached to support bracket with zerk fittings. Lubrication lines shall be a clear, high-pressure, polymer to aid in visual inspection. If extended lubrication lines are not provided, manufacturer shall provide permanently lubricated bearing with engineering calculations for proof of bearing life.

- D. All fans, including direct drive plenum fans, shall be mounted on isolation bases. Internally-mounted motor shall be on the same isolation base. Fan and motor shall be internally isolated with spring isolators. Unit sizes up to a nominal 4,000 CFM shall have 1-inch spring isolation. Units with nominal CFM's higher than 4,000 shall have 2-inch springs. A flexible connection shall be installed between fan and unit casing to ensure complete isolation. Flexible connection shall comply with NFPA 90A and UL 181 requirements. If fans and motors are not internally isolated, then the entire unit shall be externally isolated from the building, including supply and return duct work, piping, and electrical connections. External isolation shall be furnished by the installing contractor in order to avoid transmission of noise and vibration through the ductwork and building structure.
- E. Fan airflow measurement systems shall be provided as indicated on the schedule and drawings to measure fan airflow directly or to measure differential pressure that can be used to calculate airflow. The accuracy of the devices shall be no worse than +/- 5 percent when operating within stable fan operating conditions. Devices shall not affect the submitted fan performance and acoustical levels. Devices that obstruct the fan inlet or outlet shall not be acceptable. Devices shall be connected to transducers with selectable 4-20 mA or 2-10 VDC output. Signal shall be proportional to air velocity.
- F. **MOTORS AND DRIVES**
  - 1. All motors and drives shall be factory-installed and run tested. All motors shall be installed on a slide base to permit adjustment of belt tension. Slide base shall be designed to accept all motor sizes offered by the air-handler manufacturer for that fan size to allow a motor change in the future, should airflow requirements change. Fan sections without factory-installed motors shall have motors field installed by the contractor. The contractor shall be responsible for all costs associated with installation of motor and drive, alignment of sheaves and belts, run testing of the motor, and balancing of the assembly.
  - 2. Motors shall meet or exceed all NEMA Standards Publication MG 1 - 2006 requirements and comply with NEMA Premium efficiency levels when applicable. Motors shall comply with applicable requirements of NEC and shall be UL Listed.
  - 3. Fan Motors shall be heavy duty, open drip-proof operable at 460 volts, 60Hz, 3-phase. If applicable, motor efficiency shall meet or exceed NEMA Premium efficiencies.
  - 4. Belt driven fans shall use 4-pole, 1800 rpm, motors, NEMA B design, with Class B insulation, capable to operate continuously at 104 deg F (40 deg C) without tripping overloads.
  - 5. Direct driven fans shall use 2-pole (3600 rpm), 4-pole (1800 rpm) or 6-pole (1200 rpm) motors, NEMA Design B, with Class B insulation capable to operate continuously at 104 deg F (40 deg C) without tripping overloads.
  - 6. Motors shall have a +/- 10 percent voltage utilization range to protect against voltage variation.
  - 7. V-Belt Drive shall be fixed pitch rated at 1.5 times the motor nameplate. Drives 20 hp and larger or any drives on units equipped with VFDs shall be fixed pitch.
  - 8. All fans with motors 15 hp and larger shall be equipped with multiple belt drives.
  - 9. Manufacturer shall provide for each fan a nameplate with the following information to assist air balance contractor in start up and service personnel in maintenance. Fan and motor sheave part number. Fan and motor bushing part

number. Number of belts and belt part number. Fan design RPM and motor HP.  
Belt tension and deflection. Center distance between shafts

## **2.07 COILS**

- A. Coils section header end panel shall be removable to allow for removal and replacement of coils without impacting the structural integrity of the unit.
- B. Install coils such that headers and return bends are enclosed by unit casing to ensure that if condensate forms on the header or return bends, it is captured by the drain pan under the coil.
- C. Coils shall be manufactured with plate fins to minimize water carryover and maximize airside thermal efficiency. Fin tube holes shall have drawn and belled collars to maintain consistent fin spacing to ensure performance and air pressure drop across the coil as scheduled. Tubes shall be mechanically expanded and bonded to fin collars for maximum thermal conductivity. Use of soldering or tinning during the fin-to-tube bonding process is not acceptable due to the inherent thermal stress and possible loss of bonding at that joint.
- D. Construct coil casings of galvanized steel. End supports and tube sheets shall have belled tube holes to minimize wear of the tube wall during thermal expansion and contraction of the tube.
- E. All coils shall be completely cleaned prior to installation into the air handling unit. Complete fin bundle in direction of airflow shall be degreased and steam cleaned to remove any lubricants used in the manufacturing of the fins, or dirt that may have accumulated, in order to minimize the chance for water carryover.
- F. When two or more cooling coils are stacked in the unit, an intermediate drain pan shall be installed between each coil. The intermediate drain pan shall be designed being of sufficient size to collect all condensation produced from the coil and sloped to promote positive drainage to eliminate stagnant water conditions. The intermediate drain pan shall be constructed of the same material as the sections primary drain pan.
- G. The intermediate drain pan shall begin at the leading face of the water-producing device and be of sufficient length extending downstream to prevent condensate from passing through the air stream of the lower coil.
- H. Intermediate drain pan shall include downspouts to direct condensate to the primary drain pan. The intermediate drain pan outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.
- I. Hydronic Coils
  - 1. Supply and return header connections shall be clearly labeled on unit exterior such that direction of coil water-flow is counter to direction of unit air-flow.
  - 2. Coils shall be proof-tested to 300 psig and leak-tested to 200 psig air pressure under water.
  - 3. Headers shall be constructed of round copper pipe or cast iron.
  - 4. Tubes shall be copper with aluminum fins. Tube thickness and diameter shall be as indicated on plans.
  - 5. Hydronic coils shall be supplied with factory installed drain and vent piping to the unit exterior.

## **2.08 FILTERS**

- A. Provide factory-fabricated filter section of the same construction and finish as unit casings. Filter section shall have side access filter guides and access door(s) extending the full height of the casing to facilitate filter removal. Construct doors in accordance with Section 2.04. Provide fixed filter blockoffs as required to prevent air bypass around filters. Blockoffs shall not need to be removed during filter replacement. Filters to be of size, and quantity needed to maximize filter face area of each particular unit size.
- B. Filter type, MERV rating, and arrangement shall be provided as defined in project plans and schedule
- C. Manufacturer shall provide one set of startup filters.
- D. Each filter section shall be provided with a factory-installed, flush-mounted Dwyer dial-type differential pressure gauge piped to both sides of the filter to indicate status. Gauge shall maintain a +/- 5 percent accuracy within operating temperature limits of -20°F to 120°F. Filter sections consisting of pre- and post-filters shall have a gauge for each.

## **2.09 DAMPERS**

- A. All dampers, 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 4 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. Manufacturer shall submit brand and model of damper(s) being furnished, if not Ruskin CD60.
- B. Airflow measuring stations shall be provided and located in the outside and/or return air paths as indicated on the schedule and plans to measure airflow. Airflow measuring stations shall be tested per AMCA Standard 611 and licensed to bear the AMCA Ratings Seal for airflow measurement performance. Integral control damper blades shall be provided as galvanized steel and housed in a galvanized steel frame. Leakage rate shall not exceed 4 CFM/square foot at one inch water gauge complying with ASHRAE 90.1 maximum damper leakage.
  - 1. The airflow measurement station shall measure up to 100 percent of the total outside air and/or return air. The airflow measurement station shall be capable of measuring down to 300 fpm. The airflow measuring device shall adjust for temperature variations. Output shall be provided from the station as a 2-10 VDC signal. Signal shall be proportional to air velocity. The accuracy of the measuring station shall be no greater than +/- 5 percent. Airflow measuring stations shall be mounted on the AHU interior.
  - 2. The installing contractor shall provide duct-mounted pleated media MERV 8 filtration upstream of airflow monitoring stations requiring air straightening vanes to prevent blockage of vanes. A filter access door shall be provided for filter replacement that does not degrade the specified duct leakage class. Duct-mounted filtration section with access door for filter removal shall be tested for compliance to specified duct leakage class on the schedule and plans.



## **2.10 ACCESS SECTIONS**

- A. Access sections shall be provided where indicated in the schedule and plans to allow additional access for inspection, cleaning, and maintenance of unit components. The unit shall be installed for proper access. Procedure for proper access, inspection and cleaning of the unit shall be provided in the AHU manufacturer's maintenance manual. Access section doors shall be constructed per Section 2.04.

## **2.11 AIR MIXER/BLENDER SECTION**

- A. Air mixers (blenders) shall be provided and located as indicated on the schedule and drawings. Mixers shall incorporate fixed blades, with no moving parts. Mixer panels shall be sized and installed in the unit with adequate distances upstream and downstream, based on the manufacturer's cataloged performance, to ensure a minimum mixing effectiveness of 70% at 25% outside air, at one mixer diameter downstream of the mixer.

## **2.12 DISCHARGE PLENUM SECTIONS**

- A. Plenums shall be provided as indicated in the schedule and plans to efficiently turn air and provide acoustical attenuation. Discharge plenum opening types and sizes shall be scaled to meet pressure drop requirements scheduled and align with duct takeoffs.

## **2.13 MARINE LIGHTS**

- A. Marine lights shall be provided throughout AHUs as indicated on the schedule and plans. Lights shall be instant-on, light-emitting diode (LED) type to minimize amperage draw and shall produce lumens equivalent to a minimum 75W incandescent bulb (1200 lumens). LED lighting shall provide instant-on, white light and have a minimum 50,000 hr life.
- B. Light fixture shall be weather-resistant, enclosed and gasketed to prevent water and dust intrusion.
- C. Fixtures shall be designed for flexible positioning during maintenance and service activities for best possible location providing full light on work surface of interest and not being blocked by technician.
- D. All lights on a unit shall be wired in the factory to a single on-off switch.
- E. Installing contractor shall be responsible for providing 115V supply to the factory-mounted marine light circuit.

## **PART 3 EXECUTION**

### **3.01 SHIPPING**

- A. Paper copies of the IOM shall also be shipped with each AHU.
- B. The AHU manufacturer shall identify all shipments with the order number. Enough information shall be provided with each shipment to enable the Mechanical Contractor to confirm the receipt of units when they are received. For parts too small to mark individually, the AHU manufacturer shall place them in containers.
- C. To protect equipment during shipment and delivery, all indoor units shall be completely

stretch or shrink wrapped. Wrap shall be a minimum of 7 mil plastic. Pipe ends and pipe connection holes in the casing shall be capped or plugged prior to shipment

- D. After loading the equipment for shipment, the AHU manufacturer shall contact the shipping contact on the order and provide the name of the carrier, description of equipment, order number, shipping point, and date of shipment.

### **3.02 ON-SITE STORAGE**

- A. If equipment is to be stored for a period of time prior to installation, the Mechanical Contractor shall remove all stretch or shrink wrap from units upon receipt to prevent unit corrosion and shall either place the units in a controlled indoor environment or shall cover the units with canvas tarps and place them in a well-drained area. Covering units with plastic tarps shall not be acceptable.

### **3.03 FIELD EXAMINATION**

- A. The Mechanical Contractor shall verify that the mechanical room and/or roof are ready to receive work and the opening dimensions are as indicated on the shop drawings and contract documents.
- B. The Mechanical Contractor shall verify that the proper power supply is available prior to starting of the fans.

### **3.04 INSTALLATION**

- A. The Mechanical Contractor shall be responsible to coordinate ALL of his installation requirements with the Owner and the Owner's selected Mechanical Contractor to ensure that a complete installation for each unit is being provided. Coordination efforts shall include such items as unloading and hoisting requirements, field wiring requirements, field piping requirements, field ductwork requirements, requirements for assembly of field-bolted or welded joints, and all other installation and assembly requirements.
- B. The AHU manufacturer shall provide all screws and gaskets for joining of sections in the field.
- C. The Mechanical Contractor shall verify that the following items have been completed prior to scheduling the AHU manufacturer's final inspection and start up:
  - 1. All spring-isolated components have had their shipping restraints removed and the components have been leveled.
  - 2. On all field-joined units, that all interconnections have been completed, i.e., electrical and control wiring, piping, casing joints, bolting, welding, etc.
  - 3. All water and steam piping connections have been completed and hydrostatically tested and all water flow rates have been set in accordance with the capacities scheduled on the Drawings.
  - 4. All ductwork connections have been completed and all ductwork has been pressure tested for its intended service.
  - 5. All power wiring, including motor starters and disconnects, serving the unit has been completed.
  - 6. All automatic temperature and safety controls have been completed.
  - 7. All dampers are fully operational.
  - 8. All shipping materials have been removed.
  - 9. All (clean) filter media has been installed in the units.

### **3.05 LEVELING**

- A. The Mechanical Contractor shall level all unit sections in accordance with the unit manufacturer's instructions. The Mechanical Contractor shall provide and install all necessary permanent shim material to ensure individual sections and entire assembled units are level.

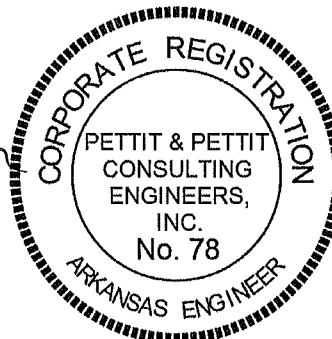
### **3.06 FINAL INSPECTION AND START UP SERVICE**

- A. After the Mechanical Contractor has provided all water and steam piping connections, ductwork connections, and field control wiring, and Electrical Contractor has provided all the field power wiring, the Mechanical Contractor shall inspect the installation. The Mechanical Contractor shall then perform startup of the equipment.
- B. The Automatic Temperature Control (Building Direct Digital Control) Contractor shall be scheduled to be at the job site at the time of the equipment start up.
- C. The Mechanical Contractor, shall perform the following tests and services and submit a report outlining the results:
  - 1. Record date, time, and person(s) performing service.
  - 2. Lubricate all moving parts.
  - 3. Check all motor and starter power lugs and tighten as required.
  - 4. Verify all electrical power connections.
  - 5. Conduct a start up inspection per the AHU manufacturer's recommendations.
  - 6. Record fan motor voltage and amperage readings.
  - 7. Check fan rotation and spin wheel to verify that rotation is free and does not rub or bind.
  - 8. Check fan for excessive vibration.
  - 9. Check V belt drive or coupling for proper alignment.
  - 10. Check V belt drive for proper tension. Tighten the belts in accordance with the AHU manufacturer's directions. Check belt tension during the second- and seventh-day's operation and re-adjust belts, as may be required, to maintain proper tension as directed by the AHU manufacturer.
  - 11. Remove all foreign loose material in ductwork leading to and from the fan and in the fan itself.
  - 12. Disengage all shipping fasteners on vibration isolation equipment.
  - 13. Check safety guards to ensure they are properly secured.
  - 14. Secure all access doors to the fan, the unit and the ductwork.
  - 15. Switch electrical supply "on" and allow fan to reach full speed.
  - 16. Physically check each fan at start up and shut down to ensure no abnormal or problem conditions exist.
  - 17. Check entering and leaving air temperatures (dry bulb and wet bulb) and simultaneously record entering and leaving chilled water temperatures and flow, steam pressures and flow, and outside air temperature.
  - 18. Check all control sequences.

**END OF SECTION**

The Engineer of Record for Divisions 26 and 28 of the Specifications for the Schichtl Hall HVAC Upgrades Project, University of Central Arkansas, Conway, Arkansas, (Pettit & Pettit Job No. 22-003A) is:

1-3-23  
Date



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**SECTION 26 0500  
COMMON WORK RESULTS FOR ELECTRICAL**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Basic Electrical Requirements specifically applicable to Divisions 26 and 28 Sections, in addition to Division 1 - General Requirements.

**1.02 REFERENCES**

- A. The following specifications and standards of issues listed below but referred to thereafter by basic designation only, form a part of these specifications:
  - 1. American Society for Testing Materials.
  - 2. American Standards Association.
  - 3. Americans with Disabilities Act (ADA).
  - 4. Arkansas Energy Code (ASHRAE 90.1).
  - 5. Arkansas Fire Prevention Code.
  - 6. Illuminating Engineering Society.
  - 7. Institute of Electrical and Electronic Engineers.
  - 8. International Building Code.
  - 9. Local, City and State Codes and Ordinances.
  - 10. National Electrical Code, 2017 Edition.
  - 11. National Electrical Manufacturers Association.
  - 12. National Electrical Safety Code, 2002 Edition.
  - 13. National Fire Protection Association's Recommended Practices.
  - 14. Occupational Safety and Health Act.
  - 15. Power Cable Engineers Association.
  - 16. Service requirements of serving utility company.
  - 17. Underwriter's Laboratories, Inc.

**1.03 SUBMITTALS**

- A. Submit six (6) sets of shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal. The basic information for each item of equipment to be included is as follows:
  - 1. Index.
  - 2. Installation and Operating Instructions
    - a. Individual tabbed sections.
    - b. Manufacturer descriptive literature.
    - c. Applicable control diagrams.
    - d. Composite wiring diagrams.
  - 3. Each submittal sheet shall be clearly marked with equipment Catalog Number and accessory items being submitted.

**1.04 REGULATORY REQUIREMENTS**

- A. Work shall conform to all applicable codes, specifications, local ordinances, industry standards and utility company regulations.
- B. Notwithstanding any reference in the specifications to any article, device, product, material, fixture, form or type of construction by name, make or catalog number, such references shall be interpreted as establishing a standard of quality and shall not be construed as limiting

competition. The Contractor, in such cases, may at his option propose any article, approved equal to or better than that specified, as approved in writing by the Engineer.

- C. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations.
- D. In case of difference between building codes, specifications, state laws, local ordinances, industry standards, and utility company regulations and the contract documents, the most stringent shall govern. The Contractor shall promptly notify the Engineer in writing of any such difference.
- E. Non-Compliance: Should the contractor perform any work that does not comply with the requirements of the applicable building codes, state laws, local ordinances, industry standards and utility company regulations, he shall bear all costs arising in correcting the deficiencies.
- F. All required fees, permits and inspections shall be obtained and paid for by the contractor under the section of the specifications for which they are required.

#### **1.05 ELECTRICAL LICENSE REQUIREMENT**

- A. No person shall perform electrical work on the Contract without possessing an Arkansas State Master or Journeyman License from the Arkansas State Electrical Examiner's Board. All electrical work and apprentice electricians shall be supervised by a Master or Journeyman Electrician on a one-to-one ratio.
- B. All electricians shall have a copy of their license with them and shall be required to show it to an appropriate inspector upon request.
- C. The Arkansas Department of Labor requires that the worker, who installs raceway for low voltage cables of temperature controls, fire alarm, telecommunications, intrusion detection, access control, public address, television distribution, etc., be paid the electrician's minimum wage rate.

#### **1.06 PROJECT/SITE CONDITIONS**

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions. The Engineer/Owner reserves the right to relocate any device a maximum distance of 6'-0" at the time of installation without an extra cost being incurred.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Engineer before proceeding.

#### **1.07 CONTRACTOR REVISED DRAWINGS**

- A. The Contractor shall, during the progress of the work, keep an accurate record of all changes and corrections from the layouts shown on the drawings. Record of changes may be kept by accurately making all changes on a set of prints during the progress of the job.
- B. Upon completion of the work and prior to final payment, the Contractor shall furnish to the Engineer, one set of "contractor revised" reproductions, legibly and accurately marked to indicate all changes, additions, deletions, etc., from the contract drawings.

## **1.08 GUARANTEE**

- A. The work herein specified shall be free from defects in workmanship and material under normal use and service. If, within twelve (12) months from date of substantial completion and Owner acceptance of the work herein described, any of the equipment or materials, or the installation thereof, is found to be defective in workmanship or material, it shall be replaced or repaired free of charge.
- B. The Contractor shall, after completion of the original test of the installation, and acceptance by the Engineer, provide any service incidental to the proper performance of the electrical systems under guarantees outlined above for a period of one (1) year.

## **1.09 OPERATING AND MAINTENANCE MANUALS**

- A. After approval of materials and equipment for use in this project, 3 copies of an Operation and Maintenance Manual shall be submitted for approval.
- B. The basic information for each item of equipment to be included is as follows:
  - 1. Index
  - 2. Maintenance and operating instructions
    - a. Manufacturer's descriptive literature and maintenance manuals
    - b. An Approved Set of Shop drawings
    - c. Applicable control diagrams
    - d. Composite wiring diagrams as applicable showing all motor controllers, relays, etc., with interlocking provisions as built in the job, along with a written description of the control sequence if applicable.
    - e. Spare parts list (when parts are provided)
    - f. Listing of part suppliers and their addresses
    - g. Single line diagram of the "as built" building electrical distribution system.
- C. Upon final approval, submit one (1) bound copy of the approved Operation and Maintenance Manual to the Engineer and hold two (2) copies for instruction of Owner as hereinafter specified.

## **1.10 CONFLICTS BETWEEN DRAWINGS AND SPECIFICATIONS**

- A. If a conflict between the drawings and the specifications occurs, the most stringent requirement shall apply.

## **PART 2 PRODUCTS**

### **2.01 UL LISTING**

- A. Where the Underwriter's Laboratories have an applicable standard, the product shall be listed with UL and shall be so marked.

### **2.02 SUBSTITUTIONS**

- A. Each Section of the Project Manual, when applicable has a paragraph entitled "Manufacturers". If "Engineer Approved Equal" is not in the list of manufacturers, no substitutions will be accepted. Submit one of the manufacturers listed.
- B. The Engineer does not give any prior approvals on submittals. Do not call the Engineer for prior approval.

## **PART 3 EXECUTION**

### **3.01 600 VOLT INSULATION TEST**

- A. Prior to energizing the electrical system, the contractor shall provide insulation resistance tests for all distribution and utilization equipment. The Contractor shall provide a suitable and stable source of test power. The insulation test shall be a "megger" test at 500 volts D.C. for one-half minute. A test report shall be submitted to the Engineer. The minimum insulation resistance for No. 12 AWG conductors shall be 1,000,000 ohms and for larger conductors shall be 250,000 ohms. Conductors testing below the minimum insulation resistance shall be replaced and tested again.

### **3.02 CONTINUITY TEST**

- A. The Contractor shall perform a continuity test on the entire electrical system prior to energizing the system to ensure proper cable connections.

### **3.03 CONNECTION TORQUE TESTS**

- A. All No. 1/0 AWG and larger conductors with bolted connections shall be torque tested using a torque wrench. Torque shall be to National Electrical Testing Association's (NETA) Standards.

### **3.04 REMOVAL OF RUBBISH**

- A. Contractor shall remove his rubbish from building site at intervals and shall maintain the spaces allotted him in an orderly manner. On completing his work, and prior to submission of final estimate, he shall remove all tools, appliances, material and rubbish from the grounds.

### **3.05 GROUND RESISTANCE MEASUREMENTS**

- A. Ground resistance measurements of each ground rod shall be taken and certified by the Contractor to the Engineer. No part of the electrical distribution system shall be energized prior to the resistance testing of that system's ground rods and grounding system and submission of test results to the Engineer. Test reports shall indicate the location of the ground rod and grounding system and the resistance and the soil conditions at the time the test was performed. When the building water service is used as a ground of part of the grounding system, ground-resistance measurements shall also be made of this connection. Ground resistance measurements shall be made in normally dry weather, not less than 48 hours after rainfall, and with the ground under test isolated from other grounds. The resistance to ground shall be measured using the fall-of-potential method described in IEEE No. 142. Submit test reports with Operation and Maintenance Manuals.

### **3.06 MECHANICAL OPERATION TESTS**

- A. All electrical equipment, such as switches, circuit breakers, etc., shall be tested by operating the device to verify that the mechanical portions of the device are functioning.

### **3.07 ROTATIONAL TESTS**

- A. The Contractor shall assist Division 15 in performing rotational tests on all motors. If rotational tests determine that conductors must be transposed to change direction of rotation, the conductors shall be changed at the make-up box on the motor; or if the change is made elsewhere, then the conductor's color coding shall be changed.



### **3.08 INSTRUCTING OWNER'S REPRESENTATIVE**

- A. The Contractor shall instruct representatives of the Owner in the proper operation and maintenance of all elements of the Electrical system.
- B. Contractor shall spend not less than one (1) day in such formal instruction to fully prepare the Owner's representative to operate and maintain the Electrical systems.

### **3.09 UL LISTINGS**

- A. The Contractor shall bear all responsibility for any work, which he performs, that voids any UL listings of any equipment.

### **3.10 OWNER OCCUPIED BUILDINGS**

- A. Holes cut in Owner occupied buildings shall be done with drills with vacuum attachments that vacuum cuttings as the drill cuts.
- B. All drilling, hammering, or other loud construction activities shall be done after Owner's normal working hours.
- C. Conduit cutting will be done outside.
- D. Contractor shall clean work area at the end of each day.

### **3.11 OBJECTIONABLE NOISE AND/OR HARMONICS**

- A. If after installation of the electrical system, it is found that objectionable noise or harmonics exists on the electrical system, the manufacturer of the equipment which is producing the objectionable noise or harmonics shall install the proper electrical equipment to prevent the noise and/or harmonics from emitting onto the building's electrical system and shall be contained within the offending equipment.

### **3.12 VOLTAGE MEASUREMENTS**

- A. Contractor shall measure and record voltage at service equipment with as much load on the system as possible. Contractor shall measure and record phase-to-phase, phase-to-neutral, and phase-to-equipment ground voltages for each phase. Where harmonic cancellation transformers are installed, contractor shall also measure and record phase-to-phase, phase-to-neutral and phase-to-equipment ground voltages for each phase on the secondary side of the transformers. Contractor shall submit records of these voltages with the Operation and Maintenance Manuals.

### **3.13 REMOVAL OF PAINT AND OTHER FINISHES**

- A. The contractor shall remove all paint and other non-factory finishes applied inadvertently by other subcontractors to all electrical equipment.

### **3.14 TEMPORARY CONSTRUCTION POWER AND LIGHTING**

- A. The contractor shall provide all necessary temporary construction power and lighting to accomplish the work.
- B. After the construction is completed, the contractor shall remove all temporary construction

power and lighting.

**3.15 PROJECT PHASING**

- A. The contractor shall become familiar with the project phasing prior to his bidding the project and shall include in his bid, the amount of money required by him to provide the necessary labor, materials, adjustments, programming, reprogramming, and accessories to provide the project in the phases shown within the general conditions of the contract documents.

**END OF SECTION**

**SECTION 26 05 01  
ELECTRICAL DEMOLITION**

**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 0 Specification sections, apply to work specified in this section.

**1.02 REGULATORY REQUIREMENTS**

- A. Conform to the requirements of NFPA 70 - National Electrical Code.

**1.03 DESCRIPTION OF WORK**

- A. The extent of general building demolition work is shown on drawings. Coordinate the required electrical work with the general demolition.
- B. Demolition includes removal and disposal of demolished materials, as shown on drawings and herein specified.
- C. Interior demolition includes work in crawl spaces, work above ceilings, finishes, and removal and disposal of demolished materials, as shown on drawings and herein specified.
- D. The Owner shall have the option of retaining any items removed. The Contractor shall dispose of all material off site, unless directed otherwise by Owner.

**1.04 JOB CONDITIONS**

- A. Condition of Structures: The Owner assumes no responsibility for actual condition of structures to be demolished.
  - 1. Conditions of the structure existing at time of inspection for bidding purposes will be maintained by Owner in so far as practicable. However, variations within structure may occur by Owner's removal and salvage operations prior to start of demolition work. The drawings are schematic and provided as an aid in bidding. The contractor shall visit the site and determine the actual conditions prior to bidding.
- B. Partial Removal: Items of salvable value to Contractor may be removed from structure as work progresses. Salvaged items must be transported from site as they are removed.
  - 1. Storage or sale of removed items on site will not be permitted.
- C. Traffic: Conduct demolition operations and removal of debris to ensure minimum interference with roads, streets, walks, occupied areas, and other adjacent occupied or used facilities.
- D. Protections: Ensure safe passage of persons around or through area of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities, and persons.
  - 1. Install temporary electrical services, lighting, etc. as required by the Owner or authorities having jurisdiction.
- E. Damages: Promptly repair damages caused to adjacent facilities by demolition operations at no cost to Owner.
- F. Utility Services: Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations. Allow no interruption in service unless coordinated with

Owner at least 24 hours in advance.

1. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing fire utilities, as acceptable to governing authorities.
  2. Contractor will disconnect and seal utilities serving each structure to be demolished, or interior area to be demolished, prior to start of demolition work.
- G. If Contractor is required to disconnect utility services or other services to an occupied area the Contractor shall provide temporary or alternative services to that area.

## **PART 2 PRODUCTS**

**Not Applicable.**

## **PART 3 EXECUTION**

### **3.01 DEMOLITION**

- A. Remove all branch and feeder conduit and wire back to panelboards.
1. Where walls, ceilings, or floors are to remain, remove all devices, and wire where indicated. Provide blank cover plate at outlet box or patch wall to match existing finish as directed by the issued documents and/or the Architect/Engineer.
  2. All items shown to remain active shall be furnished with necessary accessible junction boxes and all conduit and wire as required to maintain circuit continuity.
  3. All outlet boxes which must be removed due to demolition but which must remain active in order to maintain circuit continuity shall be relocated into ceilings or walls and shall be accessible.
  4. All material, fixtures, and equipment to be reused shall be removed and stored on site. Before reinstallation all items are to be cleaned, tested, and prepared for re-use. Fixtures shall be re-lamped and new ballasts installed.
  5. Correct existing directories of load centers, panelboards, and switchboards where circuits are removed and/or added. Corrections to existing directories of load centers and panelboards shall be neatly handwritten. Nameplates are required at switchboards.
  6. Conduit in a concrete slab or that is not shown to be reused, may be abandoned provided as follows:
    - a. Conduits in slab shall be cut off at top of slab.
    - b. Underground conduits shall be removed to 12 inches below grade before being abandoned.
  7. Fire seal all holes in fire and/or smoke walls and floors where conduits are removed.
- B. Remove all accessible low-voltage cables that are not to be reused.
1. This includes data, telephone, television, audio/visual, intercom, fire alarm, security, access control, public address, and temperature control cables.
  2. Fire seal holes where these cables penetrated fire and/or smoke walls and floors.

### **3.02 DISPOSAL OF DEMOLISHED MATERIALS**

- A. General: Remove from site debris, rubbish, and other materials resulting from demolition operations. Pay all fees related to removal and dumping.
1. Remove and dispose of interior demolition debris only.
  2. Burning of removed materials from demolished structures will not be permitted on site.
- B. Removal:
1. Transport materials removed from demolished structures and dispose of off site.

- C. Store items that Owner wishes to retain as directed by the Owner.

### **3.03 OUTAGES**

- A. The Contractor shall schedule all outages with the Owner at least two weeks in advance. Owner has the right to approve or disapprove any scheduled outages. Contractor will schedule the outage at the Owner's convenience. Contractor shall pay all costs, including overtime, necessary for the outage work schedule.
- B. Refrigerators and freezers shall not be turned off for more than 1 hour. If the Contractor needs more than 1 hour, he shall install a temporary feeder to the equipment and/or rent an emergency generator to power the equipment. Contractor shall pay all costs of the generator and/or temporary feeders at no additional cost to the Owner.

**END OF SECTION**

**SECTION 26 0502  
EQUIPMENT WIRING SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Electrical connections to elevator, plumbing, appliances, and mechanical equipment specified under other sections or Owner furnished equipment.

**1.02 RELATED SECTIONS**

- A. Section 26 0533 – Raceway and Boxes for Electrical Systems.
- B. Section 26 0519 – Low-Voltage Electrical Power Connectors and Cable.
- C. Section 26 0529 – Hangers and Supports for Electrical Systems.
- D. Section 28 3100 – Fire Detection and Alarm.

**1.03 REFERENCES**

- A. ANSI/NFPA 70 - National Electrical Code.
- B. NEMA WD 1 - General Purpose Wiring Devices.
- C. NEMA WD 6 - Wiring Device Configurations.
- D. NFPA 72 - National Fire Alarm Code.
- E. UL 498 - Attachment Plugs and Receptacles.
- F. UL 1010 - Receptacle Plug Combinations for Use in Hazardous (Classified) Locations.

**1.04 SUBMITTALS**

- A. Submit under provisions of Division 1 and Section 26 0500.
- B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

**1.05 REGULATORY REQUIREMENTS**

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.
- C. Conform to requirements of the Arkansas State Fire Protection Code.

**1.06 COORDINATION**

- A. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections. Verify voltage, ampere, and phase ratings before beginning any of the work. Notify Engineer immediately of any discrepancies found. Any work installed that has to be replaced because of the contractor's failure to verify these ratings will not be reimbursed. Verify that equipment furnished under other sections has disconnects and starters, if so specified in other sections.
- B. Determine connection locations and requirements.
- C. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
- D. Sequence electrical connections to coordinate with start-up schedule for equipment.

## **PART 2 PRODUCTS**

### **2.01 CORDS AND CAPS**

- A. Manufacturers:
  - 1. Hubbell.
  - 2. Pass & Seymour.
  - 3. Arrow-Hart.
- B. Attachment Plug Construction: Conform to NEMA WD 1.
- C. Configuration: NEMA WD-6; match receptacle configuration at outlet provided for equipment.
- D. Cord Construction: ANSI/NFPA 70, Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
- E. Size: Suitable for connected load of equipment, length of cord, and rating at branch circuit overcurrent protection.

### **2.02 BOILER SAFETY SHUTDOWN EQUIPMENT FOR BOILERS**

- A. Normally closed pushbutton(s) shall be equal to Square D #SK9RD5H13 with additional KA1 contacts for additional boilers.
- B. Power Relay shall be equal to Square D Class 8501 Type CO-7 in a NEMA 1 enclosure.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

### **3.02 ELECTRICAL CONNECTIONS**

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using liquidtight flexible conduit with watertight connectors.

- C. Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.
- D. Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated.
- E. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- F. Install disconnect switches, controllers, control stations, and control devices as indicated and as required by applicable codes.
- G. Provide interconnecting conduit and wiring between devices and equipment where indicated.
- H. All flexible conduit to pumps, chillers, air handling units, outdoor equipment, and water heaters shall be liquidtight.
- I. Ground all metal equipment. Ensure that bonding breaks through paint to bare metallic surface of all painted metallic equipment.
- J. The contractor shall check overload settings, wire sizes, fuse/circuit breaker sizes & disconnect sizes of equipment provided by others for compliance with the National Electrical Code and shall:
  - 1. Adjust settings where possible.
  - 2. Advise the Engineer of non-compliance where remedy will require more than just adjustments.

**END OF SECTION**



**SECTION 26 0519**  
**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLE**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Building wire and cable.
- B. Wiring connectors and connections.

**1.02 RELATED SECTIONS**

- A. Section 26 0529 – Hangers and Supports for Electrical Systems.
- B. Section 26 0533 – Raceway and Boxes for Electrical Systems.
- C. Section 26 0553 – Identification for Electrical Systems.

**1.03 REFERENCES**

- A. ANSI/NFPA 70 - National Electrical Code.
- B. NETA – National Electrical Testing Association.
- C. UL 83 - Thermoplastic Insulated Wires and Cables.
- D. UL 486 A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- E. UL 486 C - Splicing Wire Connectors.
- F. UL 1581 - Reference Standard for Electrical Wires, Cables and Flexible Cords.

**1.04 SUBMITTALS**

- A. Submit under provisions of Division 1 and Section 26 0500.
- B. Product Data: Provide for each wire and cable type.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

**1.05 QUALIFICATIONS**

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

**1.06 REGULATORY REQUIREMENTS**

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

**1.07 PROJECT CONDITIONS**

- A. Verify that field measurements are as shown on Drawings.
- B. Conductors shall be copper.
- C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.
- D. Where wire and cable routing are not shown, and destination only is indicated, determine exact routing and lengths required.

## **1.08 COORDINATION**

- A. Determine required separation between cable and other work.
- B. Determine cable routing to avoid interference with other work.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS - BUILDING WIRE AND CABLE**

- A. Triangle.
- B. American.
- C. Southwire
- D. Engineer Approved.

### **2.02 BUILDING WIRE AND CABLE**

- A. Description: Single conductor insulated wire.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation: ANSI/NFPA 70, Type THW (feeder circuits) and THHN/THWN (branch circuits).
- E. Aluminum conductors may be used for panel feeders #4/0 awg and larger. Refer to the electrical plans for locations approved for aluminum feeders.

### **2.03 WIRING CONNECTORS/LUGS**

- A. All cable and wire terminals, lugs, taps, and splices shall be made secure with compression type connectors, approved for the service. Connections shall be installed with approved tools and dies to assure a permanent secure joint. Compression joints shall be cleaned and made smooth with insulating compound. Connectors in dry locations shall be wrapped with varnish cambric and insulated with approved electrical grade plastic tape. Where conductors are to be connected to metallic surfaces, the coated surfaces of the metal shall be polished before installing the connector. Lacquer coating of conduits shall be removed where ground clamps are to be installed. Provide all necessary hangers, racks, cleats, and supports required to make a neat installation. Wire connectors shall conform to UL 486.

- B. Connectors in wet or damp locations shall be covered with heat shrinkable products equal to Scotch #ITCSN Series.
- C. Contractor shall provide and install all connectors, taps, lugs, and splices as required to connect all wires and cables provided under the contract. Contractor shall torque all bolted connections to manufacturer's specifications. If manufacturer's specifications do not apply, use NETA specifications.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Prior to installation verify that interior of building has been protected from weather.
- B. Prior to installation verify that mechanical work likely to damage wire and cable has been completed.

### **3.02 PREPARATION**

- A. Completely and thoroughly swab raceway before installing wire.

### **3.03 WIRING METHODS**

- A. Interior Locations: Use only building wire, Type THW or use THHN/THWN insulation, in raceway unless otherwise indicated on the Drawings.
- B. Wet or Damp Interior Locations: Use only building wire, Type THW or THHN/THWN in raceway or liquidtight flexible conduit.
- C. Exterior Locations: Use only building wire, Type THW or THHN/THWN insulation in raceway.
- D. Underground Installations: Use only building wire, Type THW or USE insulation in raceway.
- E. Use wiring methods indicated on Drawings.
- F. On the load side of GFIC circuit breaker, use only Type XHHW conductors.

### **3.04 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Use solid conductors for feeders and branch circuits No 10 AWG and smaller, except branch circuits to motors shall be stranded copper for flexibility. Stranded conductors may be used if tapped to solid conductors before terminating to wiring devices.
- C. Use stranded conductors for control circuits 24 volts and below. Minimum size shall be No. 16 AWG.
- D. Use conductors not smaller than No. 12 AWG for power and lighting circuits and 120-volt control circuits.
- E. Use No. 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 100 feet or where the distance to the first outlet exceeds 50 feet.

- F. Use No. 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.
- G. Pull all conductors into raceway at same time.
- H. Use suitable wire pulling lubricant for building wire No. 4 AWG and larger.
- I. Protect exposed cable from damage.
- J. Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.
- K. Use suitable cable fittings and connectors.
- L. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- M. Clean conductor surfaces before installing lugs and connectors.
- N. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise. Split bolt connectors are not allowed.
- O. Use sleeve compression connectors for copper conductor splices and taps, No. 6 AWG and larger. Insulated uninsulated conductors and connector with heat shrink insulation rated 600 volts.
- P. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, No. 8 AWG and smaller.
- Q. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, No. 10 AWG and smaller.
- R. Route circuits at own discretion; however, circuit numbers shall be according to Drawings.
- S. Do not share neutral or ground on computer circuits. Each circuit shall be run in a separate raceway.
- T. On three phase, four wire systems do not use a common neutral for more than 3 circuits. Common neutral wire shall only be used for circuits fed from a common trip multi-pole circuit breaker.
- U. On single phase, three wire systems do not use a common neutral for more than 2 circuits. Common neutral wire shall only be used for circuits fed from a common trip multi-pole circuit breaker.
- V. Where a common neutral is run for 2 or 3 homerun circuits connect phase conductors to breakers in panel, which are attached to separate phase legs in order that the neutral conductors will carry only the unbalanced current. Neutral conductors shall be of same size as phase conductors unless specifically noted otherwise.
- W. Run conductors of same circuit in same conduit.
- X. Run conductors of different voltage system in separate conduits.
- Y. Color-code conductors as follows:

480Y277 Volts

Phase A	Brown
Phase B	Orange
Phase C	Yellow
Ground	Green
Neutral	Gray

208Y120 Volts

Phase A	Black	Switchlegs Violet
Phase B	Red	Pink
Phase C	Blue	
Ground	Green	
Neutral	White	
Isolated Ground	Green with Yellow Stripe	

The same color code shall be used throughout the building, including type MC cable whips.

- Z. Contractor shall not install more than three (3) current-carrying conductors in one conduit without derating the conductors per NEC Table 310-15(b)(2)(a).
- AA. Where cables not in conduit pass through floors, cables shall be enclosed in conduit extending at least 6 inches above the floor.
- BB. Cables shall be protected from physical damage where necessary by conduit.
- CC. All cable splices shall be made in boxes.
- DD. The radius of bends in cables shall not be less than five times the diameter of the cable.
- EE. Cables shall be secured by staples, straps, j-hooks, or similar fittings every 4-1/2 feet and within 12 inches of every cabinet, box and fitting.
- FF. Do not pull cable sheaths back more than necessary to separate conductors.
- GG. Do not score conductors when peeling back conductor insulation. Scored conductors will be replaced.
- HH. Do not cut off strands from stranded conductors at terminations. Conductors with strands missing shall be replaced.
- II. Kinked, torn, or twisted cable sheaths are unacceptable and shall be replaced.
- JJ. Install wire and cables to avoid chemicals, cold temperature bending, and different lengths of conductors of same circuit.
- KK. Make sure conduits are properly terminated, reamed and brushed before installation of wire and cables.
- LL. Cable sheaths shall be held in place by strain relief fittings.
- MM. Verify proper conductor location at each termination before energizing.
- NN. All parallel conductors shall be of the same length, type, size and shall have the same connector pressures.

- OO. Do not splice service entrance or feeder conductors.
- PP. Maintain 18-inch clearance from all wires and cables to hot water pipes, steam pipes, and flues.
- QQ. Route all cables parallel and perpendicular to walls. This includes cables installed above ceilings, in attics, and in crawl spaces.

### **3.05 INTERFACE WITH OTHER PRODUCTS**

- A. Identify wire and cable under provisions of 26 0553 – Identification for Electrical Systems.
- B. Identify each conductor with its circuit number or other designation indicated on Drawings in each junction box, switch, switchboard, control panel, and in each panelboard.

### **3.06 FIELD QUALITY CONTROL**

- A. Perform field inspection and testing.
- B. Inspect wire and cable for physical damage and proper connection.
- C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values, if applicable. If not applicable, use NETA's recommended values.
- D. Verify continuity of each branch circuit conductor.
- E. Check tightness of all connections.

### **3.07 USE OF THE FOLLOWING IS PROHIBITED**

- A. Aluminum conductors smaller than #4/0 awg.
- B. Wire nuts in damp or wet locations.
- C. Copper-clad aluminum conductors.

**END OF SECTION**

**SECTION 26 0526**  
**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Grounding electrodes and conductors.
- B. Equipment grounding conductors.
- C. Bonding.
- D. Chemicals.
- E. Conduit.

**1.02 RELATED SECTIONS**

- A. Section 26 0519 – Low Voltage Electrical Power Conductors and Cables.
- B. Section 26 0533 – Raceway and Boxes for Electrical Systems.

**1.03 REFERENCES**

- A. ANSI/NFPA 70 - National Electrical Code.
- B. UL 467 - Grounding and Bonding Equipment.

**1.04 GROUNDING ELECTRODE SYSTEM**

- A. Metal underground water pipe, if any.
- B. Metal frame of the building, if any.
- C. Electrode.
- D. Rod electrode.
- E. "GEM encased in direct contact with earth.

**1.05 PERFORMANCE REQUIREMENTS**

- A. Grounding System Resistance: No greater than 5 ohms.

**1.06 SUBMITTALS**

- A. Submit under provisions of Division 1 and Section 26 0500.
- B. Product Data: Provide data for grounding electrodes and connections.
- C. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
- D. Manufacturer's Instructions: Include instructions for storage, handling, protection,

examination, preparation, and installation of exothermic connectors.

**1.07 PROJECT RECORD DOCUMENTS**

- A. Submit under provisions of Division 1.
- B. Accurately record actual locations of grounding electrodes.

**1.08 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 3 years documented experience.

**1.09 REGULATORY REQUIREMENTS**

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc.

**PART 2 PRODUCTS**

**2.01 ROD ELECTRODE**

- A. Material: Copper clad steel.
- B. Diameter: 3/4 inch.
- C. Length: 10 feet.

**2.02 WIRE**

- A. Material: Stranded or solid copper.
- B. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.
- C. Wire shall conform to Section 26 0519.

**2.03 EXOTHERMIC CONNECTIONS**

- A. Cadweld.
- B. Approved Equal.

**2.04 CHEMICALS**

- A. Ground enhancement materials (50 lbs. minimum per rod).
- B. Cadweld "GEM" system, or approved equal.

**2.05 CONDUIT**

- A. Conduit shall conform to Section 26 0533.



## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that final backfill and compaction has been completed around area where chemical ground is to be installed.

### **3.02 INSTALLATION**

- A. Install Products in accordance with manufacturer's instructions.
- B. Auger a 3-inch diameter hole to a depth of 9-1/2 feet.
- C. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground. Drive rod 1 foot into ground. Make Cadweld connection. Pour chemicals around rod. Tamp around rod. Pour water in augered hole. Remove excess water from hole. Fill remainder of augered hole with soil. Tamp soil.
- D. Provide grounding well pipe with cover at each rod location. Install well pipe top flush with finished grade.
- E. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus or bushing.
- F. Size and type of green equipment ground conductors and method of securing them to obtain electrical continuity and effective grounding as per National Electrical Code, Article 250. Conduit shall not be used for grounding.
- G. Neutrals shall be grounded in accordance with the National Electrical Code.
- H. All metal raceway system, including cabinets, conduit and boxes, shall be grounded in accordance with the National Electrical Code.
- I. An equipment ground conductor shall be installed in all conduits.
- J. Install a grounding electrode and grounding electrode conductor at the service equipment, meter, current transformer cabinet, and at each dry type transformer.
- K. The grounding electrode shall be connected to the metal structure of all buildings with metal structures and to a 1-1/2 inch or larger cold water pipe, if metallic. The ground connection to the metal structure shall be exothermic.
- L. Install isolated ground conductors all the way back to the service equipment ground for 240- and 208-volt services.
- M. All unburied grounding conductors shall be installed in conduit.
- N. Provide grounding of pad-mounted transformer as required by the Utility.
- O. Connect equipment ground conductor of branch circuits serving gas appliances to metallic gas lines. Do not use metallic gas lines as a grounding electrode of the electrical system.
- P. Ground all metal non-current carrying equipment. Ensure that bonding breaks through paint to bare metallic surface of all painted metallic equipment.

**3.03 FIELD QUALITY CONTROL**

- A. Inspect equipment grounding conductors and connections for tightness and proper installation.
- B. Use suitable test instrument to measure resistance to ground of system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.

**END OF SECTION**

**SECTION 26 0529  
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Conduit, cable and equipment supports.
- B. Anchors and fasteners.

**1.02 REFERENCES**

- A. ANSI/NFPA 70 - National Electrical Code.
- B. NECA - National Electrical Contractors Association.
- C. UL 514B - Fittings for Conduit and Outlet Boxes.

**1.03 SUBMITTALS**

- A. Submit under provisions of Division 1 and Section 26 0500.
- B. Product Data: Provide manufacturer's catalog data for fastening systems.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

**1.04 REGULATORY REQUIREMENTS**

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

**PART 2 PRODUCTS**

**2.01 PRODUCT REQUIREMENTS**

- A. Materials and Finishes: Provide adequate corrosion resistance.
- B. Provide materials, sizes, and types of anchors, fasteners, and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
- C. Perforated strap iron will not be acceptable as hanger or fastening material.
- D. Plastic tie wraps will not be acceptable as support materials, except:
  - 1. Inside enclosures to neatly train cables and wires.
- E. Channels shall be galvanized and not painted.
- F. All hardware shall be galvanized.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
- C. Do not fasten supports to pipes, ducts, mechanical equipment, and other conduit.
- D. Obtain permission from the Engineer before using powder-actuated anchors.
- E. Obtain permission from the Engineer before drilling or cutting structural members.
- F. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- G. Install surface-mounted cabinets with minimum of four anchors. Provide blocks between studs to support anchors.
- H. In wet and damp locations use steel channel supports to stand cabinets one inch off wall.
- I. All conduits, both horizontal and vertical, shall be accurately supported. Each hanger shall be properly sized to fit supported conduit.
- J. Where lines are supported under concrete construction, hanger rods shall be secured with concrete inserts.
- K. All hangers shall be so located as to properly grade and support horizontal conduits without appreciable sagging of these lines.
- L. Where multiple conduits are run horizontally at the same elevation and grade, they may be supported on trapezes of channels suspended on rods. Trapeze numbers, including suspension rods, shall be properly sized for number, size, and loaded weight of conduits to be supported.
- M. Conduit supports shall be installed within 3 feet of each coupling, connector, and box.
- N. Electrical contractor shall install his own supports for his equipment.
- O. All 2 inch and larger conduits shall have a swivel hanger support equal to B-Line #B446 or #B446C.

**END OF SECTION**

**SECTION 26 0533**  
**RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Rigid steel conduit.
- B. Flexible metal conduit.
- C. Liquidtight flexible metal conduit.
- D. Electrical metallic tubing.
- E. Surface mounted raceway.
- F. PVC conduit.
- G. Fittings and conduit bodies.
- H. Wall and ceiling outlet boxes.
- I. Floor boxes.
- J. Pull and junction boxes.

**1.02 RELATED SECTIONS**

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0553 - Identification for Electrical Systems.
- D. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
- E. Section 26 2726 - Wiring Devices.
- F. Section 26 0502 - Equipment Wiring Systems.

**1.03 REFERENCES**

- A. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
- B. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- C. ANSI/NFPA 70 - National Electrical Code.
- D. NECA "Standard of Installation".
- E. NEMA TC 3 - PVC Fittings to Use with Rigid PVC Conduit and Tubing.

- F. UL 1 - Flexible Metal Conduit.
- G. UL 5 - Surface Metal Raceways and Fittings
- H. UL 6 - Rigid Metal Conduit.
- I. UL 360 - Liquid-tight Flexible Steel Conduit.
- J. UL 652 - Schedule 40 and 80 Rigid PVC Conduit.
- K. ANSI/NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- L. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- M. UL 38 - Boxes for Use with Fire-Protection Signaling Systems, Manually Actuated Signaling.
- N. UL 50 - Cabinets and Boxes.
- O. UL 514A - Metallic Outlet Boxes.
- P. UL 514B - Fittings for Conduit and Outlet Boxes.
- Q. UL 996 - Electrical Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.
- R. UL 1241 - Junctions Boxes for Swimming Pool Lighting Fixtures.
- S. UL 1773 - Termination Boxes.
- T. UL 65 - Wired Cabinets.

#### **1.04 DESIGN REQUIREMENTS**

- A. Conduit Size: ANSI/NFPA 70.

#### **1.05 SUBMITTALS**

- A. Submit under provisions of Division 1 and Section 26 0500.
- B. Product Data: Provide for metallic conduit, flexible metal conduit, liquidtight flexible metal conduit, metallic tubing, non-metallic conduit, fittings, and conduit bodies.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

#### **1.06 PROJECT RECORD DOCUMENTS**

- A. Accurately record actual routing of conduits larger than 2 inches.
- B. Submit under provisions of Division 1.
- C. Accurately record actual locations and mounting heights of outlet, pull, and junction boxes.

## **1.07 REGULATORY REQUIREMENTS**

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

## **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect, and handle Products to site.
- B. Inspect all conduit for damage.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- D. Protect PVC conduit from sunlight.

## **1.09 PROJECT CONDITIONS**

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of conduit and openings prior to rough-in.
- C. Route conduit as shown on Drawings in approximate locations unless specifically dimensioned. Route as required to complete wiring system.
- D. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purpose. The exact location of all electrical boxes shall be as approved by Engineer who reserves the right to change any outlet for a distance of 6 feet in any direction from position shown on plans, before work is roughed-in, without extra charge.

## **PART 2 PRODUCTS**

### **2.01 CONDUIT REQUIREMENTS**

- A. Minimum Size: 3/4 inch unless otherwise specified.
- B. Underground Installations:
  - 1. Conduit installed below grade shall be Schedule 80 PVC (schedule 40 will not be accepted). All elbows and riser up thru floor slabs shall be galvanized rigid steel conduit (RSC).
  - 2. All conduit not installed under the floor slab shall be 24 inches below grade unless otherwise noted.
- C. Outdoor Locations, Above Grade, and On Roofs: Use galvanized rigid steel conduit. On roofs install 4 inch by 4 inch square treated wooden blocks on roof to support rigid steel conduit within 3'-0" of each coupling and box and to support liquidtight flexible conduit every 3'-0". This requirement applies to all conduits, including conduits provided by Division 23.
- D. Dry Locations:
  - 1. Concealed: Use electric metallic tubing.

- 2. Exposed:
  - a. Use galvanized rigid steel conduit in unfinished areas only (Electric Room, Mechanical Room) unless noted otherwise.
  - b. Use surface metal raceway where specifically indicated in finished areas of existing buildings where it is impossible to fish flexible metallic conduit down inside of existing walls.
  
- E. Mechanical and Electrical Rooms:
  - 1. Use 6'-0" maximum length liquidtight flexible conduit for final connections to mechanical equipment and dry type transformers. Support all flexible conduit every 3'-0".
  - 2. Use galvanized rigid steel conduit where exposed.
  
- F. In Slabs, Above Grade: Use galvanized steel only. Conduits shall not cross each other. Refer to Drawings for specific notes for conduit in slab locations.
  
- G. Electrical metallic tubing (EMT) is to be used for all HVAC equipment control wiring. The conduit system for HVAC temperature controls is to be furnished and installed by Division 23 in accordance with the requirements specified herein. Line voltage control work not specifically shown on the electrical drawings shall be furnished and installed by Division 23 with all line voltage work and all conduit work performed by licensed electricians.
  
- H. Use surface metal raceway only in existing facilities where conduit cannot be fished down walls or across finished ceilings. Surface metal raceway shall not be used in new buildings, unless noted on the Drawings.

## **2.02 RIGID STEEL CONDUIT**

- A. Manufacturers:
  - 1. Allied.
  - 2. Triangle.
  - 3. Engineer Approved.
  
- B. Rigid Steel Conduit: ANSI 80.1
  
- C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; material to match conduit.

## **2.03 FLEXIBLE METAL CONDUIT**

- A. Manufacturers:
  - 1. Allied.
  - 2. Triangle.
  - 3. Engineer Approved.
  
- B. Description: Interlocked steel construction.
  
- C. Fittings: ANSI/NEMA FB 1.
  
- D. Maximum Length: 6'-0".

## **2.04 LIQUIDTIGHT METAL CONDUIT**

- A. Manufacturers:
  - 1. Allied.



- 2. Triangle.
- 3. Engineer Approved.
- B. Description: Interlocked steel construction with PVC jacket.
- C. Fittings: ANSI/NEMA FB 1.
- D. Maximum Length: 6'-0".

## **2.05 ELECTRICAL METALLIC TUBING (EMT)**

- A. Manufacturers:
  - 1. Allied.
  - 2. Triangle.
  - 3. Engineer Approved.
- B. Description: ANSI C80.3; galvanized tubing.
- C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; die-cast compression type.

## **2.06 SURFACE METAL RACEWAY**

- A. Manufacturers:
  - 1. Wiremold.
  - 2. Engineer Approved.
- B. Description: Surface metal raceway with hidden supports.
- C. Fittings, Boxes, and Conduit Bodies: As manufactured by surface metal raceway manufacturer.

## **2.07 NONMETALLIC CONDUIT**

- A. Manufacturers:
  - 1. Carlon.
  - 2. Engineer Approved.
- B. Description: NEMA TC 3; Schedule 80 PVC.
- C. Fittings and Conduit Bodies: NEMA TC 3.

## **2.08 OUTLET BOXES**

- A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1, galvanized steel.
  - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported, include 1/2 inch male fixture studs where required.
  - 2. Concrete Ceiling Boxes: Concrete type.
  - 3. Receptacle, single switch, and 2 gang switch boxes for wood studs shall be Racor #194 or #235 with plaster ring of proper depth.
  - 4. Receptacle, single switch, and 2 gang switch boxes for metal studs shall be Racor #196 or #235 with plaster ring for proper depth.
  - 5. Gang switches of 3 or more devices for wood or metal studs and exposed work shall be Racor #950 Series, appropriate gang box and raised cover.

6. Lighting fixture outlet boxes for wood or metal studs, masonry walls, and furred ceilings shall be Racor #166, #167, or Racor #194 or #235 with plaster ring.
  7. Junction boxes for wood or metal studs, masonry walls, furred ceilings and interior exposed work shall be Racor #231, #232, #233, or #235.
  8. Receptacle boxes for masonry walls shall be Racor #695 or #191 with #785 device cover.
  9. Switches in 6 inch and wider masonry walls shall be 3-1/2 inch deep masonry boxes of gang required. Masonry boxes in 4 inch walls shall be 2-1/2 inches deep.
  10. Television outlet boxes shall be Racor #246, 4-1/16 inch box with #836 device cover ring. Telephone outlet boxes shall be Racor #256.
  11. Outlet boxes for interior exposed work in unfinished areas shall be Racor #191, #192, #231, or #232 boxes with 1/2 inch raised, 4 inch square cover of appropriate configuration.
  12. Boxes, for interior exposed work on existing walls and ceilings in finished areas in existing buildings, where it is impossible to fish conduit down walls or above ceilings, shall be boxes as manufactured by the surface metal raceway manufacturer for the intended purpose.
- B. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer.
- C. Boxes shall be oversized when required by Table 370-16(a) of the National Electrical Code.
- D. Specialty A/V floor boxes shall be as scheduled on the drawing, "FSR" or equal

## **2.09 PULL AND JUNCTION BOXES**

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Surface-Mounted Cast Metal Box: NEMA 250, Type as required; flat-flanged, surface-mounted junction box.
1. Material: Galvanized steel.
- C. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install conduit in accordance with NECA "Standard of Installation".
- B. Install surface metal raceway in accordance with manufacturer's directions.
- C. Arrange supports to prevent misalignment during wiring installation.
- D. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers. Supports shall be installed within 3 feet of every outlet box, junction box, panel, or other conduit terminations. Fastening of unbroken lengths shall be permitted to be increased to a distance of 5 feet where structural members do not readily permit fastening within 3 feet. Do not space supports further than 10 feet apart.

- E. Group related conduits; support using conduit rack. Construct rack using steel channel.
- F. Fasten conduit supports to building structure and surfaces under provisions of Section 26 0529.
- G. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
- H. Do not attach conduit to ceiling support wires.
- I. Arrange conduit to maintain headroom and present neat appearance.
- J. Route all conduit parallel and perpendicular to walls. This includes conduit installed above ceilings, in attics, on roofs, and in crawl spaces.
- K. Install insulated bushings or approved equivalent on each end of all conduit.
- L. Maintain 12-inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.
- M. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- N. Bring conduit to shoulder of fittings; fasten securely.
- O. Install no more than equivalent of four 90-degree bends between boxes. Use factory elbows for all 90-degree bends in conduits 1" and larger.
- P. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- Q. Provide suitable fittings to accommodate expansion and deflection where conduit crosses expansion joints.
- R. Use suitable caps to protect installed conduit against entrance of dirt and moisture during construction.
- S. Ground and bond conduit under provisions of Section 26 0526.
- T. Identify conduit under provisions of Section 26 0553.
- U. Provide suitable pullboxes in all conduit runs as required by the National Electrical Code and as required to facilitate wire installation.
- V. Holes for passage of conduits through all one-hour and two-hour drywall partitions shall be neatly cut to the required size. If holes are cut larger than necessary, they shall be covered with two (2) additional pieces of 5/8 inch type X gypsum wallboard, each 8 inches by 16 inches with a half circular cutout of the proper size, one (1) layer on one-hour partitions, and two (2) layers on two-hour partitions.
- W. Holes for passage of conduits through one-hour, two-hour, and four-hour masonry walls shall be fireproofed. Fireproofing materials shall be as follows:
  - 1. Cellular Glass Insulation: Pittsburgh Corning Corp. Foamglas "Regular" or UL rated or UNI-JAC UL rated pipe insulation, or approved equal.

2. Fire Retardant Putty: IPC Flamesafe Type FAS500 or FST600 Series, or improved equal, for one-hour and two-hour walls.
  3. IPC/KB5 Mortar Seal, or approved equal (full depth of wall) for four-hour walls.
- X. Holes for passage of conduits through masonry floors shall be fireproofed. Fireproofing material shall be Firestop Compound - IPC Flamesafe Type 500/FST 600, or approved equal, filled to full depth of slab. Minimum annular space around conduit shall be 3/16 inch.
- Y. Refer to Architectural drawings for locations of fire-rated walls, ceilings, and floors.
- Z. Support 2-1/2 inch and larger conduit in accordance with Section 16880.
- AA. All flexible conduit in Mechanical Rooms and outside shall be liquidtight flexible conduit.
- BB. All conduits that enter a building's basement wall below grade shall have a fitting equal to OZ Type CSBI installed inside the conduit and shall be watertight sealed between outer conduit wall and basement opening.
- CC. Conduits, which enter refrigerated areas, such as walk-in coolers and wall-in freezers, shall have a seal-off installed on the non-refrigerated side of the conduit where the conduit exits or enters the refrigerated area.
- DD. Make sure conduits are properly terminated, reamed, and brushed before installation of wire or cable.
- EE. Install bushings on all conduits.
- FF. Structural Engineer shall approve placement of conduits in all concrete slabs, beams, and columns. See Structural Drawings for structural engineer's name and address.
- GG. Conduits which pass from an air conditioned space to a non-air conditioned space shall have sealoffs installed on non-air conditioned side near wall.
- HH. Ground metallic conduits.
- II. Install gasketed conduit hubs on all conduits exiting the top or sides of NEMA 3R enclosures.
- JJ. Install electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements.
- KK. Install electrical boxes to maintain headroom and to present neat mechanical appearance.
- LL. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- MM. Install boxes to preserve fire resistance rating of partitions and other elements.
- NN. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices with each other.
- OO. Use flush mounting outlet boxes in finished areas, unless noted otherwise on the

Drawings.

- PP. Do not install flush mounting boxes back-to-back in walls; provide minimum 6-inch separation. Provide minimum 24-inch separation in acoustic rated walls. See Architectural floor plans for acoustic rated wall locations.
- QQ. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- RR. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- SS. Install flush mounting box without damaging wall insulation or reducing the effectiveness.
- TT. Use adjustable steel channel fasteners for hung ceiling outlet box.
- UU. Do not fasten boxes to ceiling support wires.
- VV. Support boxes independently of conduit.
- WW. Use gang box where more than one device is mounted together. Do not use sectional box.
- XX. In other than masonry, use 4-inch square by 1-1/2 inch minimum box with plaster ring for single devices.
- YY. Use cast outlet box in exterior locations exposed to the weather and wet locations.
- ZZ. Use cast floor boxes for installations in slab on grade. See plans for specialty A/V floorboxes equal to FSR. Coordinate cover trim with floor covering thickness and type.
- AAA. Set floor boxes level.
- BBB. Large Pull Boxes: Boxes larger than 100 cubic inches in volume or 12 inches in any dimension.
  - 1. Interior Dry Locations: Use hinged enclosure.
  - 2. Other Locations: Use surface-mounted cast metal box.
- CCC. Locate boxes so outlets are not obstructed by pipes, ducts, or other items.
- DDD. Boxes for light switches shall generally be located within 6 inches of door jamb.
- EEE. Pullboxes shall be provided at points shown on plans or required to overcome mechanical difficulties due to arrangement of runs or the fixed characteristics of the building construction. No runs of over 100 feet shall be made without use of pullbox.
- FFF. All boxes shall have covers. All boxes installed above a ceiling and installed in unfinished spaces (Mechanical and Electrical Rooms, etc.) shall have the covers clearly and legibly marked with the circuits contained within them.
- GGG. All flush-mounted boxes shall come within 1/4 inch of finished non-combustible surfaces and shall be flush with finished combustible surfaces. Install box extensions, if after rough-in and wall construction, the boxes do not come out far enough.
- HHH. Fireproof all poke-through devices in accordance with manufacturer's directions.

- III. Ground all boxes. Ensure that bonding breaks through paint to bare metallic surface.
- JJJ. Grind ears off of 2-gang boxes with isolated ground receptacles in each box. Grinding shall be done in a machine shop.

### **3.02 INTERFACE WITH OTHER PRODUCTS**

- A. Install conduit to preserve fire resistance of partitions and other elements.
- B. Pullboxes shall be provided at points shown on the plans or required to overcome mechanical difficulties due to arrangement of runs or the fixed characteristics of the building construction.
- C. All threaded conduit shall be secured to boxes, cabinets, panels, switches, etc. by means of a threaded bushing on the inside and locknutted on the box exterior and interior.
- D. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- E. Coordinate mounting heights and locations of outlets mounted above counters, branches, and backsplashes with Architect prior to rough-in.
- F. Position outlet boxes to locate luminaires as shown on reflected ceiling plan.

### **3.03 THE FOLLOWING ARE PROHIBITED**

- A. EMT crimp-on, tap-on, indenter type fittings.
- B. EMT set- screw fittings. Set-screw fittings on ends of flexible conduit are allowed.
- C. PVC inside buildings, or above grade.
- D. All thread nipples in other than dry locations.
- E. Wooden plugs inserted in concrete or masonry units as bases for fastening conduits, tubing, boxes, cabinets, or other equipment.
- F. Installation of conduit or tubing which has been crushed or deformed.
- G. Where conductors #8AWG or larger are inside, the following fittings shall not be used:
  - 1. 90° threaded hubs.
  - 2. Pulling elbows.
  - 3. Bushed elbows.
  - 4. Short box connectors.
  - 5. 90° connectors.
  - 6. Entrance elbows.
  - 7. Types LB, LL, LR, T, L, TA, TB, X, LBD, or LBDN conduit bodies.
  - 8. Short elbows.
- H. Type ENT tubing.
- I. Armored cable.
- J. Metal-clad cable.

- K. EMT on roof, exposed, outside, in concrete, or underground.
- L. Flexible or liquidtight flexible conduits concealed in walls or floors.
- M. PVC elbows.
- N. Storage of PVC in sunlight.
- O. The use of heat to bend PVC conduit.
- P. Surface non-metal raceway.
- Q. Surface metal raceway in new buildings.
- R. Surface metal raceway in damp or wet locations.
- S. Flexible or liquidtight flexible conduits in lengths exceeding 6'-0".
- T. The use of external coverclips on surface metal raceway.
- U. All steel EMT fittings.
- V. Flexible conduit connectors on which the flexible conduit is threaded.
- W. Plastic boxes.
- X. Fiberglass boxes.

**END OF SECTION**

**SECTION 26 0553**  
**IDENTIFICATION FOR ELECTRICAL SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Nameplates and labels.
- B. Wire and cable markers.
- C. Trench tape.

**1.02 REFERENCES**

- A. ANSI/NFPA 70 - National Electrical Code.

**1.03 RELATED SECTIONS**

- A. Section 09 9000 - Painting: Boxes.

**1.04 SUBMITTALS**

- A. Submit under provisions of Division 1 and Section 26 0500.
- B. Product Data: Provide catalog data for nameplates, labels, and markers.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

**1.05 REGULATORY REQUIREMENTS**

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

**PART 2 PRODUCTS**

**2.01 NAMEPLATES AND LABELS**

- A. Nameplates: Engraved three-layer laminated plastic, white letters on black bac
- B. Locations:
  - 1. Each electrical distribution equipment (switchboards, panelboards, enclosed circuit breakers, motor control centers, transformers) and control equipment enclosure (starters, disconnect switches, etc.).
- C. Letter Size:
  - 1. Use 1/2-inch letters for identifying equipment designation and voltage.
- D. Provide typewritten directory in each panelboard of circuit designations in



clear/transparent protective envelope attached to inside of panelboard door.

- E. Provide typewritten zone directory in each conventional fire alarm control panel in clear/transparent, protective envelope attached to inside of central panel door.
- F. Provide nameplate on inside of each panelboard and main indicating color code scheme for the voltage of that panelboard and main, nameplates to be red with white characters.

## **2.02 WIRE MARKERS**

- A. Description: Tape or tubing type wire markers.
- B. Locations: Each conductor at panelboard gutters switchboard gutters, motor control center gutters, pull boxes, outlet and junction boxes, disconnect switches, motor starters, and at each load connection.
- C. Leged:
  - 1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.

## **2.03 TRENCH TAPE**

- A. Tape shall be detectable aluminum foil polyethylene laminate.
- B. Tape shall be the following color and have the following wording:

Application	Color	Caution Wording
Cable TV	Orange	"Caution – Cable TV Line Buried Below"
Electrical	Red	"Caution – Electric Line Buried Below"
Telephone	Orange	"Caution – Telephone Line Buried Below:"
Fiber Optic	Orange	"Caution – Buried Fiber Optic Cable"
- C. Tape shall be equal to Panduit Type HTDU with width to match trench width.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Degrease and clean surfaces to receive nameplates and labels.

### **3.02 APPLICATION**

- A. Install nameplate and label parallel to equipment lines.
- B. Secure nameplate to equipment front using No. 4 round heat cadmium plated, steel self-tapping screws or nickel-plated brass plates.
- C. Identify underground conduits using underground warning tape. Install one tape per trench at 6 inches below finished grade.

- D. All fire alarm junction boxes and pullboxes shall be painted red where concealed or exposed in mechanical or electrical rooms.
- E. Both ends of pullwires shall be identified by means of labels or tags, reading "PULLWIRE" and shall be numbered to refer to same pullwire.
- F. Install nameplates at each circuit breaker on all switchboards and large panelboards.
- G. Install wire markers on wires in each junction box, panelboard, switchboard, control panel, etc.
- H. Install typewritten "COMPUTER" with black letters and clear background on each coverplate of receptacles adjacent to information outlets
- I. Install nameplates at each device within motor control centers.
- J. Install directory of addresses and corresponding devices and locations in each addressable fire alarm and security control panels.
- K. All security junction boxes and pullboxes shall be painted yellow where concealed or exposed in mechanical or electrical rooms.
- L. Install labels on all telephone and computer cables.
- M. All telephone junction boxes and pullboxes shall be painted white where concealed or exposed in mechanical or electrical rooms.
- N. Paint all data junction boxes and pullboxes blue where concealed or exposed in mechanical or electrical rooms.
- O. Paint all public address junction boxes and pullboxes dark gray where concealed or exposed in mechanical or electrical rooms.
- P. Paint all television cable junction boxes or pullboxes black where concealed or exposed in mechanical or electrical rooms.

**END OF SECTION**

**SECTION 26 0943**  
**DIGITAL NETWORK LIGHTING CONTROLS**

**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification Sections.
- B. All contract documents and addenda.

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Digital network lighting control system.
- B. Related Sections:
  - 1. Section 26 2726 — Wiring Devices
  - 2. Section 26 5100 — Interior Lighting Fixtures
- C. Contractor responsibilities:
  - 1. Coordinate, receive, mount, connect, and place into operation all equipment. Furnish all conduit, wire, connectors, hardware, and other incidental items necessary for the complete and properly functioning relay lighting control system as described herein and shown on the plans.

**1.03 REFERENCES**

- A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)C62.41-1991 — Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- B. ASTM International (ASTM)
  - 1. D4674 -02a Standard Test Method for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Fluorescent Lighting and Window-Filtered Daylight.
- C. International Electrotechnical Commission .
  - 1. (IEC) 801-2 Electrostatic Discharge Testing Standard.
  - 2. IEC/EN 60669-2-1 Switches for household and similar fixed electrical installations - electronic switches.
- D. International Organization for Standardization (ISO)
  - 1. 9001:2000 — Quality Management Systems.
- E. National Electrical Manufacturers Association (NEMA) WD1 (R2005) - General Color Requirements for Wiring Devices.
- F. Underwriters Laboratories, Inc. (UL)

1. 508 (1999) - Standard for Industrial Control Equipment.
- G. American Society of Heating, Refrigerating and Air-Conditioning (ASHRAE)
  1. ASHRAE 90.1

#### **1.04 SUBMITTALS**

- A. General
  1. Submit under provisions of Section 01 3300 and in accordance with Conditions of the Contract.
- B. Bill of Materials: Complete list of all parts needed to fully install selected system components.
- C. Specification Conformance Document: Indicate whether the submitted equipment:
  1. Meets specification exactly as stated.
  2. Meets specification via an alternate means and indicate the specific methodology used.
- D. Shop Drawings
  1. Submit for approval within 30 days following receipt of contract.
  2. Drawings to detail all mechanical and electrical equipment, including:
    - a. One-line diagrams
    - b. Internal wiring
    - c. Wire counts
    - d. Physical dimensions of each item.
  3. Do not fabricate any equipment prior to approval of these drawings.
- E. Product Data: Product data sheets with performance specifications demonstrating compliance with specified requirements.
- F. Installation Instructions: Manufacturer's installation instructions.

#### **1.05 CLOSEOUT SUBMITTALS**

- A. To be provided within two weeks following system turn-on.
  1. Warranty documents specified herein.
  2. Three sets of operation and maintenance manuals.
  3. Two complete sets of as-built drawings

#### **1.06 QUALITY ASSURANCE**

- A. Manufacturer Requirements
  1. Continuously engaged in the manufacture of architectural lighting controls and relays for no less than ten years.
  2. Provide factory-direct technical support hotline 24 hours per day, 7 days per week.
  3. Maintain a quality system that is registered to the ISO 9001:2000 Quality Standard.

- B. Lighting control system components:
  - 1. Listed by UL specifically for the required loads, or certified by recognized independent testing organizations that test to UL standards.
    - a. UL508
      - 1) UL916 listing not acceptable.
  - 2. Comply with ASHRAE 90.1
  - 3. Comply with CEC Title 24
- C. Relay cabinet enclosures
  - 1. NEMA 1 (indoor)
  - 2. NEMA 3R (outdoor)
- D. Installer Qualifications
  - 1. Experienced in performing the work of this section
  - 2. Has specialized in installation of work similar to that required for this project.
- E. Source Limitations
  - 1. To assure compatibility, obtain all system components from a single source with complete responsibility for all lighting controls and accessories specified in this Section. The use of subcontracted component assemblers is not acceptable.

#### **1.07 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION**

- A. Fluorescent Ballasts
  - 1. Supply ballasts that:
    - a. Are compatible with the network lighting control system.
      - 1) Accept 0 – 10V dimming control.
- B. All conduit, wire, connectors, hardware, and other incidental items necessary for the complete and properly functioning network lighting control system as described herein and shown on the plans.

#### **1.08 DELIVERY, STORAGE & HANDLING**

- A. General: Comply with Division 1 Product Requirements Sections.
- B. Ordering: Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- C. Delivery
  - 1. Deliver materials in manufacturer's original, unopened, undamaged packages with intact identification labels.
  - 2. Deliver to other trades in a timely manner.
- D. Storage and Protection: Store materials away from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

#### **1.09 PROJECT CONDITIONS**

- A. Do not install equipment until the following conditions can be maintained in spaces to receive equipment:
  - 1. Ambient temperature: 0° to 50° C (32° to 122° F).
  - 2. Relative humidity: Maximum 90 percent, non-condensing.
  - 3. Lighting control system must be protected from dust during installation.

## **1.10 WARRANTY**

- A. Manufacturer's Warranty
  - 1. Warrant all equipment free of defects in materials and workmanship.
  - 2. Warranty Period
    - a. Warrant all system components for 1 year from date of acceptance.
    - b. Make extended warranties available.
  - 3. Warrant relay modules for a period of 10 years.
    - a. Provide replacement modules at no cost to Owner.
  - 4. Owner's Rights: Manufacturer's warranty is in addition to, not a limitation of, other rights the Owner may have under contract documents.

## **1.11 COMMISSIONING**

- A. Provide factory-certified field service engineer to ensure proper system installation and operation under following parameters:
  - 1. Certified by the equipment manufacturer on the system installed.
  - 2. Site visit activities:
    - a. Verify connection of power feeds and load circuits.
    - b. Verify connection of controls.
    - c. Verify system operation control by control, circuit by circuit.
    - d. Obtain sign-off on system functions.
    - e. Demonstrate system capabilities, operation and maintenance and educate Owner's representative on the foregoing.
  - 3. At least three site visits to accomplish the following tasks:
    - a. Prior to wiring
      - 1) Review and provide installer with instructions to correct any errors in the following areas:
        - a) Low voltage wiring requirements
        - b) Separation of high and low voltage wiring runs
        - c) Wire labeling
        - d) Load schedule information
        - e) Switching cabinet locations and installation
        - f) Physical locations and network addresses of controls
        - g) Ethernet connectivity
        - h) Computer-to-network connections
        - i) Load circuit wiring
        - j) Connections to other systems and equipment
        - k) Placement and adjustment of Occupancy Sensors
        - l) Placement and adjustment of Photocells
    - b. After system installation

- 1) Check and approve or provide correction instructions on the following:
    - a) Connections of power feeds and load circuits
    - b) Connections and locations of controls
    - c) Connections of low voltage inputs
    - d) Connections of the data network
  - 2) Turn on system control processor and upload any pre-programmed system configuration
  - 3) Verify cabinet address(es)
  - 4) Upload pre-programmed system configuration and information to switching and/or dimming cabinets
  - 5) Check load currents and remove bypass jumpers
  - 6) Verify that each system control is operating to specification
  - 7) Verify that each system circuit is operational according to specification
  - 8) Verify that manufacturers' interfacing equipment is operating to specification
  - 9) Verify that any computers and software supplied by the manufacturer are performing to specifications
  - 10) Verify that any remote WAN (Wide Area Network) connections are operating properly
  - 11) Have an owner's representative sign off on the above-listed system functions
- c. Before project completion and hand-off
- 1) Demonstrate system capabilities and functions to owner's representative
  - 2) Train owner's representative on the proper operation, adjustment, and maintenance of the system.
- B. Notification: Upon completion of the installation, the contractor shall notify the manufacturer that the system is ready for formal checkout. Notification shall be given in writing a minimum of 21 days prior to the time factory-trained personnel are required on site. Each field installed RJ45 connection must be tested prior to system interconnection. A test report must be furnished to manufacturer prior to scheduling commissioning activity. Manufacturer shall have the option to waive formal turn-on.
- C. Turn-On: Upon completion of all line, load and interconnection wiring, and after all fixtures are installed and lamped, Manufacturer's Certified Technician shall completely check the installation prior to energizing the system. Each installed relay system shall be tested for proper ON/OFF operations, and proper LED illumination. Each installed control cabinet shall be tested verifying that each controlled load adjusts to the selected setting and that all switch LED's illuminate properly.
- D. At the time of checkout and testing, the owner's representative shall be thoroughly instructed in the proper operation of the system.

## 1.12 MAINTENANCE

- A. Enable the end user to order new equipment for system expansion, replacements, and spare parts.

- B. Make new replacement parts available for a minimum of ten years from the date of manufacture.
- C. Provide factory-direct technical support hotline 24 hours per day, 7 days per week.
- D. Offer renewable annual service contracts, to include parts, factory labor, and annual training visits. Make service contracts available up to ten years after date of system commissioning.

## **PART 2 PRODUCTS**

### **2.01 ACCEPTABLE MANUFACTURERS**

- A. Basis of design product: Wattstopper DLM Lighting Control Panels
- B. Substitutions: Permitted.
  - 1. Clearly delineate all proposed substitutions as such and submit in writing for approval by the design professional.
  - 2. Prior to rough-in, provide complete engineered shop drawings, including power wiring, with deviations from the original design highlighted in an alternate color, to the engineer for review and approval.
  - 3. By using substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring.
  - 4. Substitutions that affect the energy conservation capability of the completed project or its ability to meet overall energy conservation targets to be fully detailed and coordinated with other relevant sections of the specification.

### **2.02 MODULAR DIGITAL NETWORK LIGHTING CONTROL SYSTEM**

- A. System Description: provide a modular digital network lighting control system that includes:
  - 1. Configurable relay cabinets
  - 2. Remote low voltage input cabinets
  - 3. Digital switches
  - 4. Latching, Return to Closed (RTC) Latching and Dimming / Switching relay modules
  - 5. Distributed scheduling functions
    - a. Cabinets continue to operate on last established schedule in the event of a network malfunction
    - b. Network interruption alarm is displayed on Handheld Display Unit (HDU) and/or remote computer connected to Internet
  - 6. Configuration, programming and monitoring via HDU
    - a. Remote configuration, programming and monitoring available with Internet connection
    - b. System to be fully functional without a connected HDU
- B. Provide a system that has an integral power supply for Command Module, Relay Insert Panel, HDU, and other accessories.
- C. Provide a system with the following data inputs for programming and firmware upgrades:



1. Remote via Internet
  - a. Uploaded to Command Module
    - 1) Requires Owner-provided Ethernet connection to Internet with static IP address.
    - 2) Entire system to require only one Internet address and connection.
  - b. Upgrade procedure to be initiated by Owner and managed by the Command Module.
  - c. Automated system
    - 1) Allows user to select specific devices or all system devices for firmware upgrades.

### **2.03 PERFORMANCE CRITERIA**

- A. Provide a system that controls lighting with the following hierarchy
  1. Emergency: Highest priority, over-rides all other inputs.
  2. Power failure: All RTC relays close upon loss of system power.
  3. Bypass Switches: Second priority, over-rides all other inputs except Emergency
  4. Behaviors scheduled via Calendar and Agendas
- B. Power failure recovery: Provide a system that returns all devices to their last operating status when power is restored after an interruption.

### **2.04 NETWORK CABLE AND CONNECTORS**

- A. Supply the following types of twisted pair shielded cable and connectors to connect the system:
  1. Ethernet: Cat 5 or better
  2. Terminations: RJ-45 connectors

### **2.05 SYSTEM PROGRAMMING**

- A. Provide a system with following Programmable Components:
  1. Relays
    - a. Blink Warn Parameters: Blink Length, Wait Length, ON Time
  2. Switches
    - a. Parameter: Delay Time
  3. Occupancy Sensors
    - a. Parameter: Delay Time
  4. Photocells
    - a. Parameters: Trigger Point, Delay Time, Deadband
- B. Provide a system that allows the designer and/or operator to define Areas as user-defined groups of Programmable Components that corresponds to a building space or lighting circuit

- C. Provide a system that includes the following set of Behaviors as predetermined sets of operational functions for the Programmable Components within a defined Area, together with priorities among those Components
1. Component Parameters to be resettable within each Behavior.
    - a. B1: Lights turned ON with the switch; can be turned OFF with the switch; Occupancy Sensor will turn OFF upon vacancy.
    - b. B2: Lights turned ON with the Occupancy Sensor; can be turned ON or OFF with the switch; Occupancy Sensor will turn OFF upon vacancy.
    - c. B3: Occupancy Sensor turns lights ON or OFF.
    - d. B4: Switch turns lights ON or OFF.
    - e. B5: Astronomical Clock Time triggers a Blink Warn sequence; Switch interrupts sequence and starts an interval timer; Relay will automatically turn OFF when interval timer reaches zero.
    - f. B6: Astronomical Clock Time turns lights ON.
    - g. B7: Astronomical Clock Time turns lights OFF.
    - h. B8: When measured light level exceeds trigger point, Photocell turns lights OFF; When measured light level is below trigger point, Occupancy Sensor turns lights ON upon occupancy, OFF upon vacancy.
    - i. B9: When measured light level exceeds trigger point, Photocell turns lights OFF; When measured light level is below trigger point, Switch turns lights ON or OFF, Occupancy Sensor turns lights OFF upon vacancy.
    - j. B10: When measured light level exceeds trigger point, Photocell turns lights OFF; When measured light level is below trigger point, Occupancy Sensor turns lights ON upon occupancy and OFF upon vacancy, Switch turns lights ON or OFF, over-riding Occupancy Sensor.
    - k. B11: When measured light level exceeds trigger point, Photocell turns lights OFF; When measured light level is below trigger point, Switch turns lights ON or OFF.
    - l. B12: When measured light level exceeds trigger point, Photocell turns lights OFF; When measured light level is below trigger point, Astronomical Clock Time turns lights ON.
- D. Provide a system that allows the designer or operator to define Agendas as series of behavior transitions occurring during a 24 hour period
1. Native BACnet-compatible scheduling objects
  2. Each Agenda to include up to twenty-four (24) transitions for each relay or group
  3. Minimum interval between transitions to be one (1) minute.
- E. Provide a system that allows the designer or operator to define Schedules as series of seven (7) Agendas, i.e. one per weekday
1. Each Schedule shall continue to run until:
    - a) An Exception Date is encountered
    - b) A new Schedule is required for the Exception Date
  2. Start Date for a new Schedule
- F. Provide a system with an Astronomical Clock that coordinates the operation of all system components, and that
1. Will continue execution of scheduled operations if the network connection is lost.
  2. Has the following programmable Time and Date options:
    - a. Manual controls

- b. Programmable to automatically respond to Network Time Protocol (NTP) when connected to the Internet.
    - c. Allow twelve (12) or twenty-four (24) Hour display formats
    - d. Allow selection of Automatic Daylight Savings Time adjustment
  - 3. Allows the user to enter Latitude data
  - 4. Allows the user to program Sunrise/Sunset times with optional offsets
- G. Provide a system with Low Voltage inputs that are:
  - 1. Compatible with any momentary or maintained switch operating at +24 VDC
  - 2. Compatible with any photocell and/or occupancy sensor requiring +24 VDC power and providing either a dry contact closure or 0 — 10 VDC signal via three-conductor wiring
    - a. +24 VDC, Com, Signal
      - 1) If +24 VDC is supplied to the device by an external power supply, use two-wire Com and Signal configuration
- H. Provide a system with the following programmable Relay Operation operations
  - 1. Pulsed output with relay closure duration variable from one (1) to sixty seconds (60).
  - 2. Return to Closed functionality
  - 3. Enable/disable zero-cross technology
- I. Provide a system that enables photocell operation to be programmed with the follow options:
  - 1. Open or closed loop operation
  - 2. Eight (8) independent pairs of rising and falling trigger point values per photocell input
  - 3. Delay times of thirty (30) seconds to thirty (30) minutes
  - 4. ON/OFF behavior
    - a. Auto ON with Manual Override
    - b. Blink Warn Sequence
- J. Provide a system that allows the designer or operator to program each individual relay's response to an Emergency signal
- K. Provide a system that allows the designer or operator to program the following Low Voltage switch functions within each Area:
  - 1. Delay time
    - a. Thirty (30) seconds to thirty (30) minutes
  - 2. Button type
    - a. Momentary or maintained
  - 3. Switch station type
    - a. Single button operation or dedicated ON and OFF buttons
  - 4. Assign each switch to individual relays or groups
- L. Provide a system that allows the designer or operator to program the following Digital switch functions within each Area:
  - 1. Program delay time within each area or zone
    - a. Thirty (30) seconds to thirty (30) minutes
  - 2. Assign each switch to individual relays or groups

## **2.06 RELAY CABINETS**

- A. Provide a relay cabinet that allows Command Modules, Remote Input Modules and Relay Modules to be installed in the field without voiding the cabinet's UL listing.
- B. Relay cabinet size shall be sufficient to the number of relays shown on the construction drawings.
- C. Physical: provide a relay cabinet that:
  - 1. Has a removable locking hinged door
    - a. Removing the door from its hinges shall not defeat the locking mechanism
  - 2. Has sidewalls that are clear of knockouts or other obstacles
    - a. To allow custom conduit layout patterns.
  - 3. Has ventilated covers and bottom panel
    - a. NEMA1 cabinet to provide cooling to circuit conductors without the use of any moving parts such as a fan.
  - 4. Has circuit wiring covers that provide maximum arc flash protection
    - a. Low voltage and high voltage compartments to be separated for optimal safety.
    - b. Low-voltage electronics can be serviced without Personal Protective Equipment
    - c. Covers to be easily removed and replaced
  - 5. Is fabricated of steel
- D. Electrical
  - 1. Relays shall be rated to switch voltages from 24 to 277VAC and +24VDC.
  - 2. Short Circuit Current Rating (SCCR) of the assembled cabinet, regardless of its specific configuration, to be 25,000 Amperes at 277VAC.
- E. Relay Insert Panel
  - 1. Allow relays modules to be installed, removed and relocated without internal rewiring or mounting screws
- F. Grounding points
  - 1. Cabinet to provide bonding location for the Command Module in the upper left wire-way
  - 2. Cabinet to provide grounding location consisting of two threaded screw holes at bottom of enclosure
    - a. Hole spacing to allow use of typical equipment ground bus-bars in place of screws
    - b. Cabinet to include a green grounding screw as a designated grounding point

## **2.07 COMMAND MODULES**

- A. Provide a system with command modules that:
  - 1. Are field-installable and/or replaceable self-contained units with Emergency inputs

2. Have integral overload and short circuit protection.
    - a. Provide separate overload protection for:
      - 1) System processor
      - 2) LumaCAN devices including the Low Voltage Input card.
  3. Supply power to all electronics in the Relay Cabinet
  4. Supply power to digital switches and Handheld Display Unit via LumaCAN
  5. Can supply +24 VDC to other low-voltage inputs
  6. Can contain an optional Low Voltage Input (+24VDC) card suitable for termination of eight (8) or sixteen (16) low voltage inputs.
- B. Include an Emergency Signal Input for a hardwired emergency override signal
1. Requires external contacts
  2. Activates Emergency status when a signal of +24VDC is present
  3. Releases Emergency status when signal falls to zero (0VDC ).
  4. Controls all relays as assigned by the user regardless of processor operation.
  5. Provides +24VDC to external contacts
- C. Have the following controls:
1. A Handheld Display Unit that displays and programs functions
  2. A high resolution color graphic display screen
- D. Provide a grounding point

## **2.08 HANDHELD DISPLAY UNIT (HDU)**

- A. Provide a system with an HDU that:
1. Performs system programming, configuration and monitoring from any LumaCAN or Ethernet port
    - a. Ethernet ports
      - 1) As indicated on drawings (system must be interconnected with lighting control network)
    - b. LumaCAN port locations:
      - 1) Relay cabinets
      - 2) Digital switches
      - 3) Low voltage input cards
      - 4) Remote Input Cabinets
- B. Can be stored in any relay cabinet door, or at a remote docking station
- C. Has a high resolution color graphic display screen

## **2.09 RELAY MODULES**

- A. Provide a system with relay modules suitable for the installation
- B. Physical: provide relay modules that
1. Have identical dimensions equal to a single mounting space, allowing any number of each type to be used in the Relay Insert Panel

2. Are installed and removed using retaining tabs, without screws or internal wiring
  3. Have manual actuator handles that
    - a. Allow changing the relay state without tools
    - b. Allow controlled circuits to be powered as soon as they are wired, without energized Command Module electronics.
- C. Electrical: provide mechanically latching relay modules
1. Electrically held relays are unacceptable due to parasitic power loss
  2. Provide relay modules with an SCCR (Short Circuit Current Rating) of 25,000 amps
  3. Provide single and double-pole relay modules that are available with or without Return to Closed (RTC) function
    - a. To be compatible with Sentry Switches and AS100 switches

## **2.10 DIGITAL SWITCHES**

- A. Provide a system with digital switches, as indicated on the drawings:
1. Custom Engraving to be available for the following:
    - a. Individual buttons
    - b. Station wallplates
    - c. Engraved characters to be of a contrasting color as shown on drawings

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Coordinate, receive, mount, connect, and place into operation all equipment.
- B. Install equipment in accordance with manufacturer's installation instructions.
1. Install relay cabinets in locations where audible noise is acceptable.
  2. Use only with 75° C (167° F) copper wire at 75% ampacity.
- C. Provide complete installation of system in accordance with Contract Documents.
- D. Maintain performance criteria stated by the manufacturer without defects, damage, or failure.
- E. Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.
- F. Ensure that daylight sensor placement minimizes sensors view of electric light sources; ceiling mounted and fixture-mounted daylight sensors shall not have direct view of luminaries.
- G. Furnish all conduit, wire, connectors, hardware, and other incidental items necessary for a properly functioning lighting control and relay system as described herein and shown on the plans. The Electrical Contractor shall maintain performance criteria stated by the manufacturer without defects, damage, or failure.

- H. Compliance: Contractor shall comply with manufacturer's product data, including shop drawings, technical bulletins, product catalog installation instructions, and product carton instructions for installation.
- I. Circuit Testing: The contractor shall test that all branch load circuits are operational before connecting loads to system load terminals, and then de-energize all circuits before installation.
- J. Application of Power: Power shall not be applied to the relay system during construction and prior to turn-on unless specifically authorized by written instructions from the manufacturer.
- K. Programming: Program low-voltage and digital switch functionality remotely from the control cabinet.
  - 1. Terminate and test all network cable assemblies. Each field installed RJ45 connection must be tested prior to system interconnection. A test report must be furnished to factory-certified service engineer prior to scheduling commissioning activity.

### **3.02 SITE VERIFICATION**

- A. Verify that wiring conditions, which have been previously installed under other sections or at a previous time, are acceptable for product installation in accordance with manufacturer's instructions.

### **3.03 FIELD MEASUREMENTS**

- A. The electrical contractor shall be responsible for field measurements and coordinating the physical size of all equipment with the architectural requirements of the spaces into which they are to be installed.

### **3.04 INSPECTION**

- A. Inspect all material included in this contract prior to installation. Manufacturer shall be notified of unacceptable material prior to installation.

### **3.05 SITE PROTECTION**

- A. Contractor shall protect installed product and finished surfaces from damage during all phases of installation including storage, preparation, testing, and cleanup.

### **END OF SECTION**

## **SECTION 26 2726 WIRING DEVICES**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Wall switches.
- B. Receptacles.
- C. Occupancy Sensors.
- D. Device plates.

#### **1.02 RELATED SECTIONS**

- A. Section 26 0533 - Boxes.
- B. Section 26 0553 - Electrical Identification: Labels on computer outlets.

#### **1.03 REFERENCES**

- A. NEMA WD 1 - General Purpose Wiring Devices.
- B. NEMA WD 6 - Wiring Device Configurations.
- C. UL 20 - General Use Snap Switches.
- D. UL 498 - Attachment Plugs and Receptacles.
- E. UL 894 - Switches for Use in Hazardous (Classified) Locations.
- F. UL 1010 - Receptacle Plug Combinations for Use in Hazardous (Classified) Locations.

#### **1.04 SUBMITTALS**

- A. Submit under provisions of Division 1 and Section 26 0500.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
- C. Manufacturer's Instructions:
  - 1. Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.
  - 2. Include instructions for storage, handling, protection, examination, preparation, operation, and installation of product.

#### **1.05 REGULATORY REQUIREMENTS**

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.



## **1.06 EXTRA MATERIALS**

- A. Provide protective rings and split nozzles as required and as specified.

## **PART 2 PRODUCTS**

### **2.01 WALL SWITCHES**

- A. Single Pole Switch:
  - 1. Hubbell #1221.
  - 2. Pass & Seymour #20AC1.
  - 3. Cooper Wiring Devices #2221.
  - 4. Leviton #1221.
- B. Double Pole Switch:
  - 1. Hubbell #1222.
  - 2. Pass & Seymour #20AC2.
  - 3. Cooper Wiring Devices #2222.
  - 4. Leviton #1222.
- C. Three-way Switch:
  - 1. Hubbell #1223.
  - 2. Pass & Seymour #20AC3.
  - 3. Cooper Wiring Devices #2223.
  - 4. Leviton #1223.
- D. Four-way Switch:
  - 1. Hubbell #1224.
  - 2. Pass & Seymour #20AC4.
  - 3. Cooper Wiring Devices #2224.
  - 4. Leviton #1224.

### **2.02 RECEPTACLES**

- A. Single Convenience Receptacle:
  - 1. Hubbell #5361.
  - 2. Pass & Seymour #5361.
  - 3. Cooper Wiring Devices #5361.
  - 4. Leviton #5361.
- B. Duplex Convenience Receptacle:
  - 1. Hubbell #5362.
  - 2. Pass & Seymour #5362.
  - 3. Cooper Wiring Devices #5362.
  - 4. Leviton #5362.
- C. GFCI Receptacle:
  - 1. Hubbell #GF5352.
  - 2. Pass & Seymour #2091.
  - 3. Cooper Wiring Devices #XGF20.
  - 4. Leviton #GF5352.
- D. Isolated Ground Duplex Receptacle:
  - 1. Hubbell #IG5362.
  - 2. Pass & Seymour #IG6300.

- 3. Cooper Wiring Devices #IG5362.
- 4. Leviton #IG5362.
- E. Special Purpose Receptacle:
  - 1. Type, NEMA configuration and voltage as specified on Drawings as manufactured by:
    - a. Hubbell.
    - b. Pass & Seymour.
    - c. Cooper Wiring Devices.
    - d. Leviton.
- F. Color of devices as selected by Architect/Engineer.

## **2.03 OCCUPANCY SENSORS**

- A. APPROVED MANUFACTURES
  - 1. Hubbell
  - 2. WattStopper
  - 3. Engineer approved
- B. TYPE: Sensors shall be "Dual Technology" unless otherwise noted on plans
- C. INSTALLATION
  - 1. The Occupancy Sensor system shall sense the presence of human activity within the desired space and fully control the "On" / "Off" function of the lights.
  - 2. Time Delay settings shall be set at 10 minutes. This delay selection is based on lamp life vs. energy savings and sensor performance. Corridors and Bathroom time delay shall be set for 30 minutes to provide safety in such areas.
  - 3. Contractor shall adjust sensor sensitivity so the device will operate properly.
  - 4. Manufacture specified on drawings is specific to design. If an alternate manufacture is selected, the contractor is responsible for additional sensors, power pack, and additional equipment to meet the design needs. Also, contractor is to provide manufactures drawings with sensor coverage located on drawings. The revised drawing shall be included with the shop drawings. Alternate plan will only be approved once the engineer has reviewed this information.

## **2.04 WALL PLATES**

- A. Cover Plates: Stainless steel.
- B. Weatherproof Enclosures:
  - 1. Receptacles in wet locations shall be installed with an outlet enclosure clearly marked "Suitable for Wet Locations While in Use". There shall be a gasket between the enclosure and the mounting surface, and between the cover and the base to assure proper seal.
  - 2. The enclosure must employ stainless steel mounting hardware and be constructed of impact resistant polycarbonate. The outlet enclosure shall be UL listed and shall be as manufactured by TayMac Corporation, or approved equal.
- C. Isolated Ground Receptacle/Computer Receptacle: Cover plates shall be have "Computer" with black letters on clear background written from tapewriter equal to Thomas & Betts at top or coverplate.

- D. Wall-mounted Occupancy Sensors: Coverplates shall be suitable for sensor type and shape.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify conditions.
- B. Verify outlet boxes are installed at proper height.
- C. Verify wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- E. Verify color of all devices and coverplates.

### **3.02 PREPARATION**

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from outlet boxes.

### **3.03 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install devices plumb and level.
- C. Install single and double pole switches with OFF position down.
- D. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
- E. Install plates on switch, receptacle, and blank outlets in all areas.
- F. Connect wiring devices by wrapping conductor around screw terminal in clockwise direction and tightening screw. Where wiring device has two (2) plates tightened by a screw, this method may be used. However, other back-connected wiring devices, which depend upon a metal spring action, are not allowed.
- G. Use jumbo size plates for outlets installed in masonry walls.
- H. Install galvanized steel plates on outlet boxes and junction boxes above accessible ceilings, and on surface mounted outlets.
- I. All plates shall be secured by means of screws with heads matching plates.
- J. Vertically mounted receptacles shall be installed with equipment grounds down, unless local codes require otherwise. Horizontally mounted receptacles shall be installed with equipment grounds to the right, unless local codes require otherwise. Regardless, all receptacles, including GFCI receptacles, shall be installed in the same way with the ground, turned in the same direction.

- K. Install labels on computer outlets.

#### **3.04 INTERFACE WITH OTHER PRODUCTS**

- A. Coordinate locations of outlet boxes provided under Section 26 0533 to obtain mounting heights specified and indicated on Drawings.
- B. Install wall switches 48 inches above finished floor to the center of the box.
- C. Install convenience receptacle 18 (vertically oriented) inches above finished floor unless noted otherwise on Drawings.
- D. Install convenience receptacle 6 (horizontally oriented) inches above finished counter.

#### **3.05 FIELD QUALITY CONTROL**

- A. Inspect each wiring device for defects.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.
- F. Check tightness of all conductor connections.

#### **3.06 ADJUSTING**

- A. Adjust devices and wall plates to be flush and level.

**END OF SECTION**

**SECTION 26 5100  
INTERIOR LIGHTING**

**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Interior lighting fixtures, lamps, and ballasts.
  - 2. Emergency lighting units.
  - 3. Exit signs.
  - 4. Lighting fixture supports.
  - 5. Retrofit kits for fluorescent lighting fixtures.
- B. Related Sections:
  - 1. Section 26 0943 "Digital Network Lighting Controls" for programmable control systems with low-voltage control wiring or data communication circuits.
  - 2. Section 26 2726 "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

**1.03 DEFINITIONS**

- A. BF: Ballast factor.
- B. CCT: Correlated color temperature.
- C. CRI: Color-rendering index.
- D. HID: High-intensity discharge.
- E. LER: Luminaire efficacy rating.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting fixture, including ballast housing if provided.

**1.04 ACTION SUBMITTALS**

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
  - 1. Physical description of lighting fixture including dimensions.
  - 2. Emergency lighting units including battery and charger.
  - 3. Ballast, including BF.
  - 4. Energy-efficiency data.
  - 5. Air and Thermal Performance Data: For air-handling lighting fixtures. Furnish data required in "Action Submittals" Article in Section 233713 "Diffusers, Registers, and Grilles."

6. Sound Performance Data: For air-handling lighting fixtures. Indicate sound power level and sound transmission class in test reports certified according to standards specified in Section 233713 "Diffusers, Registers, and Grilles."
  7. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
  8. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
    - a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.
    - b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Shop Drawings: For nonstandard or custom lighting fixtures. Include plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  2. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples: For each lighting fixture indicated in the Interior Lighting Fixture Schedule. Each Sample shall include the following:
1. Lamps and ballasts, installed.
  2. Cords and plugs.
  3. Pendant support system.
- D. Installation instructions.

#### **1.05 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Lighting fixtures.
  2. Suspended ceiling components.
  3. Partitions and millwork that penetrate the ceiling or extends to within 12 inches (305 mm) of the plane of the luminaires.
  4. Ceiling-mounted projectors.
  5. Structural members to which suspension systems for lighting fixtures will be attached.
  6. Other items in finished ceiling including the following:
    - a. Air outlets and inlets.
    - b. Speakers.
    - c. Sprinklers.
    - d. Smoke and fire detectors.
    - e. Occupancy sensors.
    - f. Access panels.
  7. Perimeter moldings.
- B. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

- C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.
- D. Field quality-control reports.
- E. Warranty: Sample of special warranty.

#### **1.06 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
  - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

#### **1.07 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. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
  - 2. Plastic Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
  - 3. Fluorescent-fixture-mounted, emergency battery pack: One for every 50 emergency lighting units. Furnish at least one of each type
  - 4. Ballasts: One for every 100 of each type and rating installed. Furnish at least one of each type.
  - 5. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

#### **1.08 QUALITY ASSURANCE**

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910, complying with the IESNA Lighting Measurements Testing & Calculation Guides.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.
- E. FM Global Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- F. Mockups: Provide interior lighting fixtures for room or module mockups, complete with power and control connections.
  - 1. Obtain Architect's approval of fixtures for mockups before starting installations.
  - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

3. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## **1.09 COORDINATION**

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

## **1.10 WARRANTY**

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
  1. Warranty Period for Emergency Fluorescent Ballast and Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.
  1. Although substitutions are acceptable, it is the contractor responsibility to demonstrate that substitutions meet the same quality and performance requirements as the units specified. Any and all changes to the system required due to the use of a substituted component are the responsibility of the contractor.

### **2.02 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS**

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.
- C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.
- E. Metal Parts: Free of burrs and sharp corners and edges.
- F. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.



- H. Diffusers and Globes:
  - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
    - a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
    - b. UV stabilized.
  - 2. Glass: Annealed crystal glass unless otherwise indicated.
- I. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
  - 1. Label shall include the following lamp and ballast characteristics:
    - a. "USE ONLY" and include specific lamp type.
    - b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
    - c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
    - d. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
    - e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
    - f. CCT and CRI for all luminaires.
- J. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.
- K. Air-Handling Fluorescent Fixtures: For use with plenum ceiling for air return and heat extraction and for attaching an air-diffuser-boot assembly specified in Section 233713 "Diffusers, Registers, and Grilles."
  - 1. Air-Supply Units: Slots in one or both side trims join with air-diffuser-boot assemblies.
  - 2. Heat-Removal Units: Air path leads through lamp cavity.
  - 3. Combination Heat-Removal and Air-Supply Unit: Heat is removed through lamp cavity at both ends of the fixture door with air supply same as for air-supply units.
  - 4. Dampers: Operable from outside fixture for control of return-air volume.
  - 5. Static Fixture: Air-supply slots are blanked off, and fixture appearance matches active units.

## **2.03 LED LIGHTING FIXTURES**

- A. Construction: Housing formed from cold-rolled steel painted after fabrication. Smooth hemmed sides and smooth inward-formed end flanges. Extruded aluminum door frame with premium appearance and mitered corners. Door frame painted after fabrication, standard. Powder-painted rotary cam latches provide easy, secure door closure. Integral T-bar clips are standard. Acrylic shielding material is 100% UV stabilized
- B. Optics: Standard pattern #19 lens, 0.156" thick with highly transmissive overlay. Overlay shall be a minimum 0.040" thick.
- C. Electrical: Long life LEDs, coupled with high-efficiency drivers rated for 50,000 hours. Provide ballast disconnect for each fixture.
- D. Listing: UL and CSA certified to U.S. and Canadian standards.

- E. Warranty: Minimum 5-years for drivers and LEDs
- F. Lumen Management: Fixture shall automatically track runtime and manage light source such that lumen output is maintained over the system life.

## **2.04 BALLASTS FOR LINEAR FLUORESCENT LAMPS**

- A. General Requirements for Electronic Ballasts:
  - 1. Comply with UL 935 and with ANSI C82.11.
  - 2. Designed for type and quantity of lamps served.
  - 3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
  - 4. Sound Rating: Class A
  - 5. Total Harmonic Distortion Rating: Less than 10 percent.
  - 6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
  - 7. BF: 0.88 or higher.
  - 8. Power Factor: 0.95 or higher.
  - 9. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.
- B. All luminaires controlled by occupancy sensors shall have programmed-start ballasts.
- C. Electronic Programmed-Start Ballasts for T5,T8, and T5HO Lamps: Comply with ANSI C82.11 and the following:
  - 1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
  - 2. Automatic lamp starting after lamp replacement.
- D. Single Ballasts for Multiple Lighting Fixtures: Factory wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.
- E. Ballasts for Low-Temperature Environments:
  - 1. Temperatures 0 Deg F (Minus 17 Deg C) and Higher: Electronic type rated for 0 deg F (minus 17 deg C) starting and operating temperature with indicated lamp types.
  - 2. Temperatures Minus 20 Deg F (Minus 29 Deg C) and Higher: Electromagnetic type designed for use with indicated lamp types.
- F. Ballasts for Low Electromagnetic-Interference Environments: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for consumer equipment.
- G. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.
  - 1. Dimming Range: 100 to 5 percent of rated lamp lumens.
  - 2. Ballast Input Watts: Can be reduced to 20 percent of normal.
  - 3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
  - 4. Control: Coordinate wiring from ballast to control device to ensure that the ballast, controller, and connecting wiring are compatible.
- H. Ballasts for Bi-Level Controlled Lighting Fixtures: Electronic type.

1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.
    - a. High-Level Operation: 100 percent of rated lamp lumens.
    - b. Low-Level Operation: 30 percent of rated lamp lumens.
  2. Ballast shall provide equal current to each lamp in each operating mode.
  3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.
- I. Ballasts for Tri-Level Controlled Lighting Fixtures: Electronic type.
1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.
    - a. High-Level Operation: 100 percent of rated lamp lumens.
    - b. Low-Level Operation: 30 and 50 percent of rated lamp lumens.
  2. Ballast shall provide equal current to each lamp in each operating mode.
  3. Compatibility: Certified by manufacturer for use with specific tri-level control system and lamp type indicated.

## **2.05 BALLASTS FOR COMPACT FLUORESCENT LAMPS**

- A. Description: Electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:
1. Lamp end-of-life detection and shutdown circuit.
  2. Automatic lamp starting after lamp replacement.
  3. Sound Rating: Class A.
  4. Total Harmonic Distortion Rating: Less than 20 percent.
  5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
  6. Operating Frequency: 20 kHz or higher.
  7. Lamp Current Crest Factor: 1.7 or less.
  8. BF: 0.95 or higher unless otherwise indicated.
  9. Power Factor: 0.95 or higher.
  10. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

## **2.06 EMERGENCY FLUORESCENT POWER UNIT**

- A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924. Emergency ballast shall be Bodine B50 or approved equal.
1. Emergency Connection: Operate two fluorescent lamp(s) continuously at an output of 1100 lumens. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
  2. Nightlight Connection: Operate one fluorescent lamp continuously.
    - a. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
    - b. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - c. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  3. Battery: Sealed, maintenance-free, nickel-cadmium type.
  4. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.

5. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
  6. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
- B. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more fluorescent lamps, remote mounted from lighting fixture. Comply with UL 924.
1. Emergency Connection: Operate one fluorescent lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
  2. Nightlight Connection: Operate one fluorescent lamp in a remote fixture continuously.
  3. Battery: Sealed, maintenance-free, nickel-cadmium type.
  4. Charger: Fully automatic, solid-state, constant-current type.
  5. Housing: NEMA 250, Type 1 enclosure.
  6. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
  7. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
  9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

## 2.07 BALLASTS FOR HID LAMPS

- A. Electromagnetic Ballast for Metal-Halide Lamps: Comply with ANSI C82.4 and UL 1029. Include the following features unless otherwise indicated:
1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
  2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C) for single-lamp ballasts.
  3. Rated Ambient Operating Temperature: 104 deg F (40 deg C).
  4. Open-circuit operation that will not reduce average life.
  5. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.
- B. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:
1. Minimum Starting Temperature: Minus 20 deg F (Minus 29 deg C) for single-lamp ballasts.
  2. Rated Ambient Operating Temperature: 130 deg F (54 deg C).
  3. Lamp end-of-life detection and shutdown circuit.
  4. Sound Rating: Class A.
  5. Total Harmonic Distortion Rating: Less than 20 percent.
  6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
  7. Lamp Current Crest Factor: 1.5 or less.
  8. Power Factor: 0.90 or higher.

9. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
  10. Protection: Class P thermal cutout.
  11. Bi-Level Dimming Ballast: Ballast circuit and leads provide for remote control of the light output of the associated fixture between high- and low-level and off.
    - a. High-Level Operation: 100 percent of rated lamp lumens.
    - b. Low-Level Operation: 50 percent of rated lamp lumens.
    - c. Compatibility: Certified by ballast manufacturer for use with specific bi-level control system and lamp type indicated. Certified by lamp manufacturer that ballast operating modes are free from negative effect on lamp life and color-rendering capability.
  12. Continuous Dimming Ballast: Dimming range shall be from 100 to 35 percent of rated lamp lumens without flicker.
    - a. Ballast Input Watts: Reduced to a maximum of 50 percent of normal at lowest dimming setting.
- C. High-Pressure Sodium Ballasts: Electromagnetic type, with solid-state igniter/starter. Igniter/starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.
1. Instant-Restrike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150 W.
  2. Minimum Starting Temperature: Minus 40 deg F (Minus 40 deg C).

## **2.08 QUARTZ LAMP LIGHTING CONTROLLER**

- A. General Requirements for Controllers: Factory installed by lighting fixture manufacturer. Comply with UL 1598.
- B. Standby (Quartz Restrike): Automatically switches quartz lamp on when a HID lamp in the fixture is initially energized and during the HID lamp restrike period after brief power outages.
- C. Connections: Designed for a single branch -circuit connection.
- D. Switching Off: Automatically switches quartz lamp off when HID lamp strikes.
- E. Switching Off: Automatically switches quartz lamp off when HID lamp reaches approximately 60 percent light output.

## **2.09 EXIT SIGNS**

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
  1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
  2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
    - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal

- voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
- d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
- e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
- f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
- g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

## 2.10 EMERGENCY LIGHTING UNITS

- A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.
  - 1. Battery: Sealed, maintenance-free, nickel-cadmium type.
  - 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
  - 3. Lamps: LED
  - 4. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
  - 5. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
  - 6. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  - 7. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
  - 8. Integral Time-Delay Relay: Holds unit on for fixed interval when power is restored after an outage.
  - 9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

## 2.11 FLUORESCENT LAMPS

- A. T8 rapid-start lamps, rated 32 W maximum, nominal length of 48 inches (1220 mm), 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life 20,000 hours unless otherwise indicated.
- B. T8 rapid-start lamps, rated 17 W maximum, nominal length of 24 inches (610 mm), 1300 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life of 20,000 hours unless otherwise indicated.
- C. T5 rapid-start lamps, rated 28 W maximum, nominal length of 45.2 inches (1150 mm), 2900 initial lumens (minimum), CRI 85 (minimum), color temperature 3500 K, and average rated life of 20,000 hours unless otherwise indicated.

- D. T5HO rapid-start, high-output lamps, rated 54 W maximum, nominal length of 45.2 inches (1150 mm), 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 3500 K, and average rated life of 20,000 hours unless otherwise indicated.
- E. Compact Fluorescent Lamps: 4-Pin, CRI 80 (minimum), color temperature 3500 K, average rated life of 10,000 hours at three hours operation per start, and suitable for use with dimming ballasts unless otherwise indicated.
  - 1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
  - 2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
  - 3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
  - 4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
  - 5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
  - 6. 57 W: T4, triple tube, rated 4300 initial lumens (minimum).
  - 7. 70 W: T4, triple tube, rated 5200 initial lumens (minimum).

## **2.12 HID LAMPS**

- A. High-Pressure Sodium Lamps: ANSI C78.42, CRI 21 (minimum), color temperature 1900 K, and average rated life of 24,000 hours, minimum.
  - 1. Dual-Arc Tube Lamps: Arranged so only one of two arc tubes is lighted at one time and, when power is restored after an outage, the cooler arc tube, with lower internal pressure, lights instantly, providing an immediate 8 to 15 percent of normal light output.
- B. Metal-Halide Lamps: ANSI C78.43, with minimum CRI 65 and color temperature 4000 K.
- C. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000 K.
- D. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and color temperature 4000 K.
- E. Low-Pressure Sodium Lamps: ANSI 78.41, CRI 0, and color temperature 1800 K.

## **2.13 LIGHTING FIXTURE SUPPORT COMPONENTS**

- A. Comply with Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm)
- F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Lighting fixtures:
  - 1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
  - 2. Install in accordance with manufacturer's written instructions.
  - 3. Install lamps in each luminaire.
- B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- C. Remote Mounting of Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.
- D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
  - 1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches (150 mm) from lighting fixture corners.
  - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
  - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
  - 4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- E. Suspended Lighting Fixture Support:
  - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
  - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
  - 4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
- F. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- G. Fixtures shall not be supported from conduits, ducts, or piping.
- H. All recessed lighting fixtures shall have seismic clips firmly situated over tops of ceiling grid tees or plaster rings.
- I. Provide safety chains for all fixtures over 50lbs.

### **3.02 IDENTIFICATION**



- A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### **3.03 FIELD QUALITY CONTROL**

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Verify that self-luminous exit signs are installed according to their listing and the requirements in NFPA 101.
- C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.
- D. Replace all broken or cracked lenses.
- E. Replace all scratched, bent, dented reflectors and door frames.
- F. Adjust exit sign directional arrows as required to direct occupants to the path of egress.
- G. Re-lamp all fixtures that have failed lamps at substantial completing. Fluorescent lamps that fail within 90 days of operation will be considered defective and shall be replaced at no additional cost.
- H. Add glare control, adjust fixture, or relocate fixtures as required to remove objectionable glare as directed by the owner.

### **3.04 STARTUP SERVICE**

- A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

### **3.05 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.
  - 1. Adjust aimable luminaires in the presence of Architect.

**END OF SECTION**

**SECTION 28 3100  
FIRE DETECTION AND ALARM**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Fire alarm control panel.
- B. Manual fire alarm stations.
- C. Automatic smoke and heat detectors.
- D. Fire alarm signaling appliances.
- E. Auxiliary fire alarm equipment.

**1.02 RELATED SECTIONS**

- A. Section 09 9100 - Painting: Touchup and paint boxes.
- B. Section 23 0923 – Direct Digital Control System for HVAC.
- C. Section 26 0533 – Raceway and Boxes for Electrical Systems
- D. Section 26 0519 – Low-Voltage Electrical Power Connectors and Cable.
- E. Section 26 0529 – Hangers and Supports for Electrical Systems.
- F. Section 26 0553 - Identification for Electrical Systems: Address directory and painted boxes.
- G. Section 26 0548 – Vibration and Seismic Controls for Electrical Systems.

**1.03 REFERENCES**

- A. Americans with Disabilities Act.
- B. Arkansas State Fire Protection Code.
- C. ASME A17.1 - Safety Code for Elevators and Escalators.
- D. International Building Code, 2000 Edition.
- E. NFPA 70 - National Electrical Code.
- F. NFPA 72 - National Fire Alarm Code.
- G. NFPA 101 - Life Safety Code.
- H. UL 228 - Door Closers - Holders, With or Without Integral Smoke Detector.
- I. UL 268 - Smoke Detectors for Fire Protective Signaling Systems.

- J. UL 268A - Smoke Detectors for Duct Application.
- K. UL 521 - Heat Detectors for Fire Protective Signaling Systems.
- L. UL 864 - Control Units for Fire Protective Signaling Systems.
- M. UL 753 - Alarm Accessories for Automatic Water-Supply Control Valves for Fire Protection Service.
- N. UL 1653 - Digital Alarm - Communicator System Units.

#### **1.04 SYSTEM DESCRIPTION**

- A. Fire Alarm System: NFPA 72, manual and automatic local fire alarm system with connections to the existing Simplex fire alarm system in the building.

#### **1.05 SUBMITTALS**

- A. Submit under provisions of Division 1 and Section 26 0500.
- B. Shop Drawings: Shop drawings shall be submitted to the Architect for approval prior to installation. The submittal shall include complete schematic circuit diagrams for all equipment, address device type, label and reference detail, wiring diagrams showing connections between all system components, description of system operation, annunciator schedule, and manufacturer's literature marked to show model and catalog number for all equipment. Complete riser diagrams indicating wiring sequence of all alarm devices and control equipment shall be included with the submittal data. Submittals shall be a complete set; partial submittals will not be accepted. Electrical drawings shall not be on less than 8-1/2 inch by 11-inch sheets, and shall identify all modules if so constructed, shall be on a single sheet drawing with all circuit terminals and inter-connections identified. Six (6) copies of the shop drawings shall be submitted.
- C. Product Data: Provide electrical characteristics and connection requirements.
- D. Test Reports: Indicate satisfactory completion of required tests and inspections.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of products.

#### **1.06 PROJECT RECORD DOCUMENTS**

- A. Submit under provisions of Division 1 and Section 26 0500.
- B. Record actual locations of initiating devices, signaling appliances, and end-of-line devices.

#### **1.07 OPERATION AND MAINTENANCE DATA**

- A. Submit under provisions of Division 1 and Section 26 0500.
- B. Operation Data: Operating instructions.
- C. Maintenance Data: Maintenance and repair procedures.

## **1.08 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five (5) years documented experience, and with service facilities within 150 miles of Project.
- B. Installer: Company specializing in installing the products specified in this section with minimum five (5) years documented experience, and certified by State of Arkansas as fire alarm installer.
- C. The Arkansas Department of Labor requires that the worker, who installs the raceways for the equipment under this Section, be paid the electrician's minimum wage rate.

## **1.09 REGULATORY REQUIREMENTS**

- A. Conform to requirements of NFPA 70, NFPA 72 and NFPA 101.
- B. Furnish products listed and classified by UL and/or FM as suitable for purpose specified and indicated.
- C. The Arkansas Department of Labor requires that raceways, installed for equipment under this Section, be installed by licensed electricians.
- D. Conform to requirements of ASME A17.1 Safety Code for Elevators and Escalators.

## **1.10 MAINTENANCE SERVICE**

- A. Furnish service and maintenance of fire alarm system for one year from Date of Substantial Completion.

## **1.11 MONITORING SERVICE**

- A. Furnish monitoring service of fire alarm system for one year from Date of Substantial Completion.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS - LIMITED TO THE FOLLOWING**

- A. Simplex.
- B. Engineer approved.

### **2.02 ALARM CONTROL PANEL**

- A. Control Panel: Modular construction with surface-mounted enclosure.
- B. Power supply: Adequate to serve control panel modules, remote detectors, remote annunciators, relays, door holders, and alarm signaling devices. Include battery-operated emergency power supply with capacity for operating system in standby mode for 24 hours followed by alarm mode for 5 minutes. Batteries shall power door holders so that doors do not close upon loss of AC power.
- C. System Supervision: Component or power supply failure places system in trouble mode.

- D. Signaling Line Circuits: Shall consist of a shielded twisted pair wire, Class B, Style 4 circuit. T-taps are not allowed.
- E. Notification Device Circuits: Supervised so that occurrence of a single ground or open condition places circuit in trouble mode but does not disable that circuit from signaling an alarm. Circuits shall be Class B, Style X for notification device circuits.
- F. Municipal/Campus Trip Circuit: Output connections for remote station monitoring.
- G. Auxiliary Relays: Provide sufficient SPDT auxiliary relay contacts for each detection zone to provide accessory functions specified.
- H. Provide TROUBLE ACKNOWLEDGE, ALARM ACKNOWLEDGE, SUPERVISORY ACKNOWLEDGE and ALARM SILENCE switch.
- I. Trouble Sequence of Operation: System or circuit trouble places system in trouble mode, which causes the following system operations:
  - 1. Visual and audible trouble alarm indicated by address at fire alarm control panel.
  - 2. Visual and audible trouble alarm indicated at remote annunciator panel.
  - 3. Trouble-signal transmitted to campus connection where provided.
  - 4. Manual acknowledge function at fire alarm control panel silences audible alarm, visual alarm is displayed until initiating failure or circuit trouble is cleared.
  - 5. Trouble conditions shall be reported to include device number, location and type of trouble.
- J. Alarm Sequence of Operation: Actuation of any initiating device places system in trouble mode, which causes the following system operations:
  - 1. Report status of device and initiate alarm on device indicating circuits.
- K. Alarm Reset: System remains in alarm mode until manually reset with key-accessible reset function; system resets only if initiating circuits are out of alarm mode.
- L. Lamp Test: Manual lamp test function causes alarm indication at each address, at fire alarm control panel and at annunciator panel.
- M. Digital Communicator: Provide and install a digital communicator for remote station monitoring.

## **2.03 INITIATING DEVICES**

- A. Manual Pull Station: Addressable semi-flush and surface mounted, non-coded type, double action, break-glass type manual station with break-glass rod. Provide manufacturer's standard backbox. Simplex #2099-9795, addressable type.
- B. Smoke Detectors: The smoke detector shall be an intelligent digital photoelectric detector with a programmable heat detector. Detectors shall be listed for use in open area protective coverage, in duct installation and duct sampling assembly installation and shall be insensitive to air velocity changes. The detector communications shall allow the detector to provide alarm input to the system and alarm output from the system with 4 seconds. Detectors shall be programmable as application specific, selected in software for a minimum of 11 environmental fire profiles unique to the installed location. These fire profiles shall eliminate the possibility of false indications caused by duct, moisture, RFI/EMI, chemical fumes and air movement while factoring in conditions of ambient temperature rise, obscuration rate changes and hot/cold smoke phenomenon into the

alarm decision to give the earliest possible real alarm condition report. The intelligent smoke detector shall be capable of providing three distinct outputs from the control panel. The system-controlled output functions shall be from an individual or unique input of smoke obscuration, and thermal conditions. The detector shall be designed to eliminate calibration errors associated with field cleaning of the chamber. The detector shall support the use of a relay and LED remote indicator at the same time. Low profile, white case shall not exceed 2.5 inches of extension below the finish ceiling. Detector wiring shall not require any special shielded cable.

- C. Duct Mounted Smoke Detector: Detectors shall be same as detector in Paragraph B above but shall be equipped with duct mounted housing and auxiliary contacts to shut down HVAC equipment.
- D. Heat Detectors: Addressable type combination fixed temperature rate-of-rise type. Rate of rise selectable 15 degrees F or 20 degrees F per minute.
- E. Auxiliary Fire Alarm Equipment: Contractor shall provide and install all controls, relays, activation devices, and addressable modules on hood fire extinguishing systems for fire alarm to receive an alarm signal when hood extinguishing systems activate. Each hood extinguishing system shall have its own address.

#### **2.04 SIGNALING APPLIANCES**

- A. Alarm Lights: NFPA 72, UL 1971, Xenon, strobe lamp and flasher with minimum flash rate of 1 flash per second, red lettered "FIRE" on white lens. Units shall comply with A.D.A. requirements. Strobe candela ratings as shown on Drawings. All strobes shall be synchronized at 1 hertz.
- B. Alarm Horn: NFPA 72, ANSI 117.1, surface and/or flush type fire alarm horn. Sound Rating: 95 dB at 10 feet (3M). Provide integral Xenon, strobe lamp and flasher with red lettered "FIRE" on white lens where indicated. Units shall comply with A.D.A. requirements.
- C. Remote Annunciator: Minimum 40 character, back-lit, alphanumeric, liquid crystal display reports point status, type of alarm, number of alarms, supervisory conditions, troubles and custom location label. Simplex #4603-9101.

#### **2.05 FIRE ALARM WIRE AND CABLE**

- A. Fire Alarm Power Branch Circuits: Building wire as specified in Section 26 0519.
- B. Initiating Device and Indicating Appliance Circuits: Multiplex cable as recommended by manufacturer of fire alarm system. Cable shall be red.
- C. All fire alarm wire and cable shall be installed in conduit as specified in Section 26 0533.

#### **2.06 INDIVIDUAL ADDRESSABLE MODULE**

- A. Provide location specific addressable to a single initiating device by monitoring N.O. dry contacts.

#### **2.07 DOORS**

- A. Provide and install 24-volt DC at all door holders.

- B. Provide interlock with the access control system to unlock all egress doors in the event of an alarm. The contractor is responsible for all components and programming required for a complete and operative system.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install manual station with operating handle 4 feet above floor to center of device. Install audible and visual signal devices 80 inches above floor to bottom of device or 6 inches below ceiling to top of device, whichever is lower (unless noted otherwise on Drawings).
- C. Use 16 AWG minimum size conductors for fire alarm detection and signal circuit conductors. Install wiring in conduit.
- D. Mount end-of-line device in control panel.
- E. Make conduit and wiring connections to sprinkler flow switches and sprinkler valve tamper switches.
- F. Automatic Detector Installation: Conform to NFPA 72.
- G. Duct detectors shall be interlocked with air handling unit starters to de-energize units upon activation of duct detectors. All associated smoke dampers shall be interlocked to close upon activation of duct detection. Fire alarm contractor shall install wire and conduit from duct detector to air handling unit starter. Fire alarm contractor shall connect wires to duct detector. Temperature controls contractor shall connect wires at motor starter. Both contractors shall test shut down.
- H. Make conduit and wiring connections to smoke damper actuator controller.
- I. Elevator recall for firefighter's service:
  - 1. Smoke detector located in the designated elevator recall lobby shall be connected to the first elevator control circuit.
  - 2. Smoke detectors in the remaining elevator lobbies, hoistways, and elevator machine room shall be connected to the second elevator control circuit, except that when the elevator machine room is located at the designated landing, then the elevator machine room smoke detector shall be connected to the first elevator control circuit.
  - 3. Install relays, addressable control modules, contacts, and all wiring, which will cause the elevator recall.
- J. Sprinklered Elevator Shafts and Machine Rooms:
  - 1. Heat detectors, 135 degrees fixed, shall be installed next to sprinkler heads in Machine Rooms and shafts. Install relays, addressable control modules, contacts, and all wiring which will cause power to be removed from the elevator power circuit and car-lighting circuit via shunt trip breaker control.
  - 2. Smoke detectors in hoistway and the Machine Room shall return elevator to the designated floor. Detectors in pit and at the lowest lobby will cause the elevator to return to another or designated alternate floor. Smoke detectors at other lobby floors will return the elevator to the designated floor. Install all relays, addressable control modules, contacts and all wiring which will cause the above-

- described elevator control from fire alarm system.
3. The activation of any sprinkler flow switch to the pit, top of shaft or elevator equipment room shall shunt trip the elevator power and control circuits.
  4. The battery lowered device for hydraulic elevators shall be disconnected upon the shunt signal to the elevator power and control circuits. Hydraulic elevators are to stay wherever they are when a shunt trip signal is received.
- K. Signal device shall sound different from other signal devices.
- L. Bolt control panel to mounting surface in accordance with Section 26 0553.
- M. Door holders shall not release upon loss of AC power.
- N. All wire and cables shall be installed in continuous conduit.
- O. Do not peel back cable sheaths more than necessary to separate conductors.
- P. Do not score copper conductors when peeling back conductor insulation. Scored conductors shall be replaced.
- Q. Do not bend cables with a radius less than five times the cable's diameter. Cables bent with a radius less than this shall be replaced.
- R. Kinked, torn or twisted cable sheaths are unacceptable and shall be replaced.
- S. Install cables to avoid chemicals and cold temperature bending.
- T. Make sure conduits are properly reamed, terminated and brushed before installing cables or wire.
- U. Verify proper conductor location at each termination before energization.
- V. Maintain the following clearances to signal cables:
  1. 6 inches from power circuits other than fire alarm power circuits.
  2. 12 inches from light fixtures.
  3. 18 inches from hot water pipes, steam pipes and flues.
  4. 48 inches from transformers, meters and VFD's.
- W. Paint all fire alarm boxes red where (1) concealed or (2) exposed in mechanical and electrical rooms.
- X. Wall-mounted smoke detectors shall be installed with top of smoke detector between 4 inches and 12 inches down from ceiling or down from the deck where no ceilings exists.
- Y. Where there are exposed bar joists, smoke detectors shall be mounted on the bottom of the deck and shall not be mounted on the bottom of the open bar joists.
- Z. Where there are solid exposed joists, smoke detectors shall be mounted on the bottom of the joist and not on the ceiling or deck.
- AA. Adjust door of control panel so that it opens easily without dragging.
- BB. If control panel is less than 6'-6" tall, install panel with middle of panel at 48 inches. If panel is latter than 6'-6", install panel with top of panel at 7'-6".



- CC. Install remote annunciators with middle of annunciator at 48 inches, unless mounted above a countertop.
- DD. Install directory of addresses and corresponding devices and locations at control panel.
- EE. Neatly form all wires and cables in control panel.
- FF. Touchup scratched or marred surfaces to match original finish.

### **3.02 FIELD QUALITY CONTROL**

- A. Field inspection and testing will be performed under provisions of Division 1.
- B. Test in accordance with NFPA 72 and local fire department requirements in the presence of the Owner's representative and the local fire marshal. Upon completion of successful test, the Contractor shall certify in writing to the Owner and General Contractor. Certificate of completion shall be prepared as required in NFPA 72. Contractor shall sign and date all pertinent information.
- C. Check tightness of all conductor connections.

### **3.03 DEMONSTRATION**

- A. Provide a minimum of 6 hours of systems demonstration and training to Owner's designated representatives.
- B. Demonstrate normal and abnormal modes of operation, and required responses to each.

### **3.04 WARRANTY**

- A. The Contractor shall warranty the completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of one (1) year from the date of the completed and certified test or from the date of first beneficial use.
- B. The equipment manufacturer shall make available to the Owner a maintenance contract proposal to provide a minimum of two (2) inspections and tests per year in compliance with NFPA 72 guidelines. Provide smoke detector inspection forms to Owner with information as outlined in NFPA 72.
- C. A fire alarm certificate of completion form shall be issued to the Owner with all required information as outlined in NFPA 72.

**END OF SECTION**