



University of Central Arkansas

Project Manual

Campus District Loop & Chiller
Plant

UCA-26-010

Architect
AMR Architects, Inc.
1424 Main St. STE 105
Little Rock, AR
(501) 375-.378

**SECTION 000103
PROJECT DIRECTORY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Identification of project team members and their contact information.

1.02 OWNER:

- A. Name: University of Central Arkansas
1. Address Line 1: 201 Donaghey Ave.
 2. City: Conway.
 3. State: Arkansas.
 4. Zip Code: 72035.
 5. Telephone: (501) 450-5000.
- B. Primary Contact: All correspondence from the Contractor to the Architect will be direct, with copies to this party, unless alternate arrangements are mutually agreed upon at preconstruction meeting.
1. Title: Director of Planning, Design, and Construction.
 2. Name: Danielle Barron.
 3. Email: dbarron@uca.edu

1.03 CONSULTANTS:

- A. Architect: Design Professional of Record. All correspondence from the Contractor regarding construction documents authored by Architect's consultants will be through this party, unless alternate arrangements are mutually agreed upon at preconstruction meeting.
1. Company Name: AMR Architects.
 - a. Address Line 1: 1424 S Main St.
 - b. Address Line 2: Suite 105.
 - c. City: Little Rock.
 - d. State: Arkansas.
 - e. Zip Code: 72202.
 - f. Telephone: 501-375-0378.
 2. Primary Contact:
 - a. Title: Project Architect.
 - b. Name: Jacob Seither, AIA.
 - c. Email: jacob@amr-architects.com.
- B. Civil Engineering Consultant:
1. Company Name: Crafton Tull.
 - a. Address Line 1: 10825 Financial Centre Parkway.
 - b. Address Line 2: Suite 300.
 - c. City: Little Rock.
 - d. State: Arkansas.
 - e. Zip Code: 72211.
 - f. Telephone: 501-664-3245.
 2. Primary Contact:
 - a. Title: Civil Engineer of Record.
 - b. Name: Gregg Long, P.E..
 - c. Email: gregg.long@craftontull.com.
- C. Landscape Architecture Consultant:
1. Company Name: Prism Design Studio.
 - a. Address Line 1: 901 N. 47th Street.
 - b. Address Line 2: Suite 400.
 - c. City: Rogers.

- d. State: Arkansas.
 - e. Zip Code: 72756.
 - f. Telephone: 501-636-4838.
- 2. Primary Contact:
 - a. Title: Landscape Architect of Record.
 - b. Name: Jenny Burbidge, ASLA.
 - c. Email: jenny.burbidge@prismds.co.
- D. Structural Engineering Consultant:
 - 1. Company Name: Engineering Consultants, Inc..
 - a. Address Line 1: 401 W. Capitol Ave.
 - b. Address Line 2: Suite 305.
 - c. City: Little Rock.
 - d. State: Arkansas.
 - e. Zip Code: 72201.
 - f. Telephone: 501-376-3752.
 - 2. Primary Contact:
 - a. Title: Structural Engineer of Record.
 - b. Name: Brian Miller, P.E..
 - c. Email: brian.miller@ecilr.com.
- E. Mechanical, Plumbing & Electrical Engineering Consultant:
 - 1. Company Name: Pettit and Pettit Engineers.
 - a. Address Line 1: 201 E. Markham STE 400.
 - b. City: Little Rock.
 - c. State: Arkansas.
 - d. Zip Code: 72201.
 - e. Telephone: (501) 374-3731.
 - 2. Primary Contact:
 - a. Title: MEP Project Manager.
 - b. Name: Terry Jacks.
 - c. Email: TJacks@pettitinc.com.

1.04 CONSTRUCTION MANAGER:

- A. Company Name: Kinco Constructors.
 - 1. Address Line 1: 12600 Lawson Road
 - 2. City: Little Rock.
 - 3. State: Arkansas.
 - 4. Zip Code: 72210.
 - 5. Telephone: 501-225-7606 .
- B. Primary Contact:
 - 1. Title: Senior Project Manager.
 - 2. Name: Casey Sowell.
 - 3. Email: csowell@kinco.net.

PART 2 PRODUCTS - NOT USED

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END OF SECTION 000103

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NORTH CHILLER PLANT
CONWAY, ARKANSAS
PETTIT & PETTIT JOB NO. 25-048

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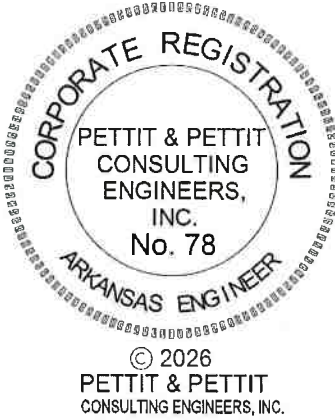
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**THE ARCHITECT OF RECORD FOR THE UCA DISTRICT CAMPUS LOOP AND CHILLER PLANT
IS:**



The Engineer of Record for Divisions 22 and 23 of the Specifications for the Campus District Loop & Chiller Plant Project, University of Central Arkansas, Conway, Arkansas, (P&P Job No. 25-048) is:

Date 04/06/26



The Engineer of Record for Divisions 26 and 28 Specifications for the Campus District Loop & Chiller Plant Project, University of Central Arkansas, Conway, Arkansas, (P&P Job No. 25-048) is:

4-6-26

Date



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PETTIT & PETTIT
CONSULTING ENGINEERS, INC.

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AGREEMENT FORM
Section 005213

THIS AGREEMENT entered into this _____ day of _____, 2026 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-26-010**

Project Name: **Campus District Loop & Chiller Plant** 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); 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 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 by May 31, 2026, 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.

Any changes made in the terms of the Contract including but not limited to the amount of the contract, or in the work to be done under it, or the giving by the Owner of any extension of time for the performance of the contract, or any other forbearance on the part of either the Owner or the Principal to the other shall not in any way release the Principal and the Surety or Sureties or either or any of them, their heirs, personal representatives, successors or assigns from their liability hereunder, notice to and consent of the Surety or Sureties of any such change, extension or forbearance being are hereby voluntarily waived. In no event shall the aggregate liability of the Surety exceed the Contract documents.

This Performance and Payment Bond Agreement is binding upon the above named parties, and their successors, heirs, assigns and personal representatives.

Executed by the parties who individually represent that each voluntarily enters into and has the authority to enter into this agreement.

BY: _____
Contractor Date

BY: _____
Arkansas Resident Agent or Non Resident Agent/ Attorney-in-Fact Date

Print: _____
Agent's Name Date

Address

City County State Zip Code

Business #: _____ Fax#: _____

E-Mail: _____

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 _____
_____, 20__.

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 9.

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. _____

TOTAL COST

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 15th 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 fixing 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 007216

(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 011000 SUMMARY

PART 1 GENERAL

1.01 PROJECT

- A. Project Name: UCA Campus District Loop & Chiller Plant
- B. Owner's Name: Central Arkansas Water.
- C. Architect's Name: AMR Architects.
- D. Additional Project contact information is specified in Section 000103 - Project Directory.

1.02 CONTRACT DESCRIPTION

- A. Contract Type: A single prime contract based on a Stipulated Price as described in Document 005200 - Agreement Form.

1.03 DESCRIPTION OF WORK

1.04 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.

1.05 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. **Contractor responsible for Phased Access Plan to keep existing and adjacent facilities in operation during construction.** Arrange use of site and premises to allow:
- C. 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.
- D. Utility Outages and Shutdown:
 - 1. Prevent accidental disruption of utility services to other adjacent facilities.

1.06 WORK SEQUENCE

- A. Coordinate construction schedule and operations with Owner.

END OF SECTION 011000

**SECTION 012000
PRICE AND PAYMENT PROCEDURES**

PART 1 GENERAL

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 RELATED REQUIREMENTS

- A. Section 005000 - Contracting Forms and Supplements: Forms to be used.
- B. Section 007200 - General Conditions: Additional requirements for progress payments, final payment, changes in the Work.
- C. Section 007300 - Supplementary Conditions: Percentage allowances for Contractor's overhead and profit.

1.03 SCHEDULE OF VALUES

- A. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
- B. Forms filled out by hand will not be accepted.
- C. Submit Schedule of Values within 15 days after date of Owner-Contractor Agreement. and **no less than 7 days** prior to the first Application for Payment.
- D. Revise schedule to list approved Change Orders, with each Application For Payment.

1.04 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. Execute certification by signature of authorized officer.
- F. 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.
- G. Submit one electronic copy of each Application for Payment.
- H. When Architect requires substantiating information, submit data justifying dollar amounts in question.

1.05 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 . Contractor shall prepare and submit a fixed price quotation within 14 days.

- D. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
- E. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

1.06 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 017000.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 012000

**SECTION 012300
ALTERNATES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Description of Alternates.
- B. Procedures for pricing Alternates.
- C. Documentation of changes to Contract Price and Contract Time.

1.02 RELATED REQUIREMENTS

- A. Document 002113 - Instructions to Bidders: Instructions for preparation of pricing for Alternates.
- B. Document 004323 - Alternates & Unit Price Form: List of Alternates as supplement to Bid Form.

1.03 ACCEPTANCE OF ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.04 SCHEDULE OF ALTERNATES

- A. Alternate No. 1 - PRE-ENGINEERED METAL BUILDING:
 - 1. Base Bid Item: As shown on drawings
 - 2. Alternate Item: Propose an alternate cost to remove all work associated with the free-standing pre-engineered metal storage building, including the PEMB building, concrete slab, all associated building systems and all associated site work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 012300

**SECTION 012500
SUBSTITUTION PROCEDURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

- A. Section 002113 - Instructions to Bidders: Restrictions on timing of substitution requests.
- B. Section 012100 - Allowances, for cash allowances affecting this section.
- C. Section 012300 - Alternates, for product alternatives affecting this section.
- D. Section 013000 - Administrative Requirements: Submittal procedures, coordination.
- E. Section 016000 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

1.03 DEFINITIONS

- A. Substitutions: See General Conditions for definition.

1.04 REFERENCE STANDARDS

- A. CSI/CSC Form 1.5C - Substitution Request (During the Bidding/Negotiating Stage); Current Edition.
- B. CSI/CSC Form 13.1A - Substitution Request (After the Bidding/Negotiating Phase); Current Edition.

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.
 - 2. Agrees to provide the same warranty for the substitution as for the specified product.
 - 3. 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.
 - 4. Waives claims for additional costs or time extension that may subsequently become apparent.
- B. 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.
- C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
 - 1. No specific form is required. Contractor's Substitution Request documentation must include the following:
 - a. Project Information:
 - 1) Owner's, Architect's, and Contractor's names.
 - b. Substitution Request Information:
 - 1) Indication of whether the substitution is for cause or convenience.
 - 2) Issue date.
 - 3) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
 - 4) Description of Substitution.
 - 5) Reason why the specified item cannot be provided.

- 6) Differences between proposed substitution and specified item.
- 7) Description of how proposed substitution affects other parts of work.
- c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
 - 1) Physical characteristics.
 - 2) In-service performance.
 - 3) Expected durability.
 - 4) Visual effect.
 - 5) Warranties.
 - 6) Other salient features and requirements.
 - 7) Include, as appropriate or requested, the following types of documentation:
 - (a) Product Data:
 - (b) Samples.
 - (c) Certificates, test, reports or similar qualification data.
 - (d) Drawings, when required to show impact on adjacent construction elements.
- d. Impact of Substitution:
 - 1) Savings to Owner for accepting substitution.
 - 2) Change to Contract Time due to accepting substitution.
- D. 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. Submittal Time Restrictions:
 - 1. Section 002113 - Instructions to Bidders specifies time restrictions and the documents required for submitting substitution requests during the bidding period.

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

- A. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
- B. Submit request for Substitution for Convenience within 14 days of discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
 - 1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
 - 2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
 - 3. Bear the costs engendered by proposed substitution of:
 - a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.

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.

3.05 ACCEPTANCE

- A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.06 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected Requests.

3.07 ATTACHMENTS

- A. A facsimile of the Substitution Request Form (During Construction) required to be used on the Project is included after this section.
- B. A facsimile of the Substitution Request Form (During Construction) required to be used on the Project is included after this section.

END OF SECTION 012500

**SECTION 013000
ADMINISTRATIVE REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General administrative requirements.
- B. Electronic document submittal service.
- C. Preconstruction meeting.
- D. Site mobilization meeting.
- E. Progress meetings.
- F. Construction progress schedule.
- G. Submittals for review and information.
- H. Number of copies of submittals.
- I. Requests for Interpretation (RFI) procedures.
- J. Submittal procedures.

1.02 RELATED REQUIREMENTS

- A. Section 007200 - General Conditions: Dates for applications for payment.
- B. Section 007300 - Supplementary Conditions: Duties of the Contractor.
- C. Section 016000 - Product Requirements: General product requirements.
- D. Section 017000 - Execution and Closeout Requirements: Additional coordination requirements.
- E. Section 017800 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

1.03 GENERAL ADMINISTRATIVE REQUIREMENTS

- A. Comply with requirements of Section 017000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
- B. Make the following types of submittals to Architect:
 - 1. Requests for Interpretation (RFI).
 - 2. Requests for substitution.
 - 3. Shop drawings, product data, and samples.
 - 4. Test and inspection reports.
 - 5. Design data.
 - 6. Manufacturer's instructions and field reports.
 - 7. Applications for payment and change order requests.
 - 8. Progress schedules.
 - 9. Coordination drawings.
 - 10. Correction Punch List and Final Correction Punch List for Substantial Completion.
 - 11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
 - 1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification

documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.

2. Contractor and Architect are required to use this service.
 3. It is Contractor's responsibility to submit documents in allowable format.
 4. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service at no extra charge.
 5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
 6. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
 7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
- B. Submittal Service: Use one of the following:
1. Procore
 2. Submittal Exchange (tel: 1-800-714-0024): www.submittalexchange.com/#sle.
 3. Or Equal.
- C. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.
- D. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

3.02 PRECONSTRUCTION MEETING

- A. Schedule meeting after Notice to Proceed.
- B. Attendance Required:
1. Owner.
 2. Architect.
 3. Contractor.
- C. Agenda:
1. Execution of Owner-Contractor Agreement.
 2. Submission of executed bonds and insurance certificates.
 3. Distribution of Contract Documents.
 4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
 5. Designation of personnel representing the parties to Contract and Architect.
 6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 7. Scheduling.
- 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.

3.03 SITE MOBILIZATION MEETING

- A. Schedule 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. Survey and building layout.
 6. Security and housekeeping procedures.
 7. Schedules.
 8. Application for payment procedures.
 9. Procedures for testing.
 10. Procedures for maintaining record documents.
 11. Requirements for start-up of equipment.
 12. 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 bi-monthly intervals.
- B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required:
1. Contractor.
 2. Owner.
 3. Architect.
 4. Contractor's superintendent.
 5. Major subcontractors.
- 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. Review of RFIs log and status of responses.
 7. Review of off-site fabrication and delivery schedules.
 8. Maintenance of progress schedule.
 9. Corrective measures to regain projected schedules.
 10. Planned progress during succeeding work period.
 11. Coordination of projected progress.
 12. Maintenance of quality and work standards.
 13. Effect of proposed changes on progress schedule and coordination.
 14. Other business relating to 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.

3.05 CONSTRUCTION PROGRESS SCHEDULE

- A. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- B. 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.

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

3.06 REQUESTS FOR INTERPRETATION (RFI)

- A. Definition: A request seeking one of the following:
 - 1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
 - 2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
 - 1. Prepare a separate RFI for each specific item.
 - a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
 - b. Do not forward requests which solely require internal coordination between subcontractors.
 - 2. Prepare in a format and with content acceptable to Owner.
 - 3. Prepare using software provided by the Electronic Document Submittal Service.
 - 4. Combine RFI and its attachments into a single electronic file. PDF format is preferred.
- C. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
 - 1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
 - 2. Unacceptable Uses for RFIs: Do not use RFIs to request the following::
 - a. Approval of submittals (use procedures specified elsewhere in this section).
 - b. Approval of substitutions (see Section - 016000 - Product Requirements)
 - c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
 - 3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
 - 4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.
 - a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.
- D. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
 - 1. Official Project name and number, and any additional required identifiers established in Contract Documents.
 - 2. Owner's, Architect's, and Contractor's names.
 - 3. Discrete and consecutive RFI number, and descriptive subject/title.
 - 4. Issue date, and requested reply date.
 - 5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
 - 6. Annotations: Field dimensions and/or description of conditions which have engendered the request.

7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.
- E. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.
- F. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
 1. Indicate current status of every RFI. Update log promptly and on a regular basis.
 2. Note dates of when each request is made, and when a response is received.
 3. Highlight items requiring priority or expedited response.
 4. Highlight items for which a timely response has not been received to date.
 5. Identify and include improper or frivolous RFIs.
- G. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 3:00 PM will be considered as having been received on the following regular working day.
 1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.
- H. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
 1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
 2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
 3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
 4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.07 SUBMITTAL SCHEDULE

- A. Submit to Architect for review a schedule for submittals in tabular format.
 1. Coordinate with Contractor's construction schedule and schedule of values.
 2. Format schedule to allow tracking of status of submittals throughout duration of construction.
 3. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
 4. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
 - a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

3.08 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
 1. Product data.
 2. Design data.
 3. Shop drawings.
 4. Samples for selection.

5. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
- C. Samples will be reviewed 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 017800 - Closeout Submittals.

3.09 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
 1. Certificates.
 2. Test reports.
 3. Inspection reports.
 4. Manufacturer's instructions.
 5. Manufacturer's field reports.
 6. Other types indicated.
- B. Submit for Architect's knowledge as contract administrator or for Owner.

3.10 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit Correction Punch List for Substantial Completion.
- B. Submit Final Correction Punch List for Substantial Completion.
- C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 017800 - Closeout Submittals:
 1. Project record documents.
 2. Operation and maintenance data.
 3. Warranties.
 4. Bonds.
 5. Other types as indicated.
- D. Submit for Owner's benefit during and after project completion.

3.11 NUMBER OF COPIES OF SUBMITTALS

- A. Electronic 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. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
 1. After review, produce duplicates.
 2. Retained samples will not be returned to Contractor unless specifically so stated.

3.12 SUBMITTAL PROCEDURES

- A. General Requirements:
 1. Use a single transmittal for related items.
 2. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
 3. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
 4. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
 5. 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.
 - a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.

6. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
 7. Schedule submittals to expedite the Project, and coordinate submission of related items.
 - a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
 - b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
 - c. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval, allow an additional 30 days.
 8. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
 9. Provide space for Contractor and Architect review stamps.
 10. When revised for resubmission, identify all changes made since previous submission.
 11. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
 12. Submittals not requested will be recognized, and will be returned "Not Reviewed",
- B. Product Data Procedures:
1. Submit only information required by individual specification sections.
 2. Collect required information into a single submittal.
 3. Submit concurrently with related shop drawing submittal.
 4. Do not submit (Material) Safety Data Sheets for materials or products.
- C. Shop Drawing Procedures:
1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
 2. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.
- D. Samples Procedures:
1. Transmit related items together as single package.
 2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.

3.13 SUBMITTAL REVIEW

- A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.
- B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.
- C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
- D. Architect's and consultants' actions on items submitted for review:
1. Authorizing purchasing, fabrication, delivery, and installation:
 - a. "Approved", or language with same legal meaning.
 - b. "Approved as Noted, Resubmission not required", or language with same legal meaning.
 - 1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
 - c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
 2. Not Authorizing fabrication, delivery, and installation:
 - a. "Revise and Resubmit".
 - 1) Resubmit revised item, with review notations acknowledged and incorporated.
 - b. "Rejected".
 - 1) Submit item complying with requirements of Contract Documents.
- E. Architect's and consultants' actions on items submitted for information:

1. Items for which no action was taken:
 - a. "Received" - to notify the Contractor that the submittal has been received for record only.
2. Items for which action was taken:
 - a. "Reviewed" - no further action is required from Contractor.

END OF SECTION 013000

**SECTION 014000
QUALITY REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Submittals.
- B. Testing and inspection agencies and services.
- C. Control of installation.
- D. Mock-ups.
- E. Tolerances.
- F. Defect Assessment.

1.02 RELATED REQUIREMENTS

- A. Document 007200 - General Conditions: Inspections and approvals required by public authorities.
- B. Section 013000 - Administrative Requirements: Submittal procedures.
- C. Section 016000 - Product Requirements: Requirements for material and product quality.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.

PART 3 EXECUTION

2.01 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

2.02 MOCK-UPS

- A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.
- B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.
- C. Notify Architect fifteen (15) working days in advance of dates and times when mock-ups will be constructed.
- D. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- E. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

- F. Architect will use accepted mock-ups as a comparison standard for the remaining Work.
- G. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

2.03 TOLERANCES

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

2.04 TESTING AND INSPECTION

- A. See individual specification sections for testing and inspection required.
- B. Testing Agency Duties:
 - 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 - 2. Perform specified sampling and testing of products in accordance with specified standards.
 - 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
 - 5. Perform additional tests and inspections required by Architect.
 - 6. Submit reports of all tests/inspections specified.
- C. Limits on Testing/Inspection Agency Authority:
 - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 - 2. Agency may not approve or accept any portion of the Work.
 - 3. Agency may not assume any duties of Contractor.
 - 4. Agency has no authority to stop the Work.
- D. Contractor Responsibilities:
 - 1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
 - 2. Cooperate with laboratory personnel, and provide access to the Work.
 - 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
 - c. To facilitate tests/inspections.
 - d. To provide storage and curing of test samples.
 - 4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
 - 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 - 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- E. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
- F. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

2.05 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not complying with specified requirements.

END OF SECTION 014000

**SECTION 015000
TEMPORARY FACILITIES AND CONTROLS**

PART 1 GENERAL

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. Contractor will provide the following:
 - 1. Electrical power and metering, consisting of connection to existing facilities.
 - 2. Water supply, consisting of connection to existing facilities.
- B. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.
- C. Existing facilities may be used with specific approval by owner.
- D. New permanent facilities may not be used.
- E. 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. Telecommunications services shall include:
 - 1. Internet Connections: Minimum of one; Cable modem or faster.
 - 2. Email: Account/address reserved for project use.

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 and to protect existing facilities and adjacent properties from damage from construction operations.
- B. Provide protection for plants designated to remain. Replace damaged plants.
- C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.
- D. Traffic Controls: Contractor responsible for Phased Access Plan providing and maintaining access to adjacent facilities throughout the duration of construction as noted in 011000 - Summary..

1.06 FENCING

- A. Provide 6 foot high fence around construction site; equip with vehicular gates with locks.

1.07 SECURITY

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

1.08 VEHICULAR ACCESS AND PARKING

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

1.09 WASTE REMOVAL

- A. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.
- B. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- C. Provide containers with lids. Remove trash from site periodically.
- D. 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.
- E. 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, construction, and location approved by Owner.
- B. 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.
 - 1. Verify location with owner.

1.12 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore existing facilities used during construction to original condition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 015000

**SECTION 016000
PRODUCT REQUIREMENTS**

PART 1 GENERAL

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 RELATED REQUIREMENTS

- A. Section 012500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.
- B. Section 014000 - Quality Requirements: Product quality monitoring.
- C. Section 017419 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.03 REFERENCE STANDARDS

1.04 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, 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. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.
- C. 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.

2.02 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by Contract Documents.
- B. See Section 014000 - Quality Requirements, for additional source quality control requirements.

- C. Use of products having any of the following characteristics is not permitted:
 - 1. Containing lead, cadmium, or asbestos.
- D. Where other criteria are met, Contractor shall give preference to products that:
 - 1. If used on interior, have lower emissions, as defined in Section 016116.
 - 2. If wet-applied, have lower VOC content, as defined in Section 016116.
 - 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 017419
 - 6. Are made of recycled materials.

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.
- D. Products Specified as Basis-of-Design: Submit substitution requests for unnamed products to Architect for evaluation.

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 and place in location as directed; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

- A. See Section 012500 - 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.
 - 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. Provide protection of stored materials and products against theft, casualty, or deterioration.
- B. 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 017419.
- C. Store and protect products in accordance with manufacturers' instructions.
- D. Store with seals and labels intact and legible.
- E. Arrange storage of materials and products to allow for visual inspection for the purpose of determination of quantities, amounts, and unit counts.
- F. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- G. For exterior storage of fabricated products, place on sloped supports above ground.
- H. Provide off-site storage and protection when site does not permit on-site storage or protection.
 - 1. For materials stored off-site, proof of insurance certificate with Owner listed as additional insured must be provided prior to payment.
- I. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- J. Comply with manufacturer's warranty conditions, if any.
- K. Do not store products directly on the ground.
- L. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- M. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- N. Prevent contact with material that may cause corrosion, discoloration, or staining.
- O. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- P. 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 016000

**SECTION 017000
EXECUTION AND CLOSEOUT REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Pre-installation meetings.
- C. Cutting and patching.
- D. Surveying for laying out the work.
- E. Cleaning and protection.
- F. Starting of systems and equipment.
- G. Demonstration and instruction of Owner personnel.
- H. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

1.02 RELATED REQUIREMENTS

- A. Section 011000 - Summary: Phasing Plan & Access requirements for adjacent facilities
- B. Section 013000 - Administrative Requirements: Submittals procedures, Electronic document submittal service.
- C. Section 014000 - Quality Requirements: Testing and inspection procedures.
- D. Section 015000 - Temporary Facilities and Controls: Fencing.
- E. Section 017419 - Construction Waste Management and Disposal: Additional procedures for trash/waste removal, recycling, salvage, and reuse.
- F. Section 017800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.

1.03 SUBMITTALS

- A. See Section 013000 - 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.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.04 QUALIFICATIONS

- A. For surveying work, employ a land surveyor registered in 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,
- B. For field engineering, employ a professional engineer of the discipline required for specific service on Project, licensed in Arkansas. Employ only individual(s) trained and experienced in

establishing and maintaining horizontal and vertical control points necessary for laying out construction work on project of similar size, scope and/or complexity.

1.05 PROJECT CONDITIONS

- A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion. Refer to erosion control plan.
- C. Perform dewatering activities, as required, for the duration of the project.
- D. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- E. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
- F. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
 - 1. Minimize amount of bare soil exposed at one time.
 - 2. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- G. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

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 016000 - 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. Contractor shall locate and protect survey control and reference points.
- D. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- E. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- F. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- G. Utilize recognized engineering survey practices.
- H. 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, ground floor elevations.
- I. Periodically verify layouts by same means.
- J. 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 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. 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.
- C. 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.
- D. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- E. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- F. Restore work with new products in accordance with requirements of Contract Documents.
- G. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- H. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 078400, to full thickness of the penetrated element.
- I. 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.

3.07 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.

3.08 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.

3.09 SYSTEM STARTUP

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- D. Verify that wiring and support components for equipment are complete and tested.
- E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- F. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- G. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.10 DEMONSTRATION AND INSTRUCTION

- A. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
- B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- C. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.

3.11 ADJUSTING

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

3.12 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.
- B. Use cleaning materials that are nonhazardous.
- C. 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.

- D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- F. Clean filters of operating equipment.
- G. Clean debris from roofs, gutters, downspouts, and drainage systems.
- H. Clean site; sweep paved areas, rake clean landscaped surfaces.
- I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.13 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 017000

**SECTION 017419
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**

PART 1 GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

- A. Owner requires that this project generate the least amount of trash and waste possible.
- B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D. Contractor Reporting Responsibilities: Submit periodic Waste Disposal Reports; report landfill disposal, recycling, salvage, and reuse regardless of to whom the cost or savings accrues; use the same units of measure on required reports.
 - 1. **While there is no specific sustainability benchmark for Waste Disposal for this project, the Owner requires documentation of project waste and recycling for their records.**
- E. Methods of trash/waste disposal that are not acceptable are:
 - 1. Burning on the project site.
 - 2. Burying on the project site.
 - 3. Dumping or burying on other property, public or private.
 - 4. Other illegal dumping or burying.
- F. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.02 RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements: Additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B. Section 015000 - Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.
- C. Section 016000 - Product Requirements: Waste prevention requirements related to delivery, storage, and handling.
- D. Section 017000 - Execution and Closeout Requirements: Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

1.03 DEFINITIONS

- A. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
- B. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
- C. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.
- D. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- E. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- F. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.

- G. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- H. Return: To give back reusable items or unused products to vendors for credit.
- I. Reuse: To reuse a construction waste material in some manner on the project site.
- J. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- K. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- L. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- M. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
 - 1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
 - 2. Submit Report on a form acceptable to Owner.
 - 3. Landfill Disposal: Include the following information:
 - a. Identification of material.
 - b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
 - c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - 4. Recycled and Salvaged Materials: Include the following information for each:
 - a. Identification of material, including those retrieved by installer for use on other projects.
 - b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
 - c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
 - 5. Material Reused on Project: Include the following information for each:
 - a. Identification of material and how it was used in the project.
 - b. Amount, in tons or cubic yards.
 - c. Include weight tickets as evidence of quantity.
 - 6. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 017419

**SECTION 017800
CLOSEOUT SUBMITTALS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project record documents.
- B. Operation and maintenance data.
- C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

- A. Section 007200 - General Conditions and 007300 - Supplementary Conditions: Performance bond and labor and material payment bonds, warranty, and correction of work.
- B. Section 013000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- C. Section 017000 - Execution and Closeout Requirements: Contract closeout procedures.
- D. Individual Product Sections: Specific requirements for operation and maintenance data.
- E. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

- A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
- B. Operation and Maintenance Data:
 - 1. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 - 2. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
 - 3. Submit two sets of revised final documents in final form within 10 days after final inspection.
- C. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 3 EXECUTION

2.01 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Addenda.
 - 3. Change Orders and other modifications to the Contract.
 - 4. Reviewed shop drawings, product data, and samples.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
 - 1. Field changes of dimension and detail.

2. Details not on original Contract drawings.

2.02 OPERATION AND MAINTENANCE DATA

- A. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- B. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- C. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

2.03 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. 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.
- B. 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.

2.04 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.

END OF SECTION 017800

**SECTION 033000
CAST-IN-PLACE CONCRETE**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete formwork.
- B. Concrete building frame members.
- C. Floors and slabs on grade.
- D. Concrete foundation walls.
- E. Concrete reinforcement.
- F. Joint devices associated with concrete work.
- G. Miscellaneous concrete elements, including equipment pads, light pole bases, and manholes.
- H. Concrete curing.

1.02 RELATED REQUIREMENTS

- A. Section 033511 - Concrete Floor Finishes: Densifiers, hardeners, applied coatings, and polishing.
- B. Section 079200 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.
- C. Section 313116 - Termite Control: Field-applied termiticide and mildewcide for concrete surfaces.
- D. Section 321313 - Concrete Paving and 321333: Sidewalks, curbs and gutters.

1.03 REFERENCE STANDARDS

- A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).
- B. ACI PRC-211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.
- C. ACI PRC-223 - Shrinkage-Compensating Concrete - Guide; 2021.
- D. ACI PRC-302.1 - Guide to Concrete Floor and Slab Construction; 2015.
- E. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- F. ACI PRC-305 - Guide to Hot Weather Concreting; 2020.
- G. ACI PRC-306 - Guide to Cold Weather Concreting; 2016.
- H. ACI PRC-308 - Guide to External Curing of Concrete; 2016.
- I. ACI PRC-347 - Guide to Formwork for Concrete; 2014 (Reapproved 2021).
- J. ACI SPEC-117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).
- K. ACI SPEC-301 - Specifications for Concrete Construction; 2020.
- L. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2024.
- M. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2024.
- N. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2024.
- O. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2025.

- P. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.
- Q. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2024.
- R. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2019.
- S. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2024.
- T. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2024.
- U. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2022.
- V. ASTM D471 - Standard Test Method for Rubber Property--Effect of Liquids; 2016a (Reapproved 2021).
- W. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2024.
- X. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017 (Reapproved 2023).
- Y. COE CRD-C 513 - Handbook for Concrete and Cement Corps of Engineers Specifications for Rubber Waterstops; 1974.
- Z. COE CRD-C 572 - Handbook for Concrete and Cement Corps of Engineers Specifications for Polyvinylchloride Waterstop; 1974.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
 - 1. For curing compounds, provide data on method of removal in the event of incompatibility with floor covering adhesives.
 - 2. For chemical-resistant waterstops, provide data on ASTM D471 test results.
 - 3. For membrane-forming, moisture emission-reducing, curing and sealing compound, provide manufacturer's installation instructions,.
- C. Mix Design: Submit proposed concrete mix design.
 - 1. Indicate proposed mix design complies with requirements of ACI SPEC-301, Section 4 - Concrete Mixtures.
 - 2. Indicate amounts of mixing water to be withheld for later addition at Project site.
 - 3. Indicate proposed mix design complies with requirements of ACI CODE-318, Chapter 5 - Concrete Quality, Mixing and Placing.
 - 4. Indicate proposed mix design complies with admixture manufacturer's written recommendations.
- D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures".
- E. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Waterstops.
 - 6. Curing compounds.
 - 7. Floor and slab treatments.

8. Bonding agents.
 9. Adhesives.
 10. Vapor retarders.
 11. Semi-rigid joint filler.
 12. Joint-filler strips.
- F. Samples: Submit samples of underslab vapor retarder to be used.
 - G. Test Reports: Submit report for each test or series of tests specified.
 - H. Manufacturer's Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.
 - I. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.
 - J. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.
 - K. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 318.
- B. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- C. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- E. Follow recommendations of ACI PRC-305 when concreting during hot weather.
- F. Follow recommendations of ACI PRC-306 when concreting during cold weather.
- G. For slabs required to include moisture vapor reducing admixture (MVRA), do not proceed with placement unless manufacturer's representative is present for every day of placement.
- H. Concrete Testing Service: Engage a qualified independent testing agency acceptable to Architect to perform material evaluation tests and to design concrete mixtures.
- I. Materials and installed work may require testing and retesting at any time during progress of Work. Tests, including retesting of rejected materials for installed Work, shall be done at Contractor's expense.
- J. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings and Coordination."
 1. At least 30 days prior to submitting design mixes, conduct a meeting to review detailed requirements for preparing concrete design mixes and to determine procedures for satisfactory concrete operations. Review requirements for submittals, status of coordinating work, and availability of materials. Establish preliminary work progress schedule and procedures for materials inspection, testing, and certifications. Require representatives of each entity directly concerned with cast-in-place concrete to attend conference, including, but not limited to the following:
 - a. Contractor's superintendent.
 - b. Agency responsible for concrete design mixes.
 - c. Agency responsible for filed quality control.

- d. Ready-mix concrete producer.
- e. Concrete subcontractor.
- f. Primary admixture manufacturers.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Slabs with Porosity Inhibiting Admixture (PIA) or Moisture Vapor Reducing Admixture (MVRA): Provide warranty to cover cost of flooring failures due to moisture migration from slabs for life of the concrete.
 - 1. Include cost of repair or removal of failed flooring, placement of topical moisture remediation system, and replacement of flooring with comparable flooring system.
 - 2. Provide warranty by admixture manufacturer matching terms of flooring adhesive or primer manufacturer's material defect warranty.

PART 2 PRODUCTS -

REFER TO STRUCTURALS GENERAL NOTES ON DRAWINGS SHEETS FOR ADDITIONAL INFORMATION. NOTIFY THE ARCHITECT OF ANY CONTRADICTIONS PRIOR TO PERFORMING WORK.

3.01 FORMWORK

- A. Formwork Design and Construction: Comply with guidelines of ACI PRC-347 to provide formwork that will produce concrete complying with tolerances of ACI SPEC-117.
- B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
 - 1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.
 - 2. Earth Cuts: Do not use earth cuts as forms for vertical surfaces. Natural rock formations that maintain a stable vertical edge may be used as side forms.
 - 3. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.
 - 4. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches of concrete surface.
 - 5. Unexposed finish or Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
 - 6. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum. E. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
 - 7. Form-Release Agent: Commercially formulated form-release agent with a maximum of 350 mg/1 volatile organic compound (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - a. Formulate form-release agent with rust inhibitor for steel form-facing materials.
 - 8. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal or glass-fiber reinforced plastic form ties designed to prevent form deflection, resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - a. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
 - b. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
 - c. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

3.02 REINFORCEMENT MATERIALS

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
 - 1. Type: Deformed billet-steel bars.

- B. Steel Welded Wire Reinforcement (WWR): Galvanized, plain type, ASTM A1064/A1064M.
 - 1. Form: Coiled Rolls.
 - 2. WWR Style: As indicated on drawings.
- C. Reinforcement Accessories:
 - 1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch.
 - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
 - 3. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

3.03 CONCRETE MATERIALS

- A. Cement: ASTM C150/C150M, Type I - Normal Portland type.
 - 1. Acquire cement for entire project from same source.
 - 2. Fly Ash: ASTM C618, Class C. subject to approval by structural engineer.
- B. Normal-Weight Aggregates: ASTM C 33, and as specified. Provide aggregates from a single source.
 - 1. For exposed exterior surfaces, do not use fine or coarse aggregates that contain substances that cause spalling.
 - 2. Local aggregates not complying with ASTM C 33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to Architect.
 - 3. Fine Aggregate: Clean, sharp, natural or manufactured sand, free from loam, clay, lumps, or materials with deleterious reactivity to alkaline cement.
- C. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.
 - 1. Water used in mixing concrete shall be clean and free from injurious amounts of oils, acids, alkalis, salts, organic materials or other substances that may be deleterious to concrete or reinforcement.

3.04 ADMIXTURES

- A. General: Provide concrete admixtures that contain not more than 0.1 percent chloride ions.
- B. Chemical Admixture: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
- C. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- D. Air Entrainment Admixture: ASTM C260/C260M.
- E. High Range Water Reducing Admixture: NOT ALLOWED

3.05 ACCESSORY MATERIALS

- A. Underslab Vapor Retarder:
 - 1. Sheet Material: ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. Single-ply polyethylene is prohibited.
 - 2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
 - 3. Products:
 - a. Stego Industries, LLC; Stego® Wrap Vapor Barrier (15-MIL): www.stegoindustries.com/#sle.
 - b. Tex-Trude, LP; Xtreme Vapor Barrier (15-mil): www.tex-trude.com/#sle.

- c. W. R. Meadows, Inc; PERMINATOR Class A - 15 mils (0.38 mm):
www.wrmeadows.com/#sle.
- d. Raven Industries Inc.; Vapor Block 15.
- e. Substitutions: See Section 016000 - Product Requirements.
- 4. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

3.06 BONDING AND JOINTING PRODUCTS

- A. Waterstops: Rubber, complying with COE CRD-C 513. with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
 - 1. Products:
 - 2. Profile: Ribbed without center bulb
 - 3. Dimensions: 4 inches by 3/16 inch thick (100 mm by 4.75 mm thick)
- B. Waterstops: PVC, complying with COE CRD-C 572 for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
 - 1. Products:
 - a. BoMetals, Inc: www.bometals.com/#sle.
 - b. Greenstreak..
 - c. Meadows, W. R., Inc. .
 - d. Murphy, Paul Plastics Co.
 - e. Progress Unlimited, Inc.
 - f. Tamms Industries, Inc.
 - g. Vinylex Corp.
 - h. Substitutions: See Section 016000 - Product Requirements.
 - 2. Profile: Ribbed without center bulb
- C. Waterstops, Chemical-Resistant: Extruded, thermoplastic, virgin rubber; no recycled or reclaimed material or pigments allowed.
 - 1. Chemical Resistance: Tested in accordance with ASTM D471.
 - 2. Products:
 - a. JP Specialties, Inc.; Earth Shield TPE-Rubber..
 - b. Vinylex Corp.; PetroStop.
 - c. WESTEC Barrier Technologies, Inc.; 600 Series TPE-R.
 - d. Substitutions: See Section 016000 - Product Requirements.
 - 3. Profile: Ribbed without center bulb
- D. Slab Isolation Joint Filler: 1/2-inch thick, height equal to slab thickness, with removable top section forming 1/2-inch deep sealant pocket after removal.
- E. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with rectangular or round knockout holes for conduit or rebar to pass through joint form at 6 inches on center; ribbed steel stakes for setting.

3.07 CURING MATERIALS

- A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement. **Certified by curing compound manufacturer to not interfere with bonding of floor covering when used on interior slabs.**
 - 1. Products:
 - a. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
 - b. Euclid Chemical Company ; EUCOBAR: www.euclidchemical.com/#sle.
 - c. Kaufman Products Inc; VaporAid: www.kaufmanproducts.net/#sle.
 - d. Nox-Crete Inc; Monofilm: www.nox-crete.com/#sle.

- e. SpecChem, LLC; SpecFilm Concentrate or SpecFilm: www.specchemllc.com/#sle.
 - f. W. R. Meadows, Inc; Evapre or Evapre-RTU: www.wrmeadows.com/#sle.
 - g. Substitutions: See Section 016000 - Product Requirements.
- B. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309. Type 1, Class B, nondissipating, **certified by curing compound manufacturer to not interfere with bonding of floor covering**.
 - 1. Products:
 - a. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
 - b. Euclid Chemical Company; COLOR-CRETE CURE AND SEAL VOC: www.euclidchemical.com/#sle.
 - c. Kaufman Products Inc; Thinfilm 420 Resin Base: www.kaufmanproducts.net/#sle.
 - d. Mapei Corporation; Mapecure DR: www.mapei.com/#sle.
 - e. Nox-Crete Inc; Res-Cure DH 100: www.nox-crete.com/#sle.
 - f. Sinak Corporation; Cure3D: www.sinak.com/#sle.
 - g. SpecChem, LLC; SpecRez: www.specchemllc.com/#sle.
 - h. W. R. Meadows, Inc; 1100: www.wrmeadows.com/#sle.
 - i. Substitutions: See Section 016000 - Product Requirements.
- C. Curing Agent, Water-Cure Equivalent Type: Clear, water-based, non-film-forming, liquid-water cure replacement agent.
 - 1. Comply with ASTM C309 standards for water retention.
 - 2. Compressive Strength of Treated Concrete: Equal to or greater than strength after 14-day water cure when tested in accordance with ASTM C39/C39M.
 - 3. VOC Content: Zero.

3.08 CONCRETE MIX DESIGN

- A. **Refer to Drawings, Sheet S0.00 for concrete mix information**
- B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
 - 1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
- C. Admixtures: Add acceptable admixtures as recommended in ACI PRC-211.1 and at rates recommended or required by manufacturer.

3.09 MIXING

- A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685/C685M. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.
 - 1. Colored Concrete: Add pigments in strict accordance with manufacturer's instructions to achieve consistent color from batch to batch.
 - 2. Fiber Reinforcement: Batch and mix as recommended by manufacturer for specific project conditions.
 - 3. Expansive Component: Batch and mix as recommended by manufacturer for specific project conditions.
- B. Transit Mixers: Comply with ASTM C94/C94M.
- C. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

4.01 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with work of this section.

4.02 PREPARATION

- A. Formwork: Comply with requirements of ACI SPEC-301. Design and fabricate forms to support all applied loads until concrete is cured and for easy removal without damage to concrete.
- B. Verify that forms are clean and free of rust before applying release agent.
- C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- D. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
- E. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Comply with ASTM E1643. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.

4.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

- A. Comply with requirements of ACI SPEC-301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.
- B. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.

4.04 PLACING CONCRETE

- A. Place concrete in accordance with ACI PRC-304.
- B. Place concrete for floor slabs in accordance with ACI PRC-302.1.
- C. Place concrete with shrinkage-compensating expansive component in accordance with ACI PRC-223.
- D. Notify Architect not less than 24 hours prior to commencement of placement operations.
- E. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- F. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- G. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.
- H. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

4.05 SLAB JOINTING

- A. Locate joints as indicated on drawings.
- B. Anchor joint fillers and devices to prevent movement during concrete placement.
- C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
- D. Load Transfer Construction and Contraction Joints: Install load transfer devices as indicated; saw cut joint at surface as indicated for contraction joints.
- E. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.
- F. Construction Joints: Where not otherwise indicated, use metal combination screed and key form, with removable top section for joint sealant.

4.06 FLOOR FLATNESS AND LEVELNESS TOLERANCES

- A. An independent testing agency, as specified in Section 014000, will inspect finished slabs for compliance with specified tolerances.
- B. Maximum Variation of Surface Flatness:
 - 1. Exposed Concrete Floors: 1/8 inch in 10 feet.
 - 2. Under Seamless Resilient Flooring: 1/4 inch in 10 feet.
 - 3. Under Carpeting: 1/4 inch in 10 feet.
- C. Correct the slab surface if tolerances are less than specified.
- D. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

4.07 CONCRETE FINISHING

- A. Repair surface defects, including tie holes, immediately after removing formwork.
- B. Concrete Slabs: Finish to requirements of ACI PRC-302.1 and as follows:
 - 1. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI PRC-302.1; thin floor coverings include carpeting, resilient flooring, seamless flooring, resinous matrix terrazzo, thin set quarry tile, and thin set ceramic tile.
 - 2. Decorative Exposed Surfaces: Trowel as described in ACI 302.1R; take measures necessary to avoid black-burnish marks; decorative exposed surfaces include surfaces to receive liquid hardeners, surfaces to be polished, and all other exposed slab surfaces.
- C. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:100 nominal.

4.08 CURING AND PROTECTION

- A. Comply with requirements of ACI PRC-308. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Surfaces Not in Contact with Forms:
 - 1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.
 - 2. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
 - 3. Final Curing: Begin after initial curing but before surface is dry.

4.09 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 014000 - Quality Requirements.
- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

4.10 DEFECTIVE CONCRETE

- A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.

- C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

4.11 PROTECTION

- A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION 033000

**SECTION 033511
CONCRETE FLOOR FINISHES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Application of clear, colorless, liquid concrete hardener and densifier.
- C. Application of water based concrete enhancer.

1.02 RELATED SECTIONS

- A. Section 03 00 00 - Cast-in-Place Concrete.

1.03 REFERENCES

- A. ASTM C779 - Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.
- B. ASTM F609 - Standard Test Method for Using a Horizontal Pull Slip meter (HPS).

1.04 SUBMITTALS

- A. Comply with Section 01 30 00.
- B. Submit manufacturer's product data and application instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Store materials in a clean dry area in accordance with manufacturer's instructions.
- C. Keep products from freezing.
- D. Avoid direct contact with this product as it may cause mild to moderate irritation of the eyes and/or skin.
- E. Protect materials during handling and application to prevent damage or contamination.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply concrete densifier and chemical hardener when concrete temperature is below 35°F (2°C) or above 135°F (57°C).
- B. Do not apply to frozen concrete.
- C. Do not use on highly dense or non-porous surfaces.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. W.R. Meadows, Inc., PO Box 338, Hampshire, Illinois 60140-0338. (800) 342-5976. (847) 683-4500. Fax (847) 683-4544. Web Site www.wrmeadows.com.
- B. Or Approved Equal

2.02 MATERIALS

- A. Concrete Densifier and Chemical Hardener Compound shall be a ready to use, water-base colorless liquid formulated with chemically reactive raw materials that meets the maximum VOC content limits of 400 g/L for Concrete Protective Coatings as required by the U.S. EPA Architectural Coatings Rule.
 - 1. LIQUI-HARD as manufactured by W.R. MEADOWS.
 - 2. Approved Equal
- B. Concrete Enhancer shall be a ready to use water-based, synthetic polymer concrete floor enhancer containing a proprietary stain blocking additive that meets the maximum VOC content limits of 100 g/L for sealers as required by California Air Pollution Control Districts as well as the 400 g/L VOC maximum required by the U.S. EPA Architectural Coatings Rule.

1. BELLATRIX as manufactured by W.R. MEADOWS.
2. Approved Equal

2.03 RELATED MATERIALS

- A. Water: Potable water.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine surfaces to receive concrete densifier and chemical hardener. Notify architect if surfaces are not acceptable. Do not begin application until unacceptable conditions have been corrected.

3.02 SURFACE PREPARATION

- A. Protect adjacent surfaces not designated to receive treatment.
- B. Clean and prepare surfaces to receive treatment in accordance with manufacturer's instructions ensuring that all stains, oil, grease, form release agents, dust and dirt removed prior to application.

3.03 APPLICATION

- A. Apply concrete densifier and chemical hardener in accordance with manufacturer's instructions.

3.04 ENSURE APPLICATION EQUIPMENT IS CLEAN AND FREE OF PREVIOUSLY USED MATERIALS.

- A. Do not dilute concrete densifier and chemical hardener.
- B. Fresh Concrete
 1. Apply concrete densifier and chemical hardener as soon as concrete is firm enough to work on after final troweling.
 2. Apply undiluted concrete densifier and chemical hardener at approximately 300 sq. ft./gal. (4.91 sq. m./L), using a low-pressure sprayer or by spreading evenly with a soft-bristled broom.
 3. Do not allow material to puddle on the surface.
- C. Existing Concrete
 1. Saturate the surface with undiluted concrete densifier and chemical hardener by sprayer, squeegee or broom.
 2. Keep the surface wet with concrete densifier and chemical hardener for a minimum of 30 minutes. (A range of 30-60 minutes may be required depending on temperature and conditions.).
 3. Ensure areas are kept wet at all times with concrete densifier and chemical hardener.
 4. Once the surface begins to gel and become slippery, immediately spray the surface with a light water mist.
 5. Scrub the surface with a broom or mechanical scrubber to increase the penetration of the concrete densifier and chemical hardener.
 6. Continue to work the concrete densifier and chemical hardener into the surface for another 5-10 minutes or until it becomes gelled and slippery for a second time.
 7. Thoroughly flush the surface with water and agitate the surface with a broom to aid in removal of the excess concrete densifier and chemical hardener.
 8. Remove all excess material with a mop or squeegee.
 9. Thoroughly squeegee the surface dry.
 10. If there are slippery patches, this is an indication that there is still excess concrete densifier and chemical hardener present. These areas should be re-flushed and squeegeed again until the entire surface is dry.

3.05 CONCRETE ENHANCER

- A. Allow 24 hours before proceeding with concrete enhancer application.

- B. Spray concrete enhancer full strength from container using an industrial sprayer delivering 1/10th of a gallon per minute.
- C. Pre-wet micro-fiber applicator with concrete enhancer prior to use.
- D. Uniformly spread concrete enhancer with a micro-fiber applicator, ensuring that the product is not allowed to dry before spreading is complete. Special caution should be taken to not over apply. A monolithic, thin, even film is desired.
- E. For optimum performance, apply a second coat at a 90° (right) angle to the first coat, after the first coat is thoroughly dry.
- F. Allow 24 hours for concrete enhancer to dry.

3.06 PROTECTION

- A. Keep surface dry for a minimum of 48 hours after application.

END OF SECTION 033511

**SECTION 061000
ROUGH CARPENTRY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nonstructural dimension lumber framing.
- B. Rough opening framing for doors, windows, and roof openings.
- C. Roofing nailers.
- D. Preservative treated wood materials.
- E. Fire retardant treated wood materials.
- F. Concealed wood blocking, nailers, and supports.
- G. Miscellaneous wood nailers, furring, and grounds.
- H. Wall sheathing with factory applied water-resistive and air barrier sheet.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Setting anchors in concrete.
- B. Section 051200 - Structural Steel Framing: Prefabricated beams and columns for support of wood framing.
- C. Section 055000 - Metal Fabrications: Miscellaneous steel connectors and support angles for wood framing.
- D. Section 072500 - Weather Barriers: Water-resistive barrier over sheathing.
- E. Section 076200 - Sheet Metal Flashing and Trim: Sill flashings.
- F. Section 313116 - Termite Control: Field-applied termiticide and mildewcide for wood materials.

1.03 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel; 2021.
- C. ASTM E2357 - Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies; 2024.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- E. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- F. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; 2024, with Errata.
- G. AWPA M4 - Standard for the Handling, Storage, Field Fabrication and Field Treatment of Preservative-Treated Wood Products; 2023.
- H. AWPA U1 - Use Category System: User Specification for Treated Wood; 2025.
- I. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. ICC-ES AC310 - Acceptance Criteria for Water-Resistive Membranes Factory-Bonded to Wood-Based Structural Sheathing, Used as Water-Resistive Barriers; 2008, with Editorial Revision (2021).
- K. PS 2 - Performance Standard for Wood Structural Panels; 2019.
- L. PS 20 - American Softwood Lumber Standard; 2025.

M. SPIB (GR) - Standard Grading Rules; 2021.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide technical data on the following products:
 - 1. Metal framing anchors
 - 2. Construction Adhesives
- C. Product Data: Submit technical data on wood treatment.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

1.06 WARRANTY

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

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. Species: Southern Pine or Douglas Fir, unless otherwise indicated.
 - 2. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
 - 3. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.02 DIMENSION LUMBER

- A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: S-dry or MC19.
- D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS

- A. Wall Sheathing: Oriented strand board structural wood panel with factory laminated water-resistive barrier layer.
 - 1. Sheathing Panel: PS 2, Exposure 1.
 - a. Size: 4 feet wide by 8 feet long.
 - b. Grade: Structural 1 Sheathing.
 - c. Performance Category: 7/16 PERF CAT.
 - d. Span Rating: 24/16.
 - 2. Integral Water-Resistive Barrier: Sheet material qualifying as a Grade D water-resistive barrier; complying with ICC-ES AC310.
 - 3. Water Vapor Permeance of Water-Resistive Barrier: 12 to 16 perms, minimum, when tested in accordance with ASTM E96/E96M Procedure B.
 - 4. Maximum Allowable Air Leakage of Assembly: Comply with ASTM E2357.
 - a. Infiltration: 0.0072 cfm/sq ft, maximum, at a pressure differential of 1.57 psf.
 - b. Exfiltration: 0.0023 cfm/sq ft, maximum, at a pressure differential of 1.57 psf.

5. Provide fastening guide on top panel surface with separate markings indicating fastener spacing for 16 inches and 24 inches on center, respectively.
6. Seam Tape: Manufacturer's standard pressure-sensitive, self-adhering, cold-applied, seam tape.
7. Warranty: Manufacturer's standard 30 year limited system warranty.
 - a. Performance: Panel and tape resistance to water penetration; tape adhesion.
 - b. Material: Free from manufacturing defects and panel delamination.
8. Manufacturers:
 - a. Georgia-Pacific LLC; ForceField Air and Water Barrier System: www.buildgp.com/#sle.
 - b. Huber Engineered Woods, LLC; ZIP System Roof/Wall Sheathing and ZIP System Seam Tape: www.huberwood.com/#sle.
 - c. Substitutions: See Section 016000 - Product Requirements.

2.04 PRESSURE-PRESERVATIVE TREATMENT (PPT)

- A. Factory-treat wood members in accordance with AWPA U1 and use category indicated.
- B. Applications - Treat the Following:
 1. Sleepers and sills on concrete or masonry in direct contact with earth: Use Category UC1, above ground, interior, dry.
- C. Kiln-dry wood after treatment with waterborne preservative to maximum moisture content of 19 percent for lumber and 15 percent for plywood.
- D. Fabricate to maximum extent possible before treatment.
- E. Label preservative-treated wood with marking as required by AWPA U1 and ICC (IBC). Unless otherwise permitted by standard U1 and building code, include the following markings: AWPA U1, accredited inspection agency mark, treating plant identification, type of preservative, preservative retention, and permitted end use.
- F. Field Treatment for Cuts and Holes in Preservative-Treated Wood: Comply with AWPA M4.

2.05 ACCESSORIES

- A. Metal and Finish of Fasteners:
 1. Preservative-Treated Wood:
 - a. Nails, timber rivets, wood screws, and lag screws - general use: Hot-dip galvanized steel complying with ASTM A153/A153M Class D.
 - b. Staples: Type 304 stainless steel.
 - c. Fasteners other than staples, nails, timber rivets, wood screws, and lag screws: Mechanically deposited zinc-coated steel, ASTM B695 Class 55 or better.
 2. Untreated Wood: Hot-dip galvanized steel complying with ASTM A153/A153M Class D.

PART 3 EXECUTION

3.01 PREPARATION

- A. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 FRAMING INSTALLATION

- A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.

- B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
- C. Install structural members full length without splices unless otherwise specifically detailed.
- D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes, AWC (WFCM) Wood Frame Construction Manual, and _____.
- E. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.
- F. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

3.04 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- D. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

3.05 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at each roof opening except where specifically indicated otherwise; form corners by alternating lapping side members.

3.06 INSTALLATION OF CONSTRUCTION PANELS

- A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
- B. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
 - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 - 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 - 3. Install adjacent boards without gaps.
 - 4. Size: 48 by 96 inches, installed horizontally at ceiling height.

3.07 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.08 CLEANING

- A. Waste Disposal: See Section 017419 - Construction Waste Management and Disposal.
 - 1. Comply with applicable regulations.
 - 2. Do not burn scrap on project site.
 - 3. Do not burn scraps that have been pressure treated.
 - 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.

- B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 061000

SECTION 072100 THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Batt insulation and vapor retarder in exterior wall, ceiling, and roof construction.
- B. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 RELATED REQUIREMENTS

1.03 DEFINITIONS

- A. Mineral Fiber Material Composition: Insulation referred to as mineral fiber block, board, and blanket insulation is composed of fibers from mineral based substances such as rock, slag, or glass and processed from the molten state into fibrous form.
 - 1. Based on type of insulation substance, the material will be referred to as a mineral fiber when having a rock or slag base, and glass fiber with a glass or silica sand base, also considered a mineral.
 - 2. Insulation blankets are flexible units consisting of felted, bonded, or unbonded fibers formed into rolls or flat cut pieces referred to as batts; rolls are simply longer versions of batts.
 - 3. For additional information about mineral fiber and the various classification types, refer to the following reference standards; ASTM C553, ASTM C612, ASTM C665, and ASTM C726.

1.04 REFERENCE STANDARDS

- A. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.
- B. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2024.
- D. ASTM C726 - Standard Specification for Mineral Wool Roof Insulation Board; 2024.
- E. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024c.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. Shop Drawings: Submit drawings that indicate location of joint or termination detail conditions.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. Insulation in Metal Framed Walls: Batt insulation with integral vapor retarder.

2.02 MINERAL FIBER BLANKET INSULATION MATERIALS

- A. Flexible Glass Fiber Blanket Thermal Insulation: Preformed insulation, complying with ASTM C665; friction fit.
 - 1. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
 - 2. Formaldehyde Content: Zero.
 - 3. Thermal Resistance: R-value of 13.
 - 4. Facing: Unfaced.

2.03 ACCESSORIES

- A. Tape: Reinforced polyethylene film with acrylic pressure sensitive adhesive.
 - 1. Application: Sealing of interior circular penetrations, such as pipes or cables.
 - 2. Width: As required for application.
- B. Self-Adhered Transition Flashing: Multipurpose, self-adhered flashing with modified butyl adhesive, polyester fiber top sheet, and polypropylene interlayer.
 - 1. Application: Primerless adhesion for use as through-wall flashings and wall transitions to roof and below-grade systems.
 - 2. Thickness: 45 mil, 0.045 inch, nominal.
 - 3. Size: 6 inches wide, in rolls 75 feet long.
- C. Flashing Tape: Special reinforced film with high performance adhesive.
 - 1. Application: Window and door opening flashing tape.
 - 2. Width: As required for application.
- D. Sill Plate Sealer: Closed-cell foam tape with rubberized adhesive membrane; bridges gap between foundation structure and sill plate or skirt board.
 - 1. Width: 5-1/2 inches.
 - 2. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 30 days of weather exposure.
- E. Tape joints of rigid insulation in accordance with roofing and insulation manufacturers' instructions.
- F. Support for Cladding and Continuous Insulation: Continuous thermal Z-girts.
 - 1. Fiberglass reinforced plastic (FRP) girts that provide cladding attachment support for brick veneer, metal wall panels, and siding.
 - 2. Fasteners: As recommended by clip manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION USING CLADDING AND CONTINUOUS INSULATION SUPPORTS

- A. Install supports in accordance with manufacturer's installation instructions.
- B. Install supports in compliance with system orientation, sizes, and locations as indicated on drawings and in accordance with approved shop drawings.
- C. Install supports to fill in exterior wall spaces without gaps or voids in insulation.
- D. Trim insulation neatly to fit spaces and provide a continuous thermal layer.

3.03 BATT INSTALLATION

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.04 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION 072100

SECTION 072116
METAL BUILDING BLANKET INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fiberglass blanket insulation for pre-engineered metal building roof and wall assemblies.
- B. Fabric liner system with support strapping.
- C. Thermal break materials at roof purlins and wall girts.

1.02 RELATED REQUIREMENTS

- A. Section 131200 - Metal Building Systems: Pre-engineered metal building, roof panels, wall panels, purlins, and girts.

1.03 REFERENCE STANDARDS

- A. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2023.
- B. ASTM C991 - Standard Specification for Flexible Fibrous Glass Insulation for Metal Buildings; 2017.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2022.
- E. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C; 2019.
- F. NAIMA 202-96 - Certification of Fiberglass Metal Building Insulation; Rev. 2000.
- G. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2019.
- H. 2009 IECC - International Energy Conservation Code; 2009, as adopted by the State of Arkansas.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's product data for each insulation product and liner system component, including R-values, facing type, thickness, and compliance with referenced standards.
- C. Shop Drawings: Project-specific installation drawings from liner system manufacturer showing purlin spacings, support strap locations and spacings, fastening points, liner fabric sizes and locations, and insulation widths, thicknesses, and locations.
- D. Samples: Samples of support strapping and vapor retarder fabric, including a sample of triple extrusion welded seam.
- E. Manufacturer's Qualification Statement.

1.05 QUALITY ASSURANCE

- A. Liner system manufacturer shall provide project-specific installation drawings and detailed installation instructions with each shipment.
- B. Installer shall review all manufacturer instructions and drawings prior to commencement of installation. Contact manufacturer prior to installation if questions arise.
- C. Maintain at project site copies of reference standards relating to installation of products specified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's instructions for delivery, storage, and handling.
- B. Store insulation indoors. Keep insulation clean and dry at all times.

- C. When transporting, cover completely with a waterproof tarpaulin.
- D. Inspect materials for damage, proper sizes, and quantities upon delivery.
- E. Store liner system fabric in a dry, secure manner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Liner System:
 - 1. Thermal Design, Inc. - EnergyCraft Liner System: www.thermaldesign.com.
 - 2. Substitutions: See Section 016000 - Product Requirements. Substitutions shall provide a continuous vapor retarder on the inside plane of purlins and girts. Systems using taping or stapling of vapor retarder lap joints are not acceptable.
- B. Fiberglass Blanket Insulation:
 - 1. Johns Manville: www.jm.com.
 - 2. CertainTeed: www.certainteed.com.
 - 3. Knauf Insulation: www.knaufinsulation.com.
 - 4. Owens Corning: www.owenscorning.com.
 - 5. Rockwool: www.rockwool.com.
 - 6. Substitutions: See Section 016000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Energy Code Compliance: Insulation assemblies shall comply with 2009 IECC Climate Zone 3A requirements using the R-value compliance method per Table 502.2(1) and Table 502.2(2).
- B. Surface Burning Characteristics: All exposed liner system components shall be Class A material with flame spread index of 25 or less and smoke developed index of 50 or less in accordance with ASTM E84.
- C. Vapor Retarder Fabric: Water vapor transmission rate of 0.02 grains per hour per square foot or less, in accordance with ASTM E96.

2.03 ROOF INSULATION ASSEMBLY

- A. Lower Layer - Unfaced Blanket:
 - 1. Type: Unfaced fiberglass blanket, complying with ASTM C991, Type I and ASTM C553.
 - 2. R-Value: R-19 minimum.
 - 3. Thickness: 6 inches nominal.
 - 4. Installation Orientation: Parallel to purlins, installed in cavity between purlins on liner fabric; full cavity depth shall be filled without voids.
 - 5. Facing: None (unfaced).
- B. Upper Layer - Faced Blanket:
 - 1. Type: Faced fiberglass blanket, complying with NAIMA 202-96 (Rev. 2000).
 - 2. R-Value: R-11 minimum.
 - 3. Thickness: 3-1/2 inches nominal.
 - 4. Installation Orientation: Perpendicular to purlins, installed over purlins as roof sheeting is applied; minimal compression permitted at purlin bearing points only.
 - 5. Facing: Manufacturer's standard vapor-retarding facing.
- C. Total Roof Assembly R-Value: R-30 minimum (pre-installed).

2.04 WALL INSULATION ASSEMBLY

- A. Single Layer - Unfaced Blanket:
 - 1. Type: Unfaced fiberglass blanket, complying with ASTM C991, Type I and ASTM C553.
 - 2. R-Value: R-19 minimum.
 - 3. Thickness: 6 inches nominal.
 - 4. Installation Orientation: Vertical, installed between girts; full girt depth shall be filled without voids or gaps.

5. Facing: None (unfaced).

2.05 LINER SYSTEM

- A. Vapor Retarder Fabric:
 1. Woven reinforced high-density polyethylene yarns coated on both sides with continuous polyethylene film.
 2. Color: White.
 3. Flame spread index of 25 or less per ASTM E84; complying with NFPA 701.
 4. Fabricated in custom pieces by triple extrusion welding from roll goods to fit full bay dimensions with minimum field seaming.
 5. Field seams, if required, shall be made on a structural member and mechanically attached with steel retaining strap along full length.
 6. Perimeter edges and all field seams shall be sealed with vapor retarder lap sealant.
- B. Support Strapping:
 1. High tensile strength steel, galvanized, primed and painted on exposed side.
 2. Minimum size: 0.015 inch x 3/4 inch x continuous length.
 3. Color: White.
 4. Traverse strap pattern: One strap 6 inches from each rafter flange with remaining space divided into equal spaces not exceeding 5 feet on center.
 5. Longitudinal straps: 30 inches on center nominally, with two adjacent straps at ridge line.
- C. Fasteners: Self-drilling screws with sealing washers, painted to match strapping color. Provide two fasteners at each strap end and one fastener at all other designated fastening points.
- D. Sealants: Manufacturer's recommended vapor retarder lap sealant. Taping or stapling of vapor retarder lap joints is not acceptable.
- E. Insulation Hangers (Walls): Preformed, rigid insulation hangers for supporting unfaced insulation between wall girts. Coiled hangers are not acceptable.

2.06 THERMAL BREAK

- A. Provide thermal break at each roof purlin and wall girt where no existing thermal break exists between metal panel and metal structure.
- B. Minimum R-Value: R-3.5.
- C. Acceptable types: Closed cell polyethylene foam tape with pre-applied adhesive, or polystyrene thermal block. Provide manufacturer's recommended product meeting minimum R-value specified.
- D. Apply to exterior flange of purlins and girts prior to installation of metal panels.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that purlin and girt spacings are consistent with liner system shop drawings.
- C. Verify that building is sufficiently enclosed to protect insulation from weather during and after installation.

3.02 PREPARATION

- A. Apply thermal break to exterior flange of purlins and girts prior to installation of metal panels.

3.03 INSTALLATION - ROOF LINER SYSTEM

- A. Install painted steel support straps in pattern and spacings shown on project shop drawings. Straps shall be installed in tension immediately below the bottom plane of purlins.
- B. Position pre-folded vapor retarder fabric on strap platform along one eave purlin. Pull fabric across building width on strap platform below purlins, pausing at ridge to fasten straps and fabric into position.

- C. Install fasteners from bottom side at each purlin/strap intersection.
- D. Seal and trim fabric edges along rafters with vapor retarder lap sealant.
- E. Install lower layer (R-19 unfaced) insulation parallel to and between purlins on top of vapor retarder fabric. Fill full cavity depth without voids.
- F. Install upper layer (R-11 faced) insulation perpendicular to and over purlins as roof sheeting is applied. Minimize compression; install with faced side up.

3.04 INSTALLATION - WALL LINER SYSTEM

- A. Install wall panels over thermal break.
- B. Cut insulation to required lengths to fit vertically between girts. Impale insulation on rigid insulation hangers. Fill full girt depth without gaps or voids.
- C. Apply wall vapor retarder fabric by clamping into position over eave strap.
- D. Install fasteners through wall straps, eave strap, and into each roof strap, permanently clamping wall fabric in place.
- E. Seal wall fabric to roof fabric, base angle or base channel, and column flanges with vapor retarder lap sealant.
- F. Install additional straps along base angle and each column to retain system permanently in place.

3.05 FIELD QUALITY CONTROL

- A. Inspect completed installation for voids, gaps, and unsealed joints prior to enclosure by subsequent work.
- B. Repair or replace damaged insulation or liner fabric before proceeding with subsequent work.
- C. Reseal any disturbed lap joints or perimeter edges with vapor retarder lap sealant.

END OF SECTION 072116

SECTION 076200
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, sheet metal roofing, and exterior penetrations.
- B. Precast concrete splash pads.

1.02 RELATED REQUIREMENTS

- A. 0742113 - Metal Roof Panels
- B. 133419 - Special Construction - Preengineered metal building

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- C. Samples: Submit two samples, 2 by 2 inches in size, illustrating metal finish color.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Sheet Metal Flashing and Trim:
 - 1. Match roof panel manufacturer
 - 2. Substitutions: See Section 016000 - Product Requirements.

2.02 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.
- F. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

2.03 GUTTERS AND DOWNSPOUTS

- A. See Section 133419
- B. Gutters and Downspouts: Size indicated on drawings.
- C. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3,000 psi at 28 days, with minimum 5 percent air entrainment.
- D. Seal metal joints.

2.04 FLASHING

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch.

3.03 INSTALLATION

- A. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.
- B. Apply plastic cement compound between metal flashings and felt flashings.
- C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- D. Exterior Flashing Receivers: Install in accordance with manufacturer's recommendations, and in proper relationship with adjacent construction, and as follows:
- E. Secure gutters and downspouts in place with concealed fasteners.
- F. Set splash pads under downspouts.

END OF SECTION 076200

**SECTION 077233
PIPE PENETRATION FLASHINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flexible pipe penetration flashing boots with flat aluminum base flange for pipes penetrating exterior wall sheathing.
- B. Accessories: Fasteners, butyl sealant, and stainless steel clamps.

RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements: Submittal procedures.
- B. Section 072500 - Weather Barriers: Coordination of flashing flange integration with weather-resistive barrier (WRB).
- C. Section 076200 - Sheet Metal Flashing and Trim: Fabricated metal trim collar at exterior PEMB wall panel face.
- D. Section 131200 - Pre-Engineered Metal Buildings: Coordination of wall panel penetration openings.

1.02 REFERENCE STANDARDS

- A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension; 2016.
- B. ASTM D573 - Standard Test Method for Rubber - Deterioration in an Air Oven; 2019.
- C. ASTM D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers; 2020.
- D. ASTM D1171 - Standard Test Method for Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber; 2020.
- E. ASTM D2137 - Standard Test Methods for Rubber Property - Brittleness Point of Flexible Polymers and Coated Fabrics; 2020.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets indicating materials, sizes, pipe OD range, temperature ratings, and installation instructions.
- C. Coordination Drawing: Indicate pipe OD (including insulation), flange dimensions, and relationship to WRB and PEMB wall panel.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Experienced in installation of pipe penetration flashings on commercial building enclosure assemblies.
- B. Pre-Installation Conference: Coordinate with WRB installer and PEMB contractor prior to installation to verify opening sizes and sequencing.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original, unopened packaging with labels intact.
- B. Store off ground, protected from direct sunlight and moisture until installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Pipe Penetration Flashing Boots:
 - 1. DEKS Industries Pty Ltd / DEKS North America Inc.: Dektite Premium; www.deksus.com.
 - 2. Substitutions: See Section 016000-Product Requirements

2.02 PIPE PENETRATION FLASHING BOOTS

- A. General: Flexible cone-type pipe flashing boot with flat aluminum base flange, sized to accommodate pipe outside diameter including insulation jacket.
- B. Basis of Design: Dektite Premium by DEKS Industries, sized as scheduled.
- C. Cone Material: EPDM (Ethylene Propylene Diene Monomer), grey or black.
 - 1. Continuous temperature resistance: -50 degrees C (-58 degrees Fahrenheit to 115 degrees C (239 degrees Fahrenheit).
 - 2. Intermittent temperature resistance: up to 150 degrees C 302 degrees Fahrenheit.
 - 3. Ozone and UV resistant.
- D. Base Flange: Flexible aluminum, flat profile, conformable to planar sheathing surface; provides continuous bearing surface for mechanical fastening and WRB integration.
 - 1. Flange width: Minimum 2 inches on all sides beyond pipe opening.
- E. Cone Design: Unique stepped cone profile providing minimum 10 mm 1/2 inch continuous contact with pipe outside diameter, forming a watertight compression seal.
- F. Markings: Metric and imperial pipe diameter markings molded into cone for accurate field cutting.
- G. Warranty: Manufacturer's 20-year warranty against defects.
- H. Performance Requirements: Comply with ASTM D412, D573, D624, D1171, and D2137.
- I. Sizes: As scheduled; provide correct size number to achieve specified pipe OD coverage.

2.03 ACCESSORIES

- A. Fasteners: Stainless steel self-drilling screws, length appropriate for sheathing thickness; corrosion resistant.
- B. Sealant: Neutral-cure, low-modulus silicone sealant, compatible with EPDM and aluminum; applied to underside of base flange prior to fastening.
- C. Flange Tape: Self-adhered WRB-compatible flashing tape as specified in Section 072500, for integration of base flange into weather-resistive barrier.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that wall sheathing and WRB substrate are complete, clean, dry, and free of damage prior to installation.
- B. Verify that pipe penetration openings in sheathing are sized correctly: opening diameter to match pipe OD (including insulation) with minimum clearance.
- C. Verify that PEMB wall panel penetration opening is sized to clear boot cone and provide clearance for exterior trim collar as detailed.
- D. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean substrate at flange bearing area; remove dust, oil, and debris.
- B. Install WRB per Section 072500 prior to boot installation; coordinate sequencing so flange can be integrated into WRB in proper lapped sequence (flange laps over WRB below, WRB laps over flange above).

3.03 INSTALLATION

- A. General: Install pipe penetration flashing boots in accordance with manufacturer's installation instructions and the following.
- B. Cone Sizing: Cut cone at appropriate diameter marking using sharp tin snips to achieve snug fit at pipe outside diameter including insulation jacket. Do not cut below required diameter marking.

- C. Slide boot cone down over pipe from above, or use retrofit (split) installation method if pipe is already in place and overhead installation is not possible.
- D. Base Flange Fastening:
 - 1. Apply continuous bead of neutral-cure silicone sealant to underside of aluminum base flange.
 - 2. Press flange firmly against sheathing face and fasten with stainless steel self-drilling screws at maximum 2 inches on center around perimeter of flange.
 - 3. Ensure flange lies flat and fully bears against sheathing with no gaps or bridging.
- E. WRB Integration: Tape base flange into weather-resistive barrier using WRB-compatible self-adhered flashing tape per Section 072500:
 - 1. Tape top and sides of flange, lapping onto WRB face minimum 3 inches.
 - 2. WRB below boot shall lap over bottom edge of base flange minimum 2 inches; WRB above shall lap over top flange tape.
 - 3. Apply additional sealant bead at perimeter edge of base flange if required by WRB manufacturer.
- F. Exterior Trim: Install fabricated metal trim collar at PEMB wall panel exterior face per Section 076200. Trim collar is not a primary water seal; primary seal is at sheathing face.

3.04 FIELD QUALITY CONTROL

- A. A. Inspect each completed installation for:
 - 1. Full bearing of base flange against sheathing with no voids.
 - 2. Snug cone-to-pipe contact with no gaps.
 - 3. Continuous sealant at flange underside and perimeter edge.
 - 4. Correct WRB tape integration sequence (lapped to shed water).
- B. Repair or replace any installation that does not comply.

3.05 SCHEDULE

- A. Pipe Penetration Locations: Refer to drawings for location of each penetration.
- B. Boot Sizing: Refer to Mechanical Drawings for pipe sizes and insulated outside diameters. Contractor shall verify insulated OD of each pipe and select Dektite Premium size number within the manufacturer's published OD range to achieve a snug compression fit at each penetration.

END OF SECTION 077233

SECTION 079200 JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Self-leveling pourable joint sealants.
- C. Joint backings and accessories.

1.02 REFERENCE STANDARDS

- A. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
- B. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2024.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2025.
- E. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.
- F. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2024.
- G. UL 263 - Standard for Fire Tests of Building Construction and Materials; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Backing material recommended by sealant manufacturer.
 - 4. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 5. Substrates the product should not be used on.
- C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
- D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
- E. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.
- F. Manufacturer's qualification statement.
- G. Installer's qualification statement.
- H. Executed warranty.

1.04 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in Owner's name and register with manufacturer.
- C. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Nonsag Sealants:
 - 1. Dow: www.dow.com/#sle.
 - 2. Hilti, Inc: www.hilti.com/#sle.
 - 3. Pecora Corporation: www.pecora.com/#sle.
 - 4. Sika Corporation: usa.sika.com/#sle.
 - 5. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
- B. Self-Leveling Sealants:
 - 1. Bostik Inc: www.bostik-us.com/#sle.
 - 2. Dow: www.dow.com/#sle.
 - 3. Pecora Corporation: www.pecora.com/#sle.
 - 4. Sika Corporation: usa.sika.com/#sle.
 - 5. W. R. Meadows, Inc: www.wrmeadows.com/#sle.

2.02 JOINT SEALANT APPLICATIONS

- A. Scope:
 - 1. Exterior Joints:
 - a. Seal the following joints:
 - 1) Wall expansion and control joints.
 - 2) Joints between doors, windows, and other frames or adjacent construction.
 - 3) Joints between different exposed materials.
 - 2. Interior Joints:
 - a. Do not seal interior joints indicated on drawings as not sealed.
 - b. Seal the following joints:
 - 1) Joints between door frames and window frames and adjacent construction.
 - 2) In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, and piping penetrations.
 - 3) In sound-rated wall and ceiling assemblies, seal joints between wall assemblies and ceiling assemblies; between wall assemblies and other construction; between ceiling assemblies and other construction.
 - 3. Do Not Seal:
 - a. Intentional weep holes in masonry.
 - b. Joints indicated to be covered with expansion joint cover assemblies.
 - c. Joints where sealant is specified to be furnished and installed by manufacturer of product to be sealed.
 - d. Joints where sealant installation is specified in other sections.
 - e. Joints between suspended ceilings and walls.
- B. Sound-Rated Assemblies: Walls and ceilings identified as STC-rated, sound-rated, or acoustical.

2.03 JOINT SEALANTS - GENERAL

- A. Sealants and Primers: Provide products with acceptable levels of volatile organic compound (VOC) content; see Section 016116.
- B. Colors: As indicated on drawings.

2.04 NONSAG JOINT SEALANTS

- A. Nonstaining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
 - 1. Movement Capability: Plus and minus 25 percent, minimum.
 - 2. Nonstaining to Porous Stone: Nonstaining to light-colored natural stone when tested in accordance with ASTM C1248.
 - 3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.

4. Color: To be selected by Architect from manufacturer's standard range.
5. Products:
 - a. Dow; DOWSIL 790 Silicone Building Sealant: www.dow.com/#sle.
 - b. Dow; DOWSIL 791 Silicone Weatherproofing Sealant: www.dow.com/#sle.
 - c. Dow; DOWSIL 795 Silicone Building Sealant: www.dow.com/#sle.
 - d. Approved Equal.
- B. Silicone Sealant: ASTM C920, Grade NS, Use T; single component, explicitly approved by manufacturer for traffic exposure when recessed below traffic surface; not expected to withstand continuous water immersion.
 1. Movement Capability: Plus 100 percent and minus 50 percent, minimum.
 2. Color: To be selected by Architect from manufacturer's standard range.
 3. Products:
 - a. Dow; DOWSIL NS Parking Structure Sealant: www.dow.com/#sle.
 - b. Dow; DOWSIL 888 Silicone Joint Sealant: www.dow.com/#sle.
 - c. Pecora Corporation; Pecora PCS: www.pecora.com/#sle.
 - d. Pecora Corporation; Pecora 301 NS (Non-Sag): www.pecora.com/#sle.
- C. Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
 1. Movement Capability: Plus and minus 25 percent, minimum.
 2. Color: To be selected by Architect from manufacturer's standard range.
 3. Products:
 - a. Dow; DOWSIL 999-A Building and Glazing Sealant: www.dow.com/#sle.
 - b. Dow; DOWSIL 758 Silicone Weather Barrier Sealant: www.dow.com/#sle.
 - c. Momentive Performance Materials, Inc/GE Silicones; SSG4600 UltraGlaze - Silicone Structural Glazing Adhesive: www.siliconeforbuilding.com/#sle.
 - d. Pecora Corporation; Pecora 860: www.pecora.com/#sle.
- D. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
 1. Color: White.
 2. Products:
 - a. Adfast USA Inc; ADSEAL KB 4800 Series: www.adfastcorp.com/#sle.
 - b. Everkem Diversified Products, Inc; TruSil 100: www.everkemproducts.com/#sle.
 - c. Pecora Corporation; Pecora 898 NST (Non-Staining Technology): www.pecora.com/#sle.
 - d. Sika Corporation; Sikasil GP: usa.sika.com/#sle.
 - e. Dow-Corning Corp; 786 .
- E. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, nonstaining, nonbleeding, nonsagging; not intended for exterior use.
 1. Color: To be selected by Architect from manufacturer's standard range.
 2. Products:
 - a. Pecora Corporation; AC-20 +Silicone: www.pecora.com/#sle.
 - b. Sherwin-Williams Company; 850A Acrylic Latex Caulk: www.sherwin-williams.com/#sle.
 - c. Sherwin-Williams Company; 950A Siliconized Acrylic Latex Caulk: www.sherwin-williams.com/#sle.
 - d. Tremco Commercial Sealants & Waterproofing; Tremflex 834: www.tremcosealants.com/#sle.
- F. Acrylic Latex Sealant: ASTM C834; for use as acoustical sealant and in firestopping systems for expansion joints and through penetrations.
 1. Color: To be selected by Architect from manufacturer's standard range.
 2. Fire Rated System: Complies with UL 263 and ASTM E119 with UL fire resistance classifications.

3. Products:
 - a. Pecora Corporation; AC-20 FTR (Fire and Temperature Rated):
www.pecora.com/#sle.

2.05 SELF-LEVELING JOINT SEALANTS

- A. Flexible Polyurethane Foam: Single component, gun grade, and low-expanding.
 1. Color: White.
 2. Products:
 - a. ADFAST Corporation; Adfoam Flex 1865: www.adfastcorp.com/#sle.
 - b. DAP Products Inc; DRAFTSTOP 812 Foam: www.dapspecline.com/#sle.
 - c. Tremco Commercial Sealants & Waterproofing; ExoAir Flex Foam:
www.tremcosealants.com/#sle.

2.06 ACCESSORIES

- A. Sealant Backing Materials, General: Materials placed in joint before applying sealants; assists sealant performance and service life by developing optimum sealant profile and preventing three-sided adhesion; type and size recommended by sealant manufacturer for compatibility with sealant, substrate, and application.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- C. Masking Tape: Self-adhesive, nonabsorbent, nonstaining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- D. Joint Cleaner: Noncorrosive and nonstaining type, type recommended by sealant manufacturer; compatible with joint forming materials.
- E. Primers: Type recommended by sealant manufacturer to suit application; nonstaining.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

- A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Provide joint sealant installations complying with ASTM C1193.
- C. Install acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve the following, unless otherwise indicated:
 1. Width/depth ratio of 2:1.
 2. Neck dimension no greater than 1/3 of the joint width.
 3. Surface bond area on each side not less than 75 percent of joint width.
- E. Install bond breaker backing tape where backer rod cannot be used.

- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

3.04 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
- C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.
- D. Repair destructive test location damage immediately after evaluation and recording of results.

3.05 POST-OCCUPANCY

- A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width, i.e., at low temperature in thermal cycle. Report failures immediately and repair them.

END OF SECTION 079200

**SECTION 079513
EXPANSION JOINT COVER ASSEMBLIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Expansion joint cover assemblies for wall surfaces.

1.02 RELATED REQUIREMENTS

- A. Section 079200 - Joint Sealants: Sealing expansion and control joints using gunnable and pourable sealants.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices and available colors and finish
- C. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, affected adjacent construction and anchorage locations.
- D. Samples: Submit two samples illustrating profile, dimension, color, and finish selected.
- E. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Expansion Joint Cover Assemblies:
 - 1. Balco, Inc: www.balcousa.com/#sle.
 - 2. Construction Specialties, Inc: www.c-sgroup.com/#sle.
 - 3. Inpro: www.inprocorp.com/#sle.
 - 4. MM Systems Corp: www.mmsystemscorp.com/#sle.
 - 5. Substitutions: See Section 016000 - Product Requirements.

2.02 EXPANSION JOINT COVER ASSEMBLY APPLICATIONS

- A. Exterior Wall Joints:
 - 1. Manufacturers:
 - a. **BASIS OF DESIGN:** Inpro; 615 Series Flush Mount
 - b. MM Systems; VSS Series
 - c. Balco, Inc; Exterior Wall, Elastomeric Face Seal System (FCWW): www.balcousa.com/#sle.
 - d. Construction Specialties, Inc; Exterior Wall Covers: www.c-sgroup.com/#sle.

2.03 EXPANSION JOINT COVER ASSEMBLIES

- A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
 - 1. Joint Dimensions and Configurations: As indicated on drawings.
 - 2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
 - 3. Joint Movement Capability: If not indicated, provide minimum plus/minus 50 percent joint movement capability.
 - 4. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
 - 5. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.

2.04 ACCESSORIES

- A. Horizontal and Vertical Insulated Moisture Barrier

1. Inpro; JL Series
2. Or Equal
 - a. Min. R Value of 15
 - b. Must meet ASTM E1399 Cyclic movement requirements matching movement requirements specific to project.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.
- B. Verify that frames and anchors installed by others are in correct locations and suitable for installation of remainder of assembly.

3.02 INSTALLATION

- A. Install components and accessories in accordance with manufacturer's instructions.
- B. Align work plumb and level, flush with adjacent surfaces.
- C. Rigidly anchor to substrate to prevent misalignment.

END OF SECTION 079513

**SECTION 081113
HOLLOW METAL DOORS AND FRAMES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.
- C. Thermally insulated hollow metal doors with frames.

1.02 RELATED REQUIREMENTS

- A. Section 087100 - Door Hardware.
- B. Section 099113 - Exterior Painting: Field painting.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2024.
- C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.
- D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2025.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2024.
- G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- I. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.
- J. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- K. NAAMM HMMA 805 - Recommended Selection and Usage Guide for Hollow Metal Doors and Frames; 2012.
- L. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- M. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2024.
- N. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2024.
- O. NAAMM HMMA 860 - Guide Specifications for Hollow Metal Doors and Frames; 2018.
- P. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.
- Q. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
- D. Samples: Submit two samples of metal, 2 by 2 inches in size, showing factory finishes, colors, and surface texture.
- E. Manufacturer's Qualification Statement.

1.05 QUALITY ASSURANCE

- A. Maintain at project site copies of reference standards relating to installation of products specified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
 1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com/#sle.
 2. Curries, an Assa Abloy Group company: www.assaabloydss.com/#sle.
 3. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
 4. Steelcraft, an Allegion brand: www.allegion.com/#sle.
 5. Titan Metal Products, Inc: www.titanmetalproducts.com/#sle.
 6. Substitutions: See Section 016000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:
 1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
 4. Door Edge Profile: Manufacturers standard for application indicated.
 5. Typical Door Face Sheets: Flush.
 6. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
 7. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvanized) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
 - a. Based on NAAMM HMMA Custom Guidelines: Provide at least A25/ZF75 (galvanized) for interior applications, and at least A60/ZF180 (galvanized) or G60/Z180 (galvanized) for corrosive locations.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

- A. Door Finish: Factory primed and field finished.

- B. Exterior Doors: Thermally insulated.
 - 1. Based on NAAMM HMMA Custom Guidelines:
 - a. Comply with guidelines of NAAMM HMMA 860 for Hollow Metal Doors and Frames.
 - b. Performance Level 2 - Moderate Duty, in accordance with NAAMM HMMA 805.
 - c. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
 - d. Door Face Metal Thickness: 20 gauge, 0.032 inch, minimum.
 - 2. Door Core Material: Polyurethane, 1.8 lbs/cu ft minimum density.
 - a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
 - 3. Door Thermal Resistance: R-Value of 8.7, minimum, for installed thickness of polyurethane.
 - 4. Door Thickness: 1-3/4 inches, nominal.
 - 5. Weatherstripping: Refer to Section 087100.

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Frame Finish: Factory primed and field finished.
- C. Exterior Door Frames: Full profile/continuously welded type.
 - 1. Frame Metal Thickness: 14 gauge, 0.067 inch, minimum.
 - 2. Weatherstripping: Separate, see Section 087100.
- D. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
- B. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15 mil, 0.015 inch dry film thickness (DFT) per coat; provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.06 ACCESSORIES

- A. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- B. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Coordinate frame anchor placement with wall construction.
- C. Install door hardware as specified in Section 087100.
- D. Coordinate installation of electrical connections to electrical hardware items.

3.04 TOLERANCES

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.05 ADJUSTING

- A. Adjust for smooth and balanced door movement.
- B. Adjust sound control doors so that seals are fully engaged when door is closed.
- C. Test sound control doors for force to close, latch, and unlatch; adjust as necessary in compliance with requirements.

3.06 SCHEDULE

- A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION 081113

**SECTION 083323
UPWARD COILING DOORS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Upward coiling service doors.

1.02 RELATED REQUIREMENTS

- A. Section 079200 - Joint Sealants: Sealing joints between frames and adjacent construction.
- B. Section 087100 - Door Hardware: Cylinder cores and keys.
- C. Section 260583 - Wiring Connections: Power to disconnect.

1.03 REFERENCE STANDARDS

- A. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- D. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- E. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. ICC (IECC)-2021 - International Energy Conservation Code; 2021.
- G. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturer's standard literature showing materials and details of construction and finish. Include data on electrical operation.
- C. Shop Drawings: Indicate rough and actual opening dimensions, anchorage methods, hardware locations, and installation details.
- D. Manufacturer's Instructions: Indicate installation sequence and installation, adjustment, and alignment procedures.
- E. Installer's Qualification Statement.
- F. Operation and Maintenance Data: Indicate modes of operation, lubrication requirements and frequency, and periodic adjustments required.
- G. Specimen Warranty.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in performing work of this section with minimum of 5 years of documented experience in fabrication and installation of upward coiling doors.
- B. Installer Qualifications: Company specializing in performing work of this section with minimum of 3 years of documented experience and approved by manufacturer.
- C. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for purpose specified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Protect materials from exposure to moisture.
- C. Store materials in dry, warm, ventilated, weathertight location.

1.07 WARRANTY

- A. Manufacturer Door and Operator Warranty: Provide manufacturer's limited warranty for door and operator system free from material and workmanship defects for duration and cycles indicated under individual doors; counterbalance spring and finish not covered by warranty.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Overhead Door Corporation; www.overheaddoor.com
- B. Substitutions: See Section 016000 – Product Requirements.

2.02 UPWARD COILING SERVICE DOORS

- A. Overhead Door Brand; Model 625 Insulated Stormtite.
 - 1. Slats: Interlocking, roll-formed, metal slats.
 - 2. Width: 14 feet..
 - 3. Height: 14 feet..
 - 4. Mounting: Between jamb.
 - 5. Opening Speed: Door to operate at variable speed of 6 to 12 inches (152 to 305 mm) per second.
 - 6. Closing Speed: Door to operate at variable speed of 6 to 12 inches (152 to 305 mm) per second.
 - 7. Operation Cycles: Capable of operating for minimum 20,000 cycles. One operation cycle is complete when door is opened from closed position to fully open position and returned to closed position.
 - 8. Warranty:
 - a. Door Only: Two years.
 - b. Door and Operator Warranty: Three years or 20,000 cycles, whichever comes first.
 - 9. Wind Load: Design door assembly to withstand ultimate static pressure load of 26 psf () in accordance with ASTM E330/E330M.
 - 10. Curtain Material:
 - a. Front Slat: Galvanized Steel: 18 gauge, 0.0516 inch.
 - b. Back Slat: Galvanized Steel: 22 gauge, 0.0336 inch.
 - c. Slat Profile: F-265i.
 - d. Slat R-Value: R-7.7 (RSI-1.35).
 - e. Through Curtain Sound Rating: STC-28 minimum in accordance with ASTM E90.
 - f. U-Factor: 0.91 maximum per NFRC test report.
 - g. Air Infiltration: Meets ASHRAE Std 90.1 I-P and ICC (IECC)-2021 C402.4.3 air leakage of fenestration, maximum 1.00 cfm/sq ft.
 - h. Vision Lites: Not required.
 - i. Galvanized Steel Finish: Standard polyester base coat. Color: Gray.
 - 11. Bottom Bar: 6063-T6 aluminum.
 - a. Profile: Double angle.
 - b. Finish: Mill finish.
 - 12. Locking: Slide lock.
 - a. Lock Locations: Right only.
 - 13. Weatherstripping and Seals:
 - a. Bottom Seal Astragal: Included.
 - b. Exterior Guide Seal: Required.
 - c. Interior Guide Seal: Required.

- d. Internal Hood Seal: Included.
- e. Lintel Brush Seal: Required.
- f. Air infiltration perimeter seal package includes guide cover, guide cap, dual brush exterior guide seal, lintel brush seal, and vinyl bottom seal.
- 14. Side Guides, Channels: Constructed of steel with members fully bolted together.
 - a. Finish: Hot-dip galvanized.
- 15. Brackets: Steel to support counterbalance and curtain.
 - a. Finish: Hot-dip galvanized.
 - b. Counterbalance: Helical torsion spring type, housed in steel tube or pipe barrel and supporting curtain with deflection limited to 0.03 inch per foot (1:400) of span. Adjustable spring tension required.
- 16. Hood: 24 gauge, 0.0278 inch galvanized steel.
 - a. Finish: Match curtain.
- 17. Manual Operation: Chain hoist.
- 18. Motor Operation: Not required.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions meet manufacturer's requirements before starting work.
- B. Verify opening sizes, tolerances, and conditions are acceptable.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's written instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building structure without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- E. Coordinate installation of electrical service; see Section 260583.
- F. Install enclosure and perimeter trim.

3.03 TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent work.
- B. Maximum Variation from Plumb: 1/16 inch.
- C. Maximum Variation from Level: 1/16 inch.
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 feet.

3.04 ADJUSTING

- A. Adjust operating assemblies for smooth and noiseless operation.

3.05 CLEANING

- A. See Section 017000 - Execution and Closeout Requirements for additional requirements.
- B. Clean installed components.
- C. Remove labels and visible markings.

3.06 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch up damaged finishes after Substantial Completion.

END OF SECTION 083323

SECTION 087100 DOOR HARDWARE

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.
- B. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2026.
- C. BHMA A156.1 - Standard for Butts and Hinges; 2021.
- D. BHMA A156.2 - Bored and Preamsembled Locks and Latches; 2022.
- E. BHMA A156.3 - Exit Devices; 2025.
- F. BHMA A156.4 - Door Closers and Pivots; 2024.
- G. BHMA A156.5 - Cylinders and Input Devices for Locks; 2020.
- H. BHMA A156.28 - Standard for Recommended Practices for Mechanical Keying Systems; 2023.
- I. BHMA A156.31 - Electric Strikes and Frame Mounted Actuators; 2024.
- J. ISO 9000 - Quality Management Systems -- Fundamentals and Vocabulary; 2015.
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
- M. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- N. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2025.
- O. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- P. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- Q. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- R. UL 305 - Standard for Panic Hardware; Current Edition, Including All Revisions.
- S. UL 1784 - Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives; Current Edition, Including All Revisions.
- T. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; 2021, with Errata (2022).

1.02 SUMMARY

- A. Section includes:
 - 1. Mechanical and electrified door hardware
 - 2. Electronic access control system components
- B. Section excludes:
 - 1. Windows
 - 2. Cabinets (casework), including locks in cabinets
 - 3. Signage
 - 4. Toilet accessories
 - 5. Overhead doors
- C. Related Sections:
 - 1. Division 01 "General Requirements" sections for Allowances, Alternates, Owner Furnished Contractor Installed, Project Management and Coordination.
 - 2. Division 06 Section "Rough Carpentry"
 - 3. Division 06 Section "Finish Carpentry"
 - 4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.

5. Division 08 Sections:
 - a. "Metal Doors and Frames"
 - b. "Flush Wood Doors"
 - c. "Stile and Rail Wood Doors"
 - d. "Interior Aluminum Doors and Frames"
 - e. "Aluminum-Framed Entrances and Storefronts"
 - f. "Stainless Steel Doors and Frames"
 - g. "Special Function Doors"
 - h. "Entrances"
6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.03 REFERENCES

- A. UL LLC
 1. UL 10B - Fire Test of Door Assemblies
 2. UL 10C - Positive Pressure Test of Fire Door Assemblies
 3. UL 1784 - Air Leakage Tests of Door Assemblies
 4. UL 305 - Panic Hardware
- B. DHI - Door and Hardware Institute
 1. Sequence and Format for the Hardware Schedule
 2. Recommended Locations for Builders Hardware
 3. Keying Systems and Nomenclature
 4. Installation Guide for Doors and Hardware
- C. NFPA – National Fire Protection Association
 1. NFPA 70 – National Electric Code
 2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
 3. NFPA 101 – Life Safety Code
 4. NFPA 105 – Smoke and Draft Control Door Assemblies
 5. NFPA 252 – Fire Tests of Door Assemblies
- D. ANSI - American National Standards Institute
 1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
 2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
 3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
 4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
 5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.04 SUBMITTALS

- A. General:
 1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
 2. Prior to forwarding submittal:
 - a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
 - b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
- B. Action Submittals:
 1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.

2. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.
 - a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
3. Door Hardware Schedule:
 - a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
 - b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
 - c. Indicate complete designations of each item required for each opening, include:
 - 1) Door Index: door number, heading number, and Architect's hardware set number.
 - 2) Quantity, type, style, function, size, and finish of each hardware item.
 - 3) Name and manufacturer of each item.
 - 4) Fastenings and other pertinent information.
 - 5) Location of each hardware set cross-referenced to indications on Drawings.
 - 6) Explanation of all abbreviations, symbols, and codes contained in schedule.
 - 7) Mounting locations for hardware.
 - 8) Door and frame sizes and materials.
 - 9) Degree of door swing and handing.
 - 10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.
4. Key Schedule:
 - a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
 - b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
 - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
 - d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
 - e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
 - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
- C. Informational Submittals:
 1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
 2. Provide Product Data:
 - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
 - b. Include warranties for specified door hardware.
- D. Closeout Submittals:
 1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:

- a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Final approved hardware schedule edited to reflect conditions as installed.
 - d. Final keying schedule
 - e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
- E. Inspection and Testing:
- 1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
 - a. Fire door assemblies, in compliance with NFPA 80.
 - b. Required egress door assemblies, in compliance with NFPA 101.

1.05 QUALITY ASSURANCE

- A. Qualifications and Responsibilities:
- 1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
 - 2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
 - 3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
 - a. For door hardware: DHI certified AHC or DHC.
 - b. Can provide installation and technical data to Architect and other related subcontractors.
 - c. Can inspect and verify components are in working order upon completion of installation.
- B. Certifications:
- 1. Fire-Rated Door Openings:
 - a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
 - b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
 - 2. Smoke and Draft Control Door Assemblies:
 - a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
 - b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
 - 3. Electrified Door Hardware
 - a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
 - 4. Accessibility Requirements:
 - a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This

project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference

- a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - 1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2) Preliminary key system schematic diagram.
 - 3) Requirements for key control system.
 - 4) Requirements for access control.
 - 5) Address for delivery of keys.

2. Pre-installation Conference

- a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- b. Inspect and discuss preparatory work performed by other trades.
- c. Inspect and discuss electrical roughing-in for electrified door hardware.
- d. Review sequence of operation for each type of electrified door hardware.
- e. Review required testing, inspecting, and certifying procedures.
- f. Review questions or concerns related to proper installation and adjustment of door hardware.

3. Electrified Hardware Coordination Conference:

- a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.
- C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
- D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.07 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.08 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.
 - 1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
 - 2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
 - a. Mechanical Warranty
 - 1) Locks
 - (a) Best 9K Series: 10 years
 - 2) Exit Devices
 - (a) Von Duprin: 10 years
 - 3) Closers
 - (a) LCN 4040XP Series: 30 years
 - b. Electrical Warranty
 - 1) Electric Strikes
 - (a) Von Duprin: 1 year electrical

1.09 MAINTENANCE

- A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
- B. Turn over unused materials to Owner for maintenance purposes.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.
- B. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

- A. Fabrication
 - 1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
 - 2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
 - 3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.
- B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
 - 1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

2.03 HINGES

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product:

- a. Ives 5BB series
- 2. Acceptable Manufacturers and Products:
 - a. Hager BB1191/1279 series
 - b. McKinney TB series
 - c. Best FBB series
- B. Requirements:
 - 1. Provide hinges conforming to ANSI/BHMA A156.1.
 - 2. Provide five knuckle, ball bearing hinges.
 - 3. 1-3/4 inch thick doors, up to and including 36 inches wide:
 - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches high
 - b. Interior: Standard weight, steel, 4-1/2 inches high
 - 4. 1-3/4 inch thick doors over 36 inches wide:
 - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches high
 - b. Interior: Heavy weight, steel, 5 inches high
 - 5. 2 inches or thicker doors:
 - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches high
 - b. Interior: Heavy weight, steel, 5 inches high
 - 6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
 - 7. Provide three hinges per door leaf for doors 90 inches or less in height, and one additional hinge for each 30 inches of additional door height.
 - 8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins
 - 9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.04 CYLINDRICAL LOCKS – GRADE 1

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product:
 - a. Best 9K series
 - 2. Acceptable Manufacturers and Products:
 - a. No Substitute
- B. Requirements:
 - 1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.
 - 2. Cylinders: Refer to "KEYING" article, herein.
 - 3. Provide locks with standard 2-3/4 inches backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
 - 4. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
 - 5. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
 - 6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
 - 7. Provide electrified options as scheduled in the hardware sets.
 - 8. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.

2.05 EXIT DEVICES

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product:

- a. Von Duprin 99 series
- 2. Acceptable Manufacturers and Products:
 - a. No Substitute
- B. Requirements:
 - 1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
 - 2. Cylinders: Refer to "KEYING" article, herein.
 - 3. Provide grooved touchpad type exit devices, fabricated from brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match the balance of door hardware.
 - 4. Touchpad must extend a minimum of one-half of the door width. No plastic inserts are allowed in touchpads.
 - 5. Provide exit devices with a deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
 - 6. Provide exit devices at exterior gate applications with the Outdoor Defense (OUT) option, engineered to safeguard against moisture, temperature variations, and corrosion. Outdoor Defense products shall include waterproof switches and weep holes and shall be warranted for outdoor applications including perimeter security gates and courtyards.
 - 7. Provide flush end caps for exit devices.
 - 8. Provide exit devices with manufacturers' approved strikes.
 - 9. Provide exit devices cut to the door width and height. Install exit devices at a height recommended by the exit device manufacturer, allowable by governing building codes, and approved by the Architect.
 - 10. Mount the mechanism case flush on the face of the doors or provide spacers to fill gaps behind the devices. Where glass trim or molding projects off the face of the door, provide glass bead kits.
 - 11. Provide cylinder or hex-key dogging as specified at non-fire-rated openings.
 - 12. Removable Mullions: 2 inches x 3 inches steel tube. Where scheduled as keyed removable mullion, provide a type that can be removed by use of a keyed cylinder, which is self-locking when reinstalled.
 - 13. Provide factory-drilled weep holes for exit devices used in full exterior applications, highly corrosive areas, and where noted in hardware sets.
 - 14. Provide electrified options as scheduled.
 - 15. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors, eliminating the requirement of tabs, and double tab mount for wood doors.
 - 16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.
 - a. Provide levers that return to within 1/2 inch of the door face.
 - 17. Provide exit devices with PA filler.
 - 18. Accessibility: Require not more than 5 lb. to retract the latchbolt, per CBC 2019 11B-404.2.7 and 11B-309.4.
 - a. Mechanical method: Von Duprin AX feature, where touchpad directly retracts the latchbolt with 5 lb. or less of force. Provide testing lab certification confirming that the mechanical device is independent third-party tested to meet this 5 lb. requirement.
 - b. Electrical method: Von Duprin's RX-QEL feature, where lightly pressing the touchpad with 5 lb. or less of force closes an electric switch, activating quiet electric latch retraction.

2.06 ELECTRIC STRIKES

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product:
 - a. Von Duprin 6000 Series
 - 2. Acceptable Manufacturers and Products:
 - a. HES 1006 Series

- B. Requirements:
 - 1. Provide electric strikes designed for use with type of locks shown at each opening.
 - 2. Provide electric strikes UL Listed as burglary resistant that are tested to a minimum endurance test of 1,000,000 cycles.
 - 3. Where required, provide electric strikes UL Listed for fire doors and frames.
 - 4. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.07 CYLINDERS

- A. Manufacturers:
 - 1. Scheduled Manufacturer and Product:
 - a. BEST EXISTING KEY SYSTEM
- B. Requirements:
 - 1. Provide cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.

2.08 KEYING

- A. Scheduled System:
 - 1. Existing factory registered system:
 - a. Provide cylinders/cores keyed into Owner's existing factory registered keying system. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
- B. Requirements:
 - 1. Construction Keying:
 - a. Replaceable Construction Cores.
 - 1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
 - (a) 3 construction control keys
 - (b) 12 construction change (day) keys.
 - 2) Owner or Owner's Representative will replace temporary construction cores with permanent cores.
 - 2. Permanent Keying:
 - a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
 - 1) Master Keying system as directed by the Owner.
 - b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
 - c. Provide keys with the following features:
 - 1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
 - 2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
 - 3) Geographically Exclusive: Where High Security or Security cylinders/cores are indicated, provide nationwide, geographically exclusive key system complying with the following restrictions.
 - d. Identification:
 - 1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
 - 2) Identification stamping provisions must be approved by the Architect and Owner.
 - 3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.

- 4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
- 5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
- e. Quantity: Furnish in the following quantities.
 - 1) Permanent Control Keys: 3.
 - 2) Master Keys: 6.
 - 3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
 - 4) Key Blanks: Quantity as determined in the keying meeting.

2.09 DOOR CLOSERS

- A. Manufacturers and Products:
 1. Scheduled Manufacturer and Product:
 - a. LCN 4040XP series
 2. Acceptable Manufacturers and Products:
 - a. No Substitute
- B. Requirements:
 1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
 2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
 3. Cylinder Body: 1-1/2-inch 1.5 inch diameter piston with 5/8-inch (0.63 inch) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
 4. Hydraulic Fluid: Fireproof, passing requirements of UL 10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees Fahrenheit to -30 degrees Fahrenheit.
 5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
 6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
 7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
 8. Pressure Relief Valve (PRV) Technology: Not permitted.
 9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
 10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.
 11. Closers shall be capable of being upgraded by adding modular mechanical or electronic components in the field.

2.10 DOOR TRIM

- A. Manufacturers:
 1. Scheduled Manufacturer:
 - a. Ives
 2. Acceptable Manufacturers:
 - a. Burns
 - b. Trimco
 - c. Rockwood

- B. Requirements:
 - 1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.
 - 2. .

2.11 DOOR STOPS AND HOLDERS

- A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Ives
 - 2. Acceptable Manufacturers:
 - a. Burns
 - b. Trimco
 - c. Rockwood
- B. Provide door stops at each door leaf:
 - 1. Provide wall stops wherever possible. Provide concave type where lockset has a push button or thumbturn.
 - 2. Where a wall stop cannot be used, provide universal floor stops.
 - 3. Where wall or floor stop cannot be used, provide overhead stop.
 - 4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.12 GATE HARDWARE ACCESSORIES

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Products:
 - a. LockeyUSA ED3x1 Edge 3-in-1 Panic Shield
 - b. LockeyUSA ED-SB Adjustable Strike Bracket
 - c. LockeyUSA TB200 Hydraulic Gate Closer with TB-LINX Chain Link Mounting Kit
 - 2. Acceptable Manufacturers and Products:
 - a. No Substitute
- B. Requirements:
 - 1. Panic Shield: Provide 16-gauge electro-galvanized steel panic shield adjustable from 28 inches to 54 inches in width, powder coated. Drill mounting holes in field to match exit device manufacturer's hole pattern. Attach to gate frame with self-drilling stainless steel screws.
 - 2. Strike Bracket: Provide adjustable 1/4-inch steel strike bracket sized to fit gate post up to 3 inches in diameter. Finish to match panic shield.
 - 3. Gate Closer: Provide hydraulic/nitrogen gas gate closer rated for gate weights of 50 to 125 lbs. and gate widths up to 52 inches. Closer shall feature adjustable closing and latching speed, hold-open function, and be suitable for left- and right-hand gates. Provide TB-LINX chain link mounting kit for installation on chain link gate posts. Operating temperature range: 15 degrees Fahrenheit to 122 degrees Fahrenheit minimum. A gate stop shall be installed per manufacturer's requirements to retain product warranty and restrict gate opening angle.

2.13 SILENCERS

- A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Ives
 - 2. Acceptable Manufacturers:
 - a. Burns
 - b. Rockwood
 - c. Trimco
- B. Requirements:
 - 1. Provide "push-in" type silencers for hollow metal or wood frames.

2. Provide one silencer per 30 inches of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.14 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

- A. Manufacturers:
- B. Scheduled Manufacturer:
 1. Zero International
- C. Acceptable Manufacturers:
 1. No Substitute
 2. National Guard
 3. Reese
 4. Pemko
- D. Seals and Gasketing: Provide continuous gasketing on exterior openings, to the head and jambs, forming a continuous seal between the door and the frame. Provide smoke, light, or sound gasketing on interior doors where indicated.
 1. Provide self-tapping fasteners for aluminum extruded gasketing being applied to hollow metal frames.
 - a. Provide non-corrosive fasteners for all exterior applications.
 - b. Provide security fasteners where indicated.
 2. Provide neoprene, EPDM, silicone, or nylon brush inserts as specified in hardware sets. Provide non brush inserts of solid or sponge cell, as specified in hardware sets. Vinyl inserts are not allowed except where specified in hardware sets.
- E. Smoke Labeled Gasketing: At all smoke labeled openings, provide smoke listed perimeter gasketing assemblies complying with NFPA 105 listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for smoke control ratings indicated based on testing according to UL 1784.
- F. Fire Listed Gasketing: Assemblies complying with NFPA 80 that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction for fire ratings indicated based on testing according to UL 10C.
 1. Where frame-applied intumescent seals are required by the manufacturer, provide gaskets that comply with UL 10C Standard for Positive Pressure Fire Tests of Door Assemblies and UBC 7-2, Fire Tests of Door Assemblies.
- G. Sound-Rated Gasketing: Provide acoustic gasketing to meet Sound Transmission Class (STC) rating required.
- H. Meeting-Stile Gasketing: Provide meeting-stile gasketing that fastens to the meeting stiles forming a continuous seal when doors are closed.
- I. Door Sweeps or Shoes: Apply to the bottom of the door to close the gap between the door bottom and finished floor or saddle threshold.
 1. Provide solid neoprene, EPDM, silicone, or nylon brush type of seal as specified in hardware sets. Vinyl inserts are not allowed except where specified in hardware sets.
- J. Rain Drips:
 1. Provide overhead rain drips for out-swinging hollow metal doors that are not covered against 45 degree blowing rain. Aluminum extrusion to be a minimum of .088 inches thick and extend 2.50 inches from the face of the frame, in anodized finish to match door.
 2. Door sweeps or shoes with integral rain drip must meet ADA requirements
- K. Thresholds: Provide threshold units not less than 4 inches wide, formed to accommodate change in floor elevation where indicated, and fabricated to accommodate door hardware and fit door frames.
 1. Threshold extrusion to be a minimum thickness as specified in hardware sets.

2.15 FINISHES

- A. FINISH: BHMA 626/652 (US26D); INTERIOR
 - 1. Hinges at Exterior Doors: BHMA 630 (US32D)
 - 2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
 - 3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
 - 4. Protection Plates: BHMA 630 (US32D)
 - 5. Overhead Stops and Holders: BHMA 630 (US32D)
 - 6. Door Closers: Powder Coat to Match
 - 7. Wall Stops: BHMA 630 (US32D)
 - 8. Latch Protectors: BHMA 630 (US32D)
 - 9. Weatherstripping: Clear Anodized Aluminum
 - 10. Thresholds: Mill Finish Aluminum
- B. FINISH: BHMA 622/631 (US19); EXTERIOR
 - 1. Door Closers: Powder Coat to Match
 - 2. Weatherstripping: Black
 - 3. Thresholds: Mill Finish Black

PART 3 EXECUTION

3.01 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
 - 3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
 - 4. Installation Guide for Doors and Hardware: DHI TDH-007-20
- B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.
- C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

- I. Lock Cylinders:
 - 1. Install construction cores to secure building and areas during construction period.
 - 2. Replace construction cores with permanent cores as indicated in keying section.
 - 3. Furnish permanent cores to Owner for installation.
- J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:
 - 1. Conduit, junction boxes and wire pulls.
 - 2. Connections to and from power supplies to electrified hardware.
 - 3. Connections to fire/smoke alarm system and smoke evacuation system.
 - 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
 - 5. Connections to panel interface modules, controllers, and gateways.
 - 6. Testing and labeling wires with Architect's opening number.
- K. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.
- L. Thresholds:
 - 1. Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
 - 2. Aluminum thresholds to be cut-in, and scribed around mullions, frame members, and stops. Do not butt to thresholds. Provide a continuous surface across full width of opening from jamb to jamb.
 - 3. Where aluminum panic-type (rabbeted) thresholds with neoprene inserts are specified, undercut doors as required to properly mate with seal in threshold.
- M. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- N. Perimeter Gasketing:
 - 1. Apply to head and jamb, forming seal between door and frame.
 - 2. Install gasketing in a manner eliminating need to cut any seal to install surface mounted hardware. Install compatible mounting bracket for surface mounted hardware unless minimum 1/4 inch thick solid aluminum seals are provided for mounting of surface applied hardware.
- O. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- P. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Spring Hinges: Adjust to achieve positive latching when door can close freely from an open position of 30 degrees.
 - 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 - 3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.04 CLEANING AND PROTECTION

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

3.05 DOOR HARDWARE SCHEDULE

- A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.
- B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.
- C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.
- D. Hardware Sets:

HARDWARE GROUP NO. 01

FOR USE ON DOOR #(S):

100B

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	BBLK / 622	IVE
1	EA	PANIC HARDWARE	LD-99-L-NL-06	315	VON
1	EA	SFIC MORTISE CYL.	AS REQ	622	BES
1	EA	PERMANENT CORE	AS REQUIRD TO MATCH EXISTING KEY SYSTEM	622	BES
1	EA	SURFACE CLOSER	4040XP SCUSH	622	LCN
1	EA	GASKETING	188S	BK	ZER
1	EA	DOOR SWEEP	39BK	BK	ZER
1	EA	THRESHOLD	655A	A	ZER

HARDWARE GROUP NO. 02

FOR USE ON DOOR #(S):

100A					

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONTINUOUS HINGE	114XY	315AN	IVE
1	EA	PANIC HARDWARE	LD-99-L-NL-06	315	VON
1	EA	SFIC MORTISE CYL.	AS REQ	622	BES
1	EA	PERMANENT CORE	AS REQUIRD TO MATCH EXISTING KEY SYSTEM	622	BES
1	EA	ELECTRIC STRIKE	6300 FSE (FAIL SECURE)	630	VON
1	EA	SURFACE CLOSER	4040XP SCUSH	622	LCN
1	EA	GASKETING	188S	BK	ZER
1	EA	DOOR SWEEP	39BK	BK	ZER

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	THRESHOLD	655A	A	ZER
1	EA	CARD READER	BY SECURITY CONTRACTOR		
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		

-INGRESS BY THE CREDENTIAL READER OR KEY OVERRIDE.

-FREE EGRESS BY PANIC HARDWARE.

HARDWARE GROUP NO. 03

FOR USE ON DOOR #(S):

101

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	9K3-7D-15D S3	626	SCH
1	EA	PERMANENT CORE	AS REQUIRED TO MATCH EXISTING KEY SYSTEM	622	BES
1	EA	ELECTRIC STRIKE	6211-FSE CON (FAIL SECURE)	630	VON
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	CARD READER	BY SECURITY CONTRACTOR		
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		

-INGRESS BY THE CREDENTIAL READER OR KEY OVERRIDE.

-FREE EGRESS BY LEVER.

HARDWARE GROUP NO. GT

FOR USE ON GATE #(S):

GT-1

PROVIDE EACH GATE WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	EXIT DEVICE (OUTDOOR)	99EO-OUT 3 (OUTDOOR DEFENSE)	626	VON
1	EA	PERMANENT CORE	AS REQUIRED TO MATCH EXISTING KEY SYSTEM	622	BES
1	EA	PANIC TRIM (NIGHT LATCH)	990NL-BE	626	VON
1	EA	SFIC MORTISE CYL.	AS REQ	626	BES

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	GATE PANIC SHIELD	ED3x1S24 (EDGE 3-IN-1, 24" SILVER)	SIL	LKY
1	EA	STRIKE BRACKET	ED-SB-S (ADJ. STRIKE BRACKET, SILVER)	SIL	LKY
1	EA	GATE CLOSER	TB200 (HYDRAULIC, 50-125 LB. GATE)	BLK	LKY
1	EA	CHAIN LINK MOUNTING KIT	TB-LINX (FOR TB200, CHAIN LINK)	ZN	LKY

-FREE EGRESS BY PUSH BAR. ENTRY BY KEY.

END OF SECTION 087100

**SECTION 095100
ACOUSTICAL CEILINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.
- C. Supplementary insulation above ceiling.

1.02 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- B. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.
- C. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019 (Reapproved 2025).
- D. 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; 2024a.
- E. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

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.
- C. Pre-installation Conference: Conduct conference at Project site. Agenda includes Project conditions, coordination with work of other trades, and layout of items that penetrate ceilings

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.
- C. Product Data: Provide data on suspension system components and acoustical units.
- D. Evaluation Service Reports: Show compliance with specified requirements.
- E. Samples: Submit a sample 12 by 12 inch in size illustrating material and finish of acoustical units.
- F. Samples: Submit for each, 12 inches long, of suspension system main runner, cross runner, and perimeter molding.
- G. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- H. Manufacturer's qualification statement.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Acoustical Units: Quantity equal to 10 percent of total installed.

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.

1.06 WARRANTY

A. Warranty Period:

1. Acoustical Panels Manufacturer Warranty: Submit a written warranty executed by manufacturer for a period of **30 years** from date of Substantial Completion, agreeing to repair or replace acoustical tile that fails or is compromised within the specified warranty period. The warranty does not cover any damage or change to the Products resulting from improper material handling or storage, water, moisture, fire, chemical fumes, bacteria, mold, fungi, wind, accident, disaster, non-intended use, improper installation, abuse, or failure of other system components or modification.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes

1.08 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. Rockfon: www.rockfon.com/#sle.
 2. Armstrong World Industries, Inc.; www.armstrongceilings.com/#sle.
 3. Approved Equal
 4. Substitutions: See Section 016000 - Product Requirements.
- B. Suspension Systems:
 1. Same as for acoustical units.
 2. Substitutions: See Section 016000 - Product Requirements.

2.02 ACOUSTICAL UNITS

- A. Acoustical Units - General: ASTM E1264, Class A.
- B. Acoustical Panels ACT-01: Mineral fiber with membrane-faced overlay, with the following characteristics:
 1. Classification: ASTM E1264 Type IV.
 2. Size: 24 by 24 inches.
 3. Thickness: Standard for humidity resistant tile.
 4. Light Reflectance: Not Less than 0.86
 5. NRC: Refer to Interior Finish Schedule
 6. Color: White.
 7. Suspension System: Exposed grid.
 8. Humidity Resistance: Rated for 95% relative humidity at 100 degrees F without sag, warping, or visible deterioration; in accordance with ASTM E1264
 9. Products:
 - a. Basis of Design: Armstrong Humigard plus
 - b. Substitutions: See Section 016000 - Product Requirements.

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.
 1. Materials:
 - a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.

- B. Exposed Suspension System: Hot-dipped galvanized steel grid with steel cap.
 - 1. Color: White.

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 gauge, 0.08 inch galvanized steel wire.
- C. Hold-Down Clips: Manufacturer's standard clips to suit application.
- D. Seismic Clips: Manufacturer's standard clips for seismic conditions and to suit application.
- E. Perimeter Moldings: Same metal and finish as grid.
 - 1. Angle Molding: L-shaped, for mounting at same elevation as face of grid.
- F. Acoustical Insulation: Specified in Section 072100.
 - 1. Thickness: 6 inch.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.

3.03 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions 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: Hang suspension system independent of walls, columns, ducts, pipes and conduits. 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.

3.04 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.

- F. Lay acoustical insulation for a distance of 48 inches either side of acoustical partitions as indicated.
- G. Install hold-down clips on panels within 20 ft of an exterior door.

3.05 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.

3.06 CLEANING

- A. See Section 017000 - Execution and Closeout Requirements for additional requirements.
- B. Clean surfaces.
- C. Replace damaged or abraded components.

END OF SECTION 095100

**SECTION 099000
PAINTING AND COATING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Interior painting and coating systems.
- C. Exterior painting and coating systems.
- D. Scope:
 - 1. Finish surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 - a. Exterior:
 - 1) Metal, Miscellaneous: Iron, ornamental iron, structural iron and steel, ferrous metal.
 - b. Interior:
 - 1) Metal: Aluminum and galvanized.
 - 2) Wood: Walls, ceilings, doors, and trim.
 - 3) Drywall: Walls, ceilings, gypsum board, and similar items.

1.02 REFERENCE STANDARDS

- A. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- B. SSPC-SP 2 - Hand Tool Cleaning; 2024.
- C. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning; 2006.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Product characteristics.
 - 2. Surface preparation instructions and recommendations.
 - 3. Primer requirements and finish specification.
 - 4. Storage and handling requirements and recommendations.
 - 5. Application methods.
 - 6. Clean-up information.
- C. Maintenance Data: Submit coating maintenance manual including finish schedule showing where each product/color/finish was used, product technical data sheets, safety data sheets (SDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements for additional provisions.
 - 2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
 - 3. Label each container with color in addition to manufacturer's label.

1.04 MOCK-UPS

- A. See Section 014000 - Quality Requirements for general requirements for mock-ups.
- B. Provide one accent wall as directed by Architect to demonstrate color and finish.
- C. Locate where directed by Architect.
- D. Mock-up may remain as part of the work.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, product name, product code, color designation, VOC content, batch date, environmental handling, surface preparation, application, and use instructions.
- C. Paint Materials: Store at a minimum of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.
- D. Handling: Maintain a clean, dry storage area to prevent contamination or damage to materials.

1.06 FIELD CONDITIONS

- A. Do not apply materials when environmental conditions are outside the ranges required by manufacturer.
- B. Follow manufacturer's recommended procedures for producing the best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Products: Subject to compliance with requirements, provide Sherwin-Williams Company (The) products indicated; www.sherwin-williams.com/#sle.
- B. Comparable Products: Products of approved manufacturers will be considered in accordance with 016000 - Product Requirements, and the following:
 - 1. Products that meet or exceed performance and physical characteristics of basis of design products.
 - 2. Other Acceptable Manufacturers:
 - a. Benjamin Moore.
 - b. PPG.
 - c. BEHR.

2.02 PAINTINGS AND COATINGS

- A. General:
 - 1. Provide factory-mixed coatings unless otherwise indicated.
 - 2. When required, mix coatings to correct consistency in accordance with manufacturer's instructions before application.
 - 3. Do not reduce, thin, or dilute coatings or add materials to coatings unless specifically indicated in manufacturer's instructions.
- B. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

2.03 PAINT SYSTEMS - EXTERIOR

- A. Metal, Miscellaneous: Iron, ornamental iron, structural iron and steel, ferrous metal.
 - 1. Alkyd Systems, Water Based:
 - a. Semi-Gloss Finish:
 - 1) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series: www.sherwin-williams.com/#sle.
 - 2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Water Based Alkyd Urethane Enamel Semi-Gloss, B53-1150 Series: www.sherwin-williams.com/#sle.

2.04 PAINT SYSTEMS - INTERIOR

- A. Metal: Aluminum and galvanized.
 - 1. Alkyd Systems, Water Based:
 - a. Semi-Gloss Finish:
 - 1) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series: www.sherwin-williams.com/#sle.

- 2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Water Based Alkyd Urethane Enamel Semi-Gloss, B53-1150 Series: www.sherwin-williams.com/#sle.
- b. Low Sheen Finish:
 - 1) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series: www.sherwin-williams.com/#sle.
 - 2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Water Based Alkyd Urethane Enamel Low Sheen, B53-1250 Series: www.sherwin-williams.com/#sle.
- B. Wood: Walls, ceilings, doors, and trim.
 1. Latex Systems:
 - a. Semi-Gloss Finish:
 - 1) 1st Coat: Sherwin-Williams Premium Wall and Wood Primer, B28W8111: www.sherwin-williams.com/#sle.
 - 2) 2nd and 3rd Coat: Sherwin-Williams ProClassic Waterborne Acrylic Semi-Gloss, B31 Series: www.sherwin-williams.com/#sle.
- C. Drywall: Walls, ceilings, gypsum board, and similar items.
 1. Latex Systems:
 - a. Semi-Gloss Finish:
 - 1) 1st Coat: Sherwin-Williams ProMar 200 Zero VOC Interior Latex Primer, B28W2600: www.sherwin-williams.com/#sle.
 - 2) 2nd and 3rd Coat: Sherwin-Williams ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series: www.sherwin-williams.com/#sle.
 - b. Eg-Shel Finish:
 - 1) 1st Coat: Sherwin-Williams ProMar 200 Zero VOC Interior Latex Primer, B28W2600: www.sherwin-williams.com/#sle.
 - 2) 2nd and 3rd Coat: Sherwin-Williams ProMar 200 Zero VOC Eg-Shel, B20-2600 Series: www.sherwin-williams.com/#sle.
 - c. Low Sheen Finish:
 - 1) 1st Coat: Sherwin-Williams ProMar 200 Zero VOC Interior Latex Primer, B28W2600: www.sherwin-williams.com/#sle.
 - 2) 2nd and 3rd Coat: Sherwin-Williams ProMar 200 Zero VOC Latex Low Gloss Eg-Shel, B41-1950 Series: www.sherwin-williams.com/#sle.
 - d. Flat Finish:
 - 1) 1st Coat: Sherwin-Williams ProMar 200 Zero VOC Interior Latex Primer, B28W2600: www.sherwin-williams.com/#sle.
 - 2) 2nd and 3rd Coat: Sherwin-Williams ProMar 200 Zero VOC Latex Flat, B30-2600 Series: www.sherwin-williams.com/#sle.
 2. Epoxy Systems, Water Based Catalyzed Epoxy: **ONLY WHERE SPECIFICALLY CALLED FOR IN DRAWINGS**
 - a. Eg-Shel/Low Luster Finish:
 - 1) 1st Coat: Sherwin-Williams ProMar 200 Zero VOC Interior Latex Primer, B28W2600: www.sherwin-williams.com/#sle.
 - (a) 4 mils wet, 1.5 mils dry per coat.
 - 2) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Pre-Catalyzed Waterbased Epoxy, K45 Series: www.sherwin-williams.com/#sle.
 - (a) 4 mils wet, 1.5 mils dry per coat.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove mildew from impervious surfaces by scrubbing with solution of water and bleach. Rinse with clean water and allow surface to dry.
- D. Gypsum Board: Fill minor defects with filler compound; sand smooth and remove dust prior to painting.
- E. Aluminum: Remove surface contamination and oil; wash with solvent according to SSPC-SP 1.
- F. Galvanized Surfaces:
 - 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- G. Ferrous Metal:
 - 1. Solvent clean according to SSPC-SP 1.
 - 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Prime bare steel surfaces.
 - 3. Remove rust, loose mill scale, and other foreign substances using methods recommended by paint manufacturer and blast cleaning in accordance with SSPC-SP 6/NACE No.3. Protect from corrosion until coated.
- H. Wood: Remove dust, grit, and foreign matter. Scrape, sand, and spot prime knots and pitch streaks. Fill nail holes and imperfections with wood filler and sand smooth.

3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's written instructions.
- C. Apply coatings at spread rate required to achieve manufacturer's recommended dry film thickness.
- D. Regardless of number of coats specified, apply additional coats until complete hide is achieved.

3.04 PRIMING

- A. Apply primer to all surfaces unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.
- B. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to top coat manufacturers.

3.05 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. Clean surfaces immediately of overspray, splatter, and excess material.
- C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.06 PROTECTION

- A. Protect finished coatings from damage until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 099000

**SECTION 104400
FIRE PROTECTION SPECIALTIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Wood blocking product and execution requirements.

1.03 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2024.
- B. FM (AG) - FM Approval Guide; Current Edition.
- C. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.
- D. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide extinguisher operational features.
- C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.05 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Extinguishers:
 - 1. Activar Construction Products Group, Inc. - JL Industries; Cosmic Extinguisher - Multipurpose Chemical: www.activarcpg.com/#sle.
 - 2. Larsens Mfg. Co - Model MP-10.
 - 3. Or Approved Equal
- B. Fire Extinguisher Cabinets and Accessories:
 - 1. Activar Construction Products Group, Inc. - JL Industries; Ambassador Series: www.activarcpg.com/#sle.
 - 2. Larsen's Manufacturing Co; Architectural Series, Vertical Duo: www.larsensmfg.com/#sle.
 - 3. Or Approved Equal

2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
 - 1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.
- B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
 - 1. Class: A:B:C type.

2. Size: 10 pound.
3. Temperature range: Minus 40 degrees F to 120 degrees F.

2.03 FIRE EXTINGUISHER CABINETS

- A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
- B. Cabinet Construction: Non-fire rated.
 1. Formed primed steel sheet; 0.036 inch thick base metal.
- C. Cabinet Configuration: Semi-Recessed
 1. Size to accommodate accessories.
 2. Trim: Flat square edge, with 1-1/4" inch wide face.
 3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.
- D. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinges.
- E. Door Glazing: Float glass, clear, 1/8 inch thick, and set in resilient channel glazing gasket.
- F. Door Handle: Recessed type
- G. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- H. Fabrication: Weld, fill, and grind components smooth.
- I. Finish of Cabinet Exterior Trim and Door: Baked enamel, color as selected.
- J. Finish of Cabinet Interior: White colored enamel.

2.04 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, galvanized and enamel finished.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure rigidly in place.
- C. Place extinguishers in cabinets.

END OF SECTION 104400

**SECTION 133419
METAL BUILDING SYSTEMS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufacturer-engineered, shop-fabricated structural steel building frame.
- B. Metal wall and roof panels including soffits and gutters and downspouts.
- C. Exterior doors and windows.

1.02 RELATED REQUIREMENTS

- A. Section 079200 - Joint Sealants: Sealing joints between accessory components and wall system.
- B. Section 081113 - Hollow Metal Doors and Frames.
- C. Section 083613 - Sectional Doors.
- D. Section 072116 - Metal Building Blanket Insulation

1.03 REFERENCE STANDARDS

- A. AISC 360 - Specification for Structural Steel Buildings; 2022, with Errata (2025).
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2023.
- D. ASTM C827/C827M - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures; 2023.
- E. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
- F. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- G. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).
- H. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- I. IAS AC472 - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems; 2024.
- J. MBMA (MBSM) - Metal Building Systems Manual; 2024.
- K. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on profiles, component dimensions, fasteners.
- C. Shop Drawings: Indicate assembly dimensions, locations of structural members, connections; wall and roof system dimensions, panel layout, general construction details, anchors and methods of anchorage, and installation; framing anchor bolt settings, sizes, locations from datum, and foundation loads; indicate welded connections with AWS A2.4 welding symbols; indicate net weld lengths; provide professional seal and signature.
- D. Samples: Submit two samples of precoated metal panels for each color selected, 2 by 2 inch in size illustrating color and texture of finish.

- E. Erection Drawings: Indicate members by label, assembly sequence, and temporary erection bracing.
- F. Manufacturer's Qualification Statement: Provide documentation showing metal building manufacturer is accredited under IAS AC472.
 - 1. Include statement that manufacturer designs and fabricates metal building system as integrated components and assemblies, including but not limited to primary structural members, secondary members, joints, roof, and wall cladding components specifically designed to support and transfer loads and properly assembled components form a complete or partial building shell.
- G. Erector's Qualification Statement.
- H. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

1.06 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural components, develop shop drawings, and perform shop and site work under direct supervision of a Professional Structural Engineer experienced in design of this type of work.
 - 1. Design Engineer Qualifications: Licensed in Arkansas.
 - 2. Comply with 2021 Arkansas Fire Prevention Code (2021 International Building Code) for submission of design calculations as required for acquiring permits.
 - 3. Cooperate with regulatory agency or authorities having jurisdiction (AHJ), and provide data as requested.
- B. Perform work in accordance with AISC 360 and MBMA (MBSM).
- C. Manufacturer Qualifications: Company specializing in the manufacture of products similar to those required for this project.
 - 1. Not less than three years of documented experience.
- D. Erector Qualifications: Company specializing in performing the work of this section approved by manufacturer.
- E. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Provide 20 year manufacturer warranty for weather tightness, substrate, and finish..
 - 1. Include coverage for exterior pre-finished surfaces to cover pre-finished color coat against chipping, cracking or crazing, blistering, peeling, chalking, or fading. Include coverage for weather tightness of building enclosure elements after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Buildings Systems:
 - 1. Butler Manufacturing Company: www.butlermfg.com/#sle.
 - 2. Ceco Building Systems: www.cecobuildings.com/#sle.
 - 3. Chief Buildings: www.chiefbuildings.com/#sle.
 - 4. Kirby Building Systems, a Nucor Company: www.kirbybuildingsystems.com/#sle.
 - 5. Metallic Building Systems: www.metallic.com/#sle.
 - 6. Nucor Building Systems: www.nucorbuildingsystems.com/#sle.
 - 7. Red Dot Buildings: www.reddotbuildings.com/#sle.
 - 8. VP Buildings: www.vp.com/#sle.
 - 9. Pinnacle Structures, Inc.: www.pinnaclestructures.com
 - 10. : www.cowellsteel.com/
 - 11. Or Approved Equal (Refer to 012500)

2.02 ASSEMBLIES

- A. Single span rigid frame.
- B. Bay Spacing: Refer to Drawings.
- C. Primary Framing: Rigid frame of rafter beams and columns, canopy beams, and wind bracing.
- D. Secondary Framing: Purlins, and other items detailed.
- E. Wall System: Preformed metal panels of vertical profile, with sub-girt framing/anchorage assembly, insulation, and liner sheets, and accessory components.
- F. Roof System: Preformed metal panels oriented parallel to slope, with sub-girt framing/anchorage assembly and insulation, and accessory components.
- G. Roof Slope: Refer to Drawings.

2.03 PERFORMANCE REQUIREMENTS

- A. See section 072116 for Insulation Requirements
- B. See structural drawings for structural requirements
- C. Provide drainage to exterior for water entering or condensation occurring within wall or roof system.

2.04 MATERIALS - FRAMING

- A. See structural drawings for structural and fastening materials requirements.
- B. Primer: SSPC-Paint 20 zinc rich.
- C. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
 - 2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.
 - 3. Height Change, Plastic State: When tested in accordance with ASTM C827/C827M:
 - a. Maximum: Plus 4 percent.
 - b. Minimum: Plus 1 percent.

2.05 MATERIALS - WALLS AND ROOF

- A. Steel Sheet: ASTM A792/A792M aluminum-zinc alloy coated to AZ50/AZM150.
- B. Joint Seal Gaskets: Manufacturer's standard type.
- C. Fasteners: Manufacturer's standard type, galvanized to comply with requirements of ASTM A153/A153M, finish to match adjacent surfaces when exterior exposed.
- D. Sealant: Manufacturer's standard type.
- E. Trim, Closure Pieces, Caps, Flashings, Gutters, Downspouts, Rain Water Diverter, Fascias, and Infills: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

2.06 COMPONENTS

- A. Doors and Frames: Manufacturer's standard where noted
- B. Doors and Frames: See Section 081113.
- C. Overhead Doors: See Section 083613.
- D. Wall Louvers: Refer to Mechanical Drawings

2.07 FABRICATION - FRAMING

- A. Fabricate members in accordance with AISC 360 for plate, bar, tube, or rolled structural shapes.
- B. Anchor Bolts: Formed with bent shank, assembled with template for casting into concrete.
- C. Provide wall opening framing for doors, windows, and other accessory components.

2.08 FABRICATION - WALL AND ROOF PANELS

- A. Siding:
 - 1. R-panel profile, 1-1/4 inch rib height, exposed fastener, minimum 26 gauge.
 - 2. Finish: 70% PVDF fluoropolymer (Kynar 500 or Hylar 5000), color selected by Architect
- B. Roofing:
 - 1. Trapezoidal standing seam panel, 3 inch rib height, mechanically seamed, concealed clip fastener.
 - 2. Finish: 70% PVDF fluoropolymer (Kynar 500 or Hylar 5000), color selected by Architect.
- C. Liner Panel:
 - 1. R-panel profile, minimum 24 gauge, exposed fastener, lapped edges.
 - 2. Finish: manufacturer's standard polyester coating, color selected by Architect.
 - 3. Provide additional horizontal girts at equipment mounting locations as indicated on drawings or as necessary.
- D. Girts/Purlins: Rolled formed structural shape to receive siding, roofing and liner sheet.
- E. Internal and External Corners: Same material thickness and finish as adjacent material, profile brake formed to required angles.
- F. Flashings, Closure Pieces, Fascia: Same material and finish as adjacent material, profile to suit system.
- G. Fasteners: To maintain load requirements and weather tight installation, same finish as cladding, non-corrosive type.
- H. Flexible Closure Strips: Closed-cell, expanded cellular rubber, self-extinguishing, cut or premolded to match corrugation configuration of roofing and siding sheets. Provide where indicated and necessary to ensure weather tight construction, as well as at base of wall panels to prevent entry by rodents and vermin..

2.09 FABRICATION - GUTTERS AND DOWNSPOUTS

- A. Fabricate of same material and finish as roofing metal.
- B. Form gutters and downspouts of manufacturer standard profile and size to collect and remove water. Fabricate with connection pieces.
- C. Form sections in maximum possible lengths. Hem exposed edges. Allow for expansion at joints.
- D. Fabricate support straps of same material and finish as roofing metal, color as selected.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that foundation, floor slab, mechanical and electrical utilities, and placed anchors are in correct position

3.02 ERECTION - FRAMING

- A. Erect framing in accordance with AISC 360.
- B. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent bracing. Locate braced bays as indicated.
- C. Set column base plates with non-shrink grout to achieve full plate bearing.
- D. Do not field cut or alter structural members without approval.
- E. After erection, prime welds, abrasions, and surfaces not shop primed.

3.03 ERECTION - WALL AND ROOF PANELS

- A. Install in accordance with manufacturer's instructions.

- B. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.
- C. Fasten cladding system to structural supports, aligned level and plumb.
- D. Locate end laps over supports. End laps minimum 2 inches. Place side laps over bearing.
- E. Provide expansion joints where indicated.
- F. Install sealant and gaskets, providing weather tight installation.

3.04 ERECTION - GUTTERS AND DOWNSPOUTS

- A. Rigidly support and secure components. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts.
- B. Slope gutters minimum 1/16"/ft
- C. Furnish gutter supports spaced at 36" on center maximum.
- D. Fabricate, attach and anchor gutter to guard against ice and snow damage.
- E. Install splash pads under each surface-draining downspout (refer to drawings for locations).

3.05 INSTALLATION - ACCESSORY COMPONENTS IN WALL SYSTEM

- A. Install door frames, doors, overhead doors, and windows and glass in accordance with manufacturer's instructions.

END OF SECTION 133419

**SECTION 311100
SITE PREPARATION & CLEARING**

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Removal of miscellaneous existing site appurtenances.
 - 2. Protection and/or removal of trees and other vegetation.
 - 3. Topsoil stripping
 - 4. Clearing, grubbing and mowing

1.02 RELATED REQUIREMENTS

- A. Construction Drawings

1.03 PROTECTION

- A. Provide protection necessary to prevent damage to existing improvements, trees, or vegetation light poles, power poles, fire hydrants, etc., indicated on the Contract Documents are to remain.
- B. Protect improvements on adjoining properties and on Owner's property.
- C. Restore damaged improvements to original condition as acceptable to parties having jurisdiction.
- D. Conduct site clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction. Streets and roadways shall be thoroughly cleaned and/or swept on a daily basis or more frequently as required by the governing authority.
- E. Provide traffic control as required, in accordance with the U.S. Department of Transportation "Manual of Uniform Traffic Control Devices" and the state highway department requirements.
- F. Unknown Utility Lines: All known utilities have been shown according to the information available. Contractor is responsible for coordinating with local utility companies and owner to locate and confirm all buried utilities in the construction area. Contractor is to notify Architect immediately if unknown lines, pipes, or other underground objects are encountered.
- G. Mow and remove weeds and small undergrowth vegetation in the construction area as defined on the drawings.

PART 2 PRODUCTS NOT USED

PART 3 EXECUTION

3.01 GENERAL PROCEDURE

- A. Unless otherwise indicated on the drawings, remove trees, shrubs, grass, other vegetation, improvements, or obstructions interfering with installation of new construction. Removal includes digging out stumps and roots. Dispose of off-site. Do not remove items elsewhere on site or premises unless specifically indicated. Notify Architect prior to clearing if any item called for as "removed by Owner" remains upon issuance of Notice to Proceed.
- B. Strip topsoil to whatever depths encountered to prevent intermingling with underlying subsoil or other objectionable material. Cut heavy growths of grass from areas before stripping. Topsoil shall consist of sandy clay surficial soil found in depth of not less than 6". Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones and other objects over 2" in diameter, weeds, roots, and other objectionable material.
- C. Completely remove stumps, roots, and other debris below proposed subgrade elevation. Fill depressions caused by clearing and grubbing operations with satisfactory soil material as per requirements of Section 31 23 00 unless further excavation or earthwork is required.

- D. Remove existing above grade and below grade improvements and abandoned underground piping or conduit necessary to permit construction and other work.
- E. Retain boxing and protection for items to remain in construction until finish grade is completed. Repair any damage that occurs to these items without expense to the Owner.

END OF SECTION 311100

SECTION 312200 SITE GRADING

PART 1 GENERAL

1.01 RELATED SECTIONS

- A. Section 31 23 00, Excavation and Backfill.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 GENERAL

- A. Do all cutting, filling, compacting, and rough grading required to bring entire project area within the limits of construction shown to indicated grades.
- B. Subgrades should be consistent with finish grades shown, allowing for an uniform layer of topsoil, properly graded to drain away from the building. Provide smooth ditches or swales as shown to carry water away from the project area without standing.
- C. Contractor shall be responsible for setting all grades and slope stakes; and locating all buildings, drives, parking areas, walks and other site items as shown on drawings.
- D. Control grading operations to prevent water from running into excavated areas.

3.02 ENVIRONMENTAL REQUIREMENTS

- A. Construct temporary erosion control systems as shown on Construction Drawings or as directed by "Storm Water Pollution Prevention Plan" (SWPPP) to protect adjacent properties and water resources from erosion and sedimentation.
- B. In event that site work on this project will disturb 1.0 or more acres, Contractor shall not begin construction without posting on site the "National Pollution Discharge Elimination System" (NPDES) permit governing discharge of storm water from site for entire construction period. NPDES permit requires SWPPP to be in place during construction.
- C. Contractor shall be totally responsible for conducting storm water management practices in accordance with NPDES permit and for enforcement action taken or imposed by Federal or State agencies, including cost of fines, construction delays, and remedial actions resulting from Contractor's failure to comply with provisions of NPDES permit.
- D. All grading operations are operations that are to be in strict compliance with the provisions of the Arkansas Water and Air Pollution Control Act Act 472 of 1949 as amended, AR Ann. 8-4-101 et seq.), and the Federal Clean Water Act 33 U.S.C. 1251 et. seq. Contractor shall be responsible for submitting application to state authority and obtaining permits.
- E. It shall be the Contractor's responsibility to comply with current OSHA and other local, state, and federal requirements for all excavation and fill operations, and other areas of the work.
- F. Contractor to keep dust on site to a minimum the entire duration of construction by means of regular watering. This will include dust created by grading operations, vehicular traffic, and wind.

END OF SECTION 312200

SECTION 312300 EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

- A. Furnish labor and materials for all work under this section.

1.02 RELATED SECTIONS

- A. Section 31 11 00 - Site Preparation
- B. Section 31 22 00 - Site Grading
- C. Section 32 92 23 – Sodding

1.03 SOILS VERIFICATION

- A. The Owner shall be responsible for having Terracon, the registered soils engineer, present on site to examine and conduct tests of soils preparation and construction per IBC required special inspections including filling and grading. The soils engineer shall inspect excavations for foundations, footings, and paving areas perform bearing testing, and will submit a report to general contractor with a copy to the Architect stating conditions observed meet or exceed the limits found in the specifications and are consistent with acceptable construction practices. Construction shall not begin before report is received by the Architect. Contractor shall be responsible for any costs for meeting these requirements. Contractor shall coordinate inspections, testing, and observation with soils engineer.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 TOPSOIL AND UNSUITABLE SOILS EXCAVATION

- A. Strip off topsoil and unsuitable fill material (refer to soils report), at new building, paving, drives and equipment pad areas. Remove all vegetation, rocks, and any soft soils. Haul away and dispose of unsuitable fill material and excess excavated topsoil material off site. –OR- Stock pile topsoil on-site as instructed in specification Section 31 11 00. Excavate to minimum thicknesses as recommended by the Soils Engineer.
- B. After stripping unsuitable soils as described in soils report to required depth (refer to "Preparation Of Original Earth" section), the entire building area, drives, walks, and all areas to be paved shall be proof-rolled with a loaded rubber-tired tandem-axle dump truck or scraper weighing at least 25 tons, and any soft soils are to be undercut and replaced with properly compacted fill. Soils engineer shall be present when proof rolling is being performed.
- C. After proofrolling, scarify to a depth of at least 6" adjusting the moisture content to within 2 percent of optimum moisture content, then compacted to specified density.
- D. Retain sufficient topsoil on site to accomplish final grading.
-OR-
- E. Store topsoil on site per section 31 11 00.
-OR-
- F. Store sufficient quantity of topsoil on site per section 31 11 00 to accomplish final grading for building phase. (Use for grading [portion of a 2-part contract-Delete if single building contract.]
- G. Use no topsoil for compacted fill inside building perimeter.
- H. Use no on-site excavated material for fill inside building perimeter, below footings, or behind retaining walls.
- I. If insufficient topsoil on site, furnish good topsoil, approved by Landscape Architect, for finish grading and planting areas.

3.02 EARTH EXCAVATION

- A. A. Excavation for walks, pavements, curbs, gutters, roof drainage, conductors, retaining walls, building volume below grade, underfill below slabs on grade, foundation walls, footings and other items indicated by drawings or otherwise necessary for construction.
- B. Excavate to elevations and dimensions indicated, plus minimum, yet sufficient, space to permit erection of forms, shoring, drain tile waterproofing, masonry and the inspection of foundations.
- C. Dress earth banks and bottoms for footings forms. Bear footings on engineered fill
- OR - undisturbed soil at elevations shown on drawings.
- D. Insure all exterior footing excavations are below frost line at a minimum of 24" below final finish grade.
- E. If footings occur in poor materials at footing depths indicated (as determined by soils engineer), over excavate as required and compact with approved fill compacted to 95% of standard Proctor density (ASTM D-698).
- F. Remove any existing foundations, footings, piers, and other construction found in the area of new construction.
- G. Material to be excavated is assumed to be earth and other materials that can be removed with a Caterpillar D-8 Dozer with single tooth ripper (mass grading), a Caterpillar 330B tracked excavator equipped with rock teeth (utility trenches) or equipment of similar power and capability. If unanticipated rock is encountered within limits of excavation, contractor shall immediately notify Architect and not proceed further until instructions are given and measurements made for purpose of establishing volume of rock excavation. Rock is defined as any stone or boulders that cannot be removed with the use of a Caterpillar D-8 Dozer with single tooth ripper (mass grading), a Caterpillar 330B tracked excavator equipped with rock teeth (utility trenches) or equipment of similar power and capability.
- H. Only as a last resort, should explosives be used. Should explosives be necessary, work shall be done by experienced powder men using small charges and in strict accordance with all regulations governing this work. Contractor secure permits required for such work and correct any damage to foundations and/or property caused by improper use of explosives at his expense. Architect to be notified and approval granted before explosives are allowed.
- I. Specifically notify Architect and Geotechnical Engineer to inspect excavations, and receive his approval before placing concrete.
- J. Not Used.
- K. Not Used.

3.03 PREPARATION OF ORIGINAL EARTH

- A. Floor slab areas should be stripped of all surface vegetation, topsoil and unsuitable soil to depths as called for in paragraph 3.1. Any soft or unstable materials should be removed and replaced with engineered fill. The subgrade, exposed after stripping and completing any cuts, should be scarified to a minimum depth of 8 inches and moisture conditioned to level within 2 percent of the materials' optimum moisture content. The subgrade should then be compacted to at least 98 percent of the material's maximum laboratory dry density determined in accordance with ASTM Specification D-698, the Standard Proctor procedure.
- B. Remove all topsoil below areas to receive sidewalks. Bear concrete sidewalks on natural earth or minimum 12" engineered fill as required to meet elevations as shown on grading plan.

3.04 3.4 FILL MATERIAL AND GRADING

- A. Placing of fill materials and grading shall be in accordance with the Geotech Engineer's recommendations (Terracon).
- B. Haul in additional earth required. Should there be an excess of excavated material, haul it to area off site.

- C. Haul away and dispose of any surface rubble and debris.
- D. Remove any groundwater accumulated in excavations prior to placement of concrete. Soils Engineer to verify conditions are acceptable and bearing capacity is at or exceeds specified bearing pressure

3.05 SHOT ROCK MATERIAL AND INSTALLATION

(USE ONLY WHEN RECOMMENDED BY GEOTECHNICAL ENGINEER AND APPROVED BY ENGINEER)

- A. Shotrock shall be quarried sandstone,, Limestone, or other hard durable stone with a percent wear no greater than 50% by Los Angeles Test (AASHTO T 96) with angular or fractured faces with pieces no greater than 12-14 inches in any dimension, more than 40% greater than 8 inches in size, 10-30% passing the 3 inch sieve and no more than 15% passing the 0.5 inch sieve.

Screen Size% Passing

12-14 inch 100

8 inch 60-100

3 inch 10-30

0.5 inch 0-15

- B. Excavate to the planned depth.
- C. Place first shot rock layer no deeper than the largest rock.
- D. Force the shot rock into the soft soil until it becomes buried or refuses to penetrate into the soil.
- E. Perform additional layers as described in #C and #D above until the shot rock is no longer accepted by the soil (this operation should be witnessed by the inspector).
- F. Place and compact 1 inch base rock on top of the stabilized shot rock to fill any voids present.
- G. Continue with planned construction.

3.06 CONTROLLED LOW STRENGTH MATERIAL (CLSM) / FLOWABLE FILL AND INSTALLATION

(USE ONLY WHEN RECOMMENDED BY GEOTECHNICAL ENGINEER AND APPROVED BY ENGINEER)

- A. CLSM fill to be 150 PSI minimum or meeting DOT specifications.
- B. Excavate or over-excavate unsuitable soil per soils engineer's instruction to the required depth.
- C. Following verification of required bearing by soils engineer, place CLSM to proper depth for footing bearing elevation
- D. Construction shall continue after material has taken initial set, is stable, and does not displace under equipment; minimum of 24 hours.

3.07 TOPSOIL

- A. After rough grading is completed and approved, scarify subsoil in areas to be lawns to a depth of 4" and place a layer of topsoil there over, providing additional topsoil required to give thickness specified.
- B. Topsoil material: Fertile, natural topsoil, typical of locality, free from stones, debris, clay and weeds.
- C. Topsoil minimum thicknesses: 4" seeded and sodded areas, 12" landscaped areas. (Adjust final cut and fill depth as required to accommodate lawn type.)
- D. Fill to finish grade indicated, eliminate water pockets and irregularities, ready to receive seed or sod.
- E. Finish site grading to be smooth throughout contours. Abrupt changes, uneven, or undulating grading will not be accepted unless shown as such on grading plan.

3.08 EXTENT OF FINISH GRADING

- A. Cut, fill and grade to extent of contours and elevations indicated by drawings.
- B. At building perimeter, keep finish grades generally 6" below finish floor elevation with exception of areas at drives and walks.

3.09 QUANTITY VERIFICATION

- A. Contractor to be responsible for costs incurred by Surveyor and/or Geotechnical Engineer, or other qualified individuals to verify quantity of rock or additional unsuitable soil removed.

3.10 OBSERVATION AND SPECIAL INSPECTIONS

- A. Soils cut and fill operations shall be observed periodically by the Geotechnical Engineer and Architect prior to placing of concrete footings and slabs, and paving. Inspection of soils bearing pressure, verification of soils, and cut/fill operations for conformance to the construction documents and IBC shall be performed by the designated third party Special Inspector.

TEST REQUIRED:

- 1. Contractor shall coordinate compaction tests as recommended by the geotech engineer (Terracon).

END OF SECTION 312300

SECTION 312500
STORM WATER POLLUTION PREVENTION PLAN AND EROSION CONTROL

PART 1 GENERAL

1.01 1.1 SCOPE

- A. A. PURPOSE OF SWPPP: This SWPPP covers the storm water management practices that the Construction Manager shall employ in accordance with the NPDES permit governing storm water discharges during construction, and in accordance with erosion control practices specified in other sections.
- B. B. The Construction Manager will be responsible for securing and maintaining the SWPPP Plan, if required.
- C. C. Erosion Control
 - 1. 1. The Contractor shall provide Erosion Control measures in accordance with the Construction Drawings, and requirements of the SWPPP.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 NOT USED

END OF SECTION 312500

SECTION 313116 TERMITE CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Soil-applied chemical treatment.

1.02 RELATED REQUIREMENTS

- A. Section 312200 - Grading.

1.03 REFERENCE STANDARDS

- A. Title 7, United States Code, 136 through 136y - Federal Insecticide, Fungicide and Rodenticide Act; 2022.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate toxicants to be used, composition by percentage, dilution schedule, intended application rate.
- C. Test Reports: Indicate regulatory agency approval reports when required.
- D. Manufacturer's Instructions: Indicate caution requirement.
- E. Executed warranty.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing this type of work and:
 - 1. Having minimum of three (3) years documented experience.
 - 2. Licensed in Arkansas.
 - 3. Contractor shall provide Arkansas State Plant Board 48 hours advance notice of anticipated application time
 - a. The Contractor shall provide the Architect with a copy of the Arkansas State Plant Board's Notice of Inspection within 48 hours of issuance
 - 1) Failure to notify the Arkansas State Plant Board and provide the Architect a copy of the Notice of Inspection will result in retreatment at the Contractor's time and expense.
 - 2) Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination" to schedule application of termiticide products.

1.06 WARRANTY

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

PART 2 PRODUCTS

2.01 MATERIALS

2.02 CHEMICAL SOIL TREATMENT

- A. Toxicant Chemical: EPA Title 7, United States Code, 136 through 136y approved; synthetically color dyed to permit visual identification of treated soil.
- B. Diluent: Recommended by toxicant manufacturer.
- C. Manufacturers:
 - 1. Bayer Environmental Science Corp: www.backedbybayer.com/pest-management/#sle.
 - 2. FMC Professional Solutions; Dragnet: www.fmcprosolutions.com/#sle.
 - 3. Syngenta Professional Products: www.syngentaprofessionalproducts.com/#sle.
 - 4. ICI Americas, Inc.; Torpedo.
 - 5. Substitutions: See Section 016000 - Product Requirements.
- D. Mixes: Mix toxicant to manufacturer's instructions.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that soil surfaces are unfrozen and dry to absorb toxicant, ready to receive treatment.
- B. Verify final grading is complete; see Section 312200.
- C. Verify utility trenches are wide enough to receive application.

3.02 APPLICATION

- A. Comply with manufacturer's written instructions.

3.03 APPLICATION - CHEMICAL TREATMENT

- A. Spray apply toxicant in accordance with manufacturer's instructions.
- B. Apply toxicant at following locations:
 - 1. Under Slabs-on-Grade.
 - 2. At Both Sides of Foundation Surface.
- C. Under slabs, apply toxicant immediately prior to installation of vapor barrier.
- D. At foundation walls, apply toxicant immediately prior to finish grading work outside foundations
- E. Apply extra treatment to structure penetration surfaces such as pipe or ducts, and soil penetrations such as grounding rods or posts.
- F. Re-treat disturbed treated soil with same toxicant as original treatment.
- G. If inspection or testing identifies the presence of termites, re-treat soil and re-test.

3.04 PROTECTION

- A. Do not permit soil grading over treated work.
- B. Protect applications from damage after completion. Repair disturbances according to manufacturer's written instructions.

END OF SECTION 313116

**SECTION 321116
AGGREGATE BASE COURSE**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop; 2025.

1.02 SCOPE

- A. This Section covers the materials for crushed stone base course to be used as a base material for paving.
- B. This material may also be used for embedment for water and sewer utility lines.

1.03 RELATED WORK

- A. Arkansas Department of Transportation Standard Specification for Highway Construction

1.04 QUALITY ASSURANCE

- A. The moisture density relations of material shall be determined in the laboratory in accordance with AASHTO T 180.
- B. Compacted base shall be tested for depth and any deficiencies corrected by scarifying, placing additional material, mixing, reshaping, and re-compacting to the specified density, as directed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Aggregate Base Course shall be in accordance with SECTION 303 and Table 303-1 of the Arkansas Department of Transportation Standard Specifications.

PART 3 - EXECUTION

3.01 BASE COURSE

- A. The base course material shall be placed on the completed and approved subgrade, that has been bladed to substantially conform to the grade and cross section shown on the Drawings.
- B. The sub-grade shall be prepared as specified and shall be free from an excess or deficiency of moisture at the time of placing the base course.
- C. The subgrade shall also comply, where applicable, with the requirements of other items that may be contained in the contract that provide for the construction, reconstruction or shaping of the subgrade or the reconstruction of the existing base course.
- D. Base course material shall not be placed on a frozen subgrade.
- E. The crushed stone shall be placed on the subgrade or previous base course layer in lifts not to exceed 4" and spread uniformly to such depth and lines that when compacted it will have the thickness as follows:
- F. The spreading shall be done the same day that the material is hauled, and shall be performed in such a manner that no segregation of coarse and fine particles nor nests or hard areas caused by dumping the crushed stone on the subgrade will exist.
- G. To insure proper mixing, the crushed stone shall be bladed across the roadbed before being spread. Care must be taken to prevent mixing of subgrade or shoulder material with the base course material in the blading and spreading operation
- H. The crushed stone shall be substantially maintained at optimum moisture during the mixing, spreading, and compacting operations, water being added or the material aerated as may be necessary.
- I. The specified grade and section shall be maintained by blading throughout the compaction operation.

- J. The material in each course shall be compacted to a density, as determined by AASHTO T 238, Method B, of not less than 95% of the maximum laboratory density determined in the laboratory by AASHTO T 180, Method D. The aggregate shall be compacted across the full width of application.
- K. The crushed stone shall be compacted across the full width of application.
- L. The compacted base course shall be tested for depth and any deficiencies corrected by scarifying, placing additional material, mixing, reshaping, and re-compacting to the specified density, as required by the Architect.
- M. Compaction testing shall be as specified in Section 31 23 00

END OF SECTION 321116

**SECTION 321313
PORTLAND CEMENT CONCRETE PAVING**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types); 2023.

1.02 SUMMARY

- A. Arkansas Highway and Transportation Department; specifications and those noted on the drawings shall supersede respective items contained in this section.
- B. Related Sections:
 - Section 31 23 00: Earthwork
 - Section 32 11 16: Aggregate Base Course

1.03 PROJECT CONDITIONS

- A. Traffic Control:
 - Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Utilize flagmen, barricades, warning signs, and warning lights as required.

1.04 REFERENCES

- A. Arkansas Department of Transportation Standard Specifications

PART 2 PRODUCTS

2.01 MATERIALS

- A. Forms:
 - 1. Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects.
 - 2. Use flexible spring steel forms or laminated boards to form radius bends as required.
 - 3. Form Release Agent: Coat forms with non-staining type coating that will not discolor or deface surface of concrete.
- B. Concrete Materials: Comply with requirements of applicable DIVISION 5, SECTION 505 of the Arkansas Department of Transportation Standard Specifications.
- C. Joint Fillers: Resilient pre-molded bituminous impregnated fiberboard units complying with ASTM D1751 FS HH-F-341, Type II, Class A; or AASHTO M 153, Type I.
- D. Curing Compound: FS TT-C-800, with a minimum of 17% solids content.

2.02 MIXING

- A. Concrete Mix, Design and Testing shall be in accordance with SECTION 802 of the Arkansas Department of Transportation Standard Specifications and Table 802-1 for Class S Concrete.

PART 3 EXECUTION

3.01 PREPARATION

- A. Surface Preparation: Remove loose material from compacted base material surface immediately before placing concrete.
- B. Proof-roll prepared base material surface to check for unstable areas. The paving work shall begin after the unsuitable areas have been corrected and are ready to receive paving. Compaction testing for the base material shall be completed prior to the placement of the paving.

3.02 CONCRETE INSTALLATION

- A. Form Construction:

1. Set forms to required grades and lines, rigidly braced and secured. Install sufficient quantity of forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.
 2. Check completed form work for grade and alignment to following tolerances:
 3. Top of forms not more than 1/8" in 10'-0".
 4. Vertical face on longitudinal axis, not more than 1/4" in 10'-0".
 5. Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage.
 6. Reinforcement: Locate, place, and support reinforcement as specified in Division 3 sections.
- B. Concrete Placement:
1. Do not place concrete until base material and forms have been checked for line and grade. Moisten base material if required to provide uniform dampened condition at time concrete is placed. Concrete shall be placed around manholes or other structures until they are at the required finish elevation and alignment.
 2. Place concrete using methods which prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement or side forms. consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.
 3. Deposit and spread concrete in continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2 hours, place construction joint.

3.03 JOINT CONSTRUCTION

- A. Provide joints as shown on drawings and as specified, but in no case exceed requirements of ACI 302.1R and 316R code requirements.
- B. Construction expansion, weakened-plane (contraction), and construction joints true-to-line with face perpendicular to surface of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
- C. Weakened-Plane (Contraction) Joints: Provide weakened-plane (contraction) joints, sectioning concrete into areas at 15'-0" o.c. maximum each way. Construct weakened-plane joints for depth equal to at least 1/4 concrete thickness, as follows:
- D. Tooled Joints: Form weakened-plane joints in fresh concrete by grooving top portion with recommended cutting tool and finishing edges with jointer.
- E. Sawed Joints: Form weakened-plane joints using powered saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into hardened concrete as soon as surface will not be torn, abraded, or otherwise damaged by cutting action.
- F. Construction Joints:
 1. Place concrete joints at end of placements and at locations where placement operations are stopped for period of more than 1/2 hour, except where such placements terminate at expansion joints.
 2. Construct joints using standard metal keyway-section forms.
- G. Expansion Joints:
 1. Provide pre-molded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks, and other fixed objects.
 2. Locate expansion joints at 60'-0" o.c. maximum for each pavement lane.
- H. Joint Fillers:
 1. Extend joint fillers full-width and depth of joint, and not less than 1/2" or more than 1" below finished surface where joint sealer is indicated. If no joint sealer, place top of joint filler flush with finished concrete surface.
 2. Furnish joint fillers in one-piece lengths for full width being placed, wherever possible. Where more than one length is required, lace of clip joint filler sections together.
- I. Joint Sealants:

1. Exterior pavement joint sealants shall be composed of a non-priming, pourable, self-leveling type of a coal tar modified polyurethane, or a polyurethane, sealant suitable for use in pavements and sidewalks.

3.04 CONCRETE FINISHING

- A. After striking-off and consolidating concrete, smooth surface by screeding and floating. Adjust floating to compact surface and produce uniform texture.
- B. After floating, test surface for trueness with 10'-0" straightedge. Distribute concrete as required to remove surface irregularities, and re-float repaired areas to provide continuous smooth finish.
- C. Work edges of slabs, back top edge of gutter, and formed joints with an edging tool, and round to 1/2" radius. Eliminate tool marks on concrete surface.
- D. After completion of floating and troweling when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:
 1. Broom finish by drawing fine-hair broom across concrete surface perpendicular to line of traffic. Repeat operation if required to provide fine line texture. Inclined Slab Surfaces: Provide coarse, non-slip finish by scoring surface with stiff-bristled broom perpendicular to line traffic.
- E. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed.
- F. Protect and cure finished concrete paving using acceptable moist-curing methods.

3.05 CLEANING AND ADJUSTING

- A. Repair or replace broken or defective concrete, as directed.
- B. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials.
- C. Sweep concrete pavement and wash free of stains, discolorations, dirt, and other foreign material just prior to final inspection.

3.06 TESTING AND SAMPLING:

- A. Slump Tests: A minimum of two slump tests shall be made each day concrete is placed with one test being made at the time test cylinders are made. Slump tests are to be made in accordance with "Method of Test for Slump of Portland Cement Concrete" (ASTM C-143-78). Where slump exceeds five inches (5") or the average 28 day strength of the three test specimens falls below the strength specified (3000 p.s.i.) for the class of concrete tested, or below proportional minimum 7 day strengths, 2,400 psi the proportions, water content or temperature conditions shall be changed to secure the required properties, and, at the discretion of the Architect, portions of the structure containing such concrete shall be removed and replaced, or reinforced as necessary.
- B. Strength Tests: Compression strength test shall be performed in accordance with "Method of Test for Compressive Strength of Molded Concrete Cylinders" (ASTM C39-81). Samples for concrete cylinders shall be made in accordance with "Method of Sampling Fresh Concrete" (ASTM C172-82), and test cylinders shall be prepared and laboratory cured in accordance with "Method of Making and Curing Concrete Compression and Flexure Test in the Field" (ASTM C31-69).
- C. Cylinders: Three cylinders from the same batch shall be made for each 50 cubic yards or fraction thereof placed, but not less than three cylinders for each day of concrete operations shall be made. Location of batch as to placement on the subject shall be noted, and cylinders so designated. No tests shall be required for sidewalks. One cylinder shall be tested at 7 days and two at 28 days.
- D. A minimum of 3 cylinders shall be tested for each class of concrete used on the project and the average of any three consecutive strength tests at 28 days shall be equal to or greater than the

specified strength. Result of any individual strength test shall not be less than 500 p.s.i. of required fc.

- E. Contractor shall bear expense of all testing by a recognized licensed engineer.

END OF SECTION 321313

SECTION 321600 WALKS & CURBS

PART 1 GENERAL

1.01 SCOPE:

- A. Provide all materials, labor, equipment and related items necessary to complete the concrete walks and curbs as shown on the drawings.

1.02 RELATED SECTIONS

- A. Section 32 11 16: Aggregate Base Course.

PART 2 PRODUCTS/ MATERIALS

2.01 WALKS & CURBS:

- A. Concrete for Walks shall be in accordance with SECTION 633 of the Arkansas Department of Transportation Standard Specifications.
- B. Reinforcement shall be Sika-300 Fibermesh Additive (or approved equal) at a ration of 1.5 lbs. per Cubic Yard.
- C. Strength: 3,000 psi at 28 days in accordance with ACI and CRSI Standards, 3,500 for curbs.

2.02 EXPANSION JOINTS

- A. Expansion joint material shall be 1/2" pre-molded filler especially made for such use - not INSULATION or SHEATHING BOARD for all curbs and non-exposed aggregate walks and pavement.

PART 3 EXECUTION

3.01 CONCRETE WALKS

- A. Concrete walks shall be of one course construction 4 inches thick, and of widths shown on the drawings. Provide 1/8" per foot crown or cross slope in the direction of drainage. All steps are to drain freely. Provide tooled joints as shown on drawings.
- B. Expansion joints: Provide 1/2" transverse expansion joints, at walk junctions and intersections, at top and bottom of steps, and where walks abut curb returns, buildings, platforms or other fixed structures, or terminate at curbs. Expansion joints shall be at right angles to the slab and extend the full depth thereof. Pre-molded filler where called for shall extend to within 1/2" of the surface. Fill remaining void with sealant as specified in Section 07 92 00. Locate expansion joints in walks as shown on plans and nearly as practicable opposite those in abutting curbs, approximately 20' on center.
- C. Control Joints: Provide troweled joints 1/4 of slab depth where indicated on plans.
- D. Protection. Remove no forms for 24 hours after pouring concrete. Protect concrete walks and courtyards from pedestrian traffic for a period of three days after pouring.

3.02 WALKS AND CURB FINISH

- A. Finish Types shall be the following:
 - 1. 1. Light Broom Finish
- B. Light Broom Finish:
 - 1. After placing concrete paving, do not work the surface further until ready for floating.
 - 2. Begin floating when the surface water has disappeared and when the concrete has stiffened sufficiently to permit operation of a power- driven float, or both.
 - 3. Consolidate the surface with power-driven floats, or by hand-floating if the area is small or inaccessible to power units.
 - 4. Check and level the surface plane to a tolerance not exceeding 6mm in 3.28 yard when tested with a 3.28 yard straightedge placed on the surface at not less than two different angles.
 - 5. Cut down high spots and fill low spots.

6. Uniformly slope surfaces to drains where required.
7. Immediately after leveling, re-float the surface to a uniform, smooth, granular texture as approved by the Architect.
8. At this point, apply a light broom finish in one direction. Make sweeps uniform and continuous, keeping bristles clean after each sweep. Provide a small sample area for approval by Architect prior to finishing entire surface.

3.03 CONCRETE CURBS

- A. All machine poured curbs to be shape and profile shown on Drawings.
- B. Construct hand formed concrete curbs in small workable sections. Size and depth of curbs shall be generally 6" wide x 18" deep with sloped face, unless noted otherwise on Drawings.
- C. Provide 1/2 inch expansion joints, with pre-molded filler cut to shape of cross section at ends of all returns at 40 foot intervals, maximum. Align with sidewalk expansion joints where curb abuts sidewalk. Fill top 1/2" of joint with sealant as specified in section 07 92 00. Provide sawn control joints at 20' o.c., max. Fill with sealant.
- D. Tamp and screed concrete as soon as placed. Remove division plates and face forms as soon as practicable; fill any honeycombed places with 1:2 mortar and give exposed surfaces same finish as specified for concrete walks.
- E. Remove no forms, except face forms, for 24 hours after placing concrete. Protect against pedestrian traffic for three (3) days and against vehicular traffic for 14 days. Compact thoroughly and backfill behind curb. Place and compact fill behind curb as soon as practical.

3.04 CURB CUTS

- A. At streets, where indicated on Drawings, construct curbs to conform to shape and dimension as shown on the Drawings.
- B. Contractor is responsible for obtaining permit to cut curbs on highways and paying any fees associated with the same.

END OF SECTION 321600

**SECTION 323113
CHAIN LINK FENCES AND GATES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Chain link fence fabric and framework, 8 feet tall.
- B. Single swing gates with medium duty hardware, diagonal brace, bottom rail, and gate closer.
- C. Mechanical keyless gate lock hardware as specified in Section 32 31 13.16.

1.02 RELATED REQUIREMENTS

- A. Section 31 20 00 - Earth Moving: Excavation for post footings.
- B. Section 32 31 13.16 - Gate Locks: Mechanical keyless gate lock hardware.

1.03 REFERENCE STANDARDS

- A. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric; 2021.
- B. ASTM A824 - Standard Specification for Metallic-Coated Steel Marcellled Tension Wire for Use with Chain Link Fence; 2015 (2021).
- C. ASTM F626 - Standard Specification for Fence Fittings; 2020.
- D. ASTM F900 - Standard Specification for Industrial and Commercial Swing Gates; 2018.
- E. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework; 2020.
- F. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; 2023.
- G. CLFMI CLF-05 - Chain Link Fence Manufacturers Institute Product Manual; current edition.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data for fabric, framework, fittings, gate hardware, and closer.
- C. Shop Drawings: Layout plan showing post locations, gate locations, gate swing direction, and post footing details.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original bundles and rolls, labeled with product identification.
- B. Store materials off ground on blocking, protected from mud and moisture. Do not store galvanized pipe in contact with soil.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Chain Link Fence Systems:
 - 1. Merchants Metals: www.merchantsmetals.com.
 - 2. Master Halco: www.masterhalco.com.
 - 3. Ameristar Perimeter Security: www.ameristarfence.com.
 - 4. Substitutions: See Section 016000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Fence Height: 8 feet nominal, measured from finish grade to top of fence fabric.
- B. Framework: Comply with ASTM F1043 for industrial and commercial applications, Group IA (galvanized steel pipe).
- C. Coating: Hot-dipped galvanized, complying with ASTM F1083, throughout.

2.03 FENCE FABRIC

- A. Chain Link Fabric: Comply with ASTM A392, Class 1 zinc-coated (galvanized).
 - 1. Wire Gauge: 9 gauge, 0.148 inch diameter minimum.
 - 2. Mesh Opening: 2-inch diamond pattern.
 - 3. Selvage: Knuckled both top and bottom.
- B. Tension Wire: Comply with ASTM A824, Class 1 zinc-coated; 7 gauge 0.177 inch at bottom of fabric.

2.04 FENCE FRAMEWORK

- A. Posts: Hot-dipped galvanized steel pipe, complying with ASTM F1083.
 - 1. Line Posts: 2-3/8 inch O.D., Schedule 20 minimum; spaced 10 feet on center maximum.
 - 2. Terminal Posts (end, corner, and gate posts): 2-7/8 inch O.D., Schedule 20 minimum.
 - 3. Post Height: Set to achieve 8-foot nominal fence height above finish grade. Embed posts in concrete footings per shop drawings.
- B. Top Rail: 1-5/8 inch O.D. hot-dipped galvanized steel pipe, complying with ASTM F1083; continuous through line post caps, coupled at mid-span only.
- C. Fittings and Accessories: Comply with ASTM F626; hot-dipped galvanized steel.
- D. Post Footings: Concrete, 3,000 psi minimum at 28 days. Size per post manufacturer's requirements for post height and soil conditions; 24-inch diameter minimum.

2.05 GATES

- A. Gate Type: Single swing, as shown on drawings.
- B. Gate Frame: Hot-dipped galvanized steel pipe; comply with ASTM F900 and ASTM F1083.
 - 1. Frame Pipe: 1-7/8 inch O.D., Schedule 20 minimum.
 - 2. Bottom Rail: Provide horizontal bottom rail across full gate width.
 - 3. Diagonal Brace: Provide diagonal tension rod or pipe brace from top latch corner to bottom hinge corner to prevent racking.
- C. Gate Fabric: Match fence fabric specification.
- D. Gate Width and Height: As indicated on drawings.

2.06 GATE HARDWARE

- A. Hardware Duty: Medium duty, complying with ASTM F626 and ASTM F900.
- B. Hinges: Heavy malleable iron or pressed steel; offset to permit gate to open 180 degrees; provide two hinges per leaf for gates up to 6 feet tall, three hinges for gates exceeding 6 feet tall.
- C. Gate Latch: Mechanical keyless combination latch lock as specified in Section 32 31 13.16 - Gate Locks.
- D. Gate Closer: Hydraulic or mechanical gate closer, suitable for exterior use; adjust to close and latch gate from fully open position.
 - 1. Closer shall be rated for gate weight and size indicated; adjustable closing speed.
 - 2. Provide slam prevention to satisfy gate lock manufacturer's warranty requirements per Section 32 31 13.16.
- E. Finish: All hardware galvanized or otherwise corrosion-resistant; compatible with galvanized fence framework finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that layout, elevations, and underground utility locations have been confirmed before beginning work.
- B. Verify finish grades are established before setting posts. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION - FENCE

- A. Install fence in accordance with CLFMI CLF-05 and manufacturer's instructions.
- B. Set posts plumb, aligned, and at uniform spacing. Set terminal posts first; establish line post spacing from terminal posts.
- C. Install posts in concrete footings. Allow concrete to cure 72 hours minimum before applying fabric tension or gate loads.
- D. Stretch fabric taut and attach to framework. Fabric shall have no sag or waviness when installed.
- E. Install tension wire along bottom of fabric and tie to each post and fabric at maximum 24-inch intervals.
- F. Cap all open post tops with weathertight caps.

3.03 INSTALLATION - GATES

- A. Hang gates level, plumb, and true to line. Provide uniform clearance between gate frame and posts.
- B. Install hinges at locations shown, tightened securely. Adjust to allow free swing without binding.
- C. Install gate closer and adjust closing speed so gate closes and latches fully from the fully open position without slamming.
- D. Install gate lock hardware as specified in Section 32 31 13.16.

3.04 ADJUSTING

- A. Adjust gate hardware for smooth operation. Lubricate hinges and moving parts with a corrosion-inhibiting lubricant.
- B. Test gate operation: gate shall swing freely, close fully under closer action, and latch positively without manual assistance.
- C. Repair all damaged galvanized coatings with zinc-rich paint per ASTM A780.

END OF SECTION 323113

SECTION 329223 SODDING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preparation of subsoil.
- B. Fertilizing.
- C. Sod installation.
- D. Maintenance.

1.02 RELATED SECTIONS

- A. Section 31 23 00 – Earthwork: Topsoil material.

1.03 REFERENCES

- A. ASPA (American Sod Producers Association) - Guideline Specifications to Sodding.
- B. FS O-F-241 - Fertilizers, Mixed, Commercial.

1.04 DEFINITIONS

- A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.05 SUBMITTALS AT PROJECT CLOSEOUT

Not Used.

1.06 QUALITY ASSURANCE

- A. Sod: Minimum age of 18 months, with root development that will support its own weight without tearing, when suspended vertically by holding the upper two corners.
- B. Submit sod certification for grass species and location of sod source.
- C. Sod Producer: Company specializing in sod production and harvesting with minimum five years experience.
- D. Installer: Company approved by the sod producer.

1.07 REGULATORY REQUIREMENTS

- A. Comply with regulatory agencies for fertilizer and herbicide composition.

1.08 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver sod on pallet or in rolls. Protect exposed roots from dehydration.

1.09 DO NOT DELIVER MORE SOD THAN CAN BE LAID WITHIN 24 HOURS.

1.10 PROJECT CONDITIONS

- A. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.
- B. Coordinate with installation of underground sprinkler system piping and watering heads.
- C. Sod Installation Season: Verify with a local A.N.L. A. certified nursery or county agent.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Sod: ASPA Approved Field grown; cultivated grass sod; as noted on Landscape drawings with strong fibrous root system, free of stones, burned or bare spots; containing no more than 10 weeds per 1000 sq ft.
- B. Topsoil: As specified in Section 31 23 00.

- C. Fertilizer: 13-13-13 Time release.
- D. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass.

2.02 ACCESSORIES

- A. Wood Pegs: Softwood, sufficient size and length to ensure anchorage of sod on slope.
- B. Wire Mesh: Interwoven hexagonal plastic mesh of 2 inch size.

2.03 HARVESTING SOD

- A. Machine cut sod and load on pallets or in rolls in accordance with ASPA Guidelines.
- B. Cut sod with minimum 1/2 inch and maximum 1 inch topsoil base.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared soil base is ready to receive the work of this section.

3.02 PREPARATION OF SUBSOIL

- A. Prepare subsoil and eliminate uneven areas and low spots.
- B. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.
- C. Remove foreign materials and undesirable plants and their roots. Do not bury foreign material beneath areas to be sodded.
- D. Remove contaminated subsoil.
- E. Scarify subsoil to a depth of 4 inches where topsoil is to be placed.
- F. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.

3.03 FERTILIZING

- A. Apply fertilizer in accordance with manufacturer's instructions.
- B. Apply after smooth raking of topsoil and prior to installation of sod.
- C. Apply fertilizer no more than 48 hours before laying sod.
- D. Mix thoroughly into upper 2 inches of topsoil.
- E. Lightly water to aid the dissipation of fertilizer.

3.04 LAYING SOD

- A. Moisten prepared surface immediately prior to laying sod.
- B. Lay sod within 24 hours after harvesting to prevent deterioration.
- C. Lay sod tight with no open joints visible, and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.
- D. Lay smooth. Align with adjoining grass areas.
- E. Place top elevation of sod 1/2 inch below adjoining paving or curbs.
- F. On slopes 3:1 and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet on center. Drive pegs flush with soil portion of sod.
- G. Water sodded areas immediately after installation. Saturate soil to a depth of 4 inches.
- H. After sod and soil have dried, roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities. Roll sodded areas with roller.

3.05 MAINTENANCE

- A. Sod shall be maintained by the contractor until project closeout.

END OF SECTION 329223

**SECTION 220500
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 220548 – Vibration and Seismic Controls for Plumbing Piping and Equipment.
- B. Section 221005 – Plumbing Piping.
- C. Section 223000 – Plumbing Fixtures.
- D. Section 312316 – 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.

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. 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 re-compact 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 insure noiseless circulation.
- C. Minimum slope of piping shall be in accordance with the following unless otherwise specifically shown on the drawings or specified:

Type of Piping Fluid Conveyed	Length for System Component	1" Fall	Direction of Fall
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 ensuring 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 220500

SECTION 220513
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. Division 22 – All Sections.

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 220513

**SECTION 220548
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 2021 Arkansas Fire Prevention Code. The HVAC 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.

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 2021 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

<u>Weight (Pounds)</u>	
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.
- 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 220548

SECTION 220553
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-22 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 221005 – 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.
 - c. 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-23 sections for identification requirements of work; 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 220553

**SECTION 220719
PLUMBING PIPING INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Insulation Requirements for complete plumbing piping system.

1.02 RELATED SECTIONS

- A. Section 220500 – Common Work Results for Plumbing.
- B. Section 220548 – Vibration and Seismic Controls for Plumbing Piping and Equipment.
- C. Section 220553 – Identification for Plumbing Piping
- D. Section 221005 – Plumbing 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 220500.
- 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 220500.
- 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)	1/2 inch
Domestic Cold Water (Out of Doors)	1 inch
Storm Water	1 inch

END OF SECTION 220719

**SECTION 221005
PLUMBING PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Basic Requirements for complete plumbing piping system.

1.02 RELATED SECTIONS

- A. Section 220500 – Common Work Results for Plumbing.
- B. Section 220553 – Identification for Plumbing Piping
- C. Section 220548 – Vibration and Seismic controls for Plumbing Piping and Equipment.
- D. Section 312316 – 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 220500.
- 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 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 22 10 06). Valves shall be for 150psi SWP.
 2. All valves shall be bronze, threaded ends, bronze ball and 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, WASTE, VENT AND STORM PIPING SYSTEMS

- A. PIPING
1. Piping Above and Below Grade – PVC Drainage Pipe:
 - a. All piping 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.
 - b. 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 shall be 16 feet. Any depths greater than 16 feet shall require rigid pipe.
 2. 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 roof. Each riser extending through the roof shall project 10" above roof line. Flashing shall be by roofing contractor. Counter flashing shall be by plumbing contractor. Where so shown, connect vents below roof.
 3. Piping Exterior of Building:
 - a. Sanitary sewer pipe and fittings (exterior of the building) shall be Schedule 40 PVC pipe,

reinforced hub type, same as waste piping.

B. 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.

C. 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.

D. 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, deep seal type, bell and spigot pattern.
2. Drains shall be Zurn, Wade, or Jay R. Smith, in accordance with the schedule on the drawings.

E. 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.

F. 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, 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.
2. Related Work Specified Elsewhere:

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

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 Sensus with internal relief.

PART 3 EXECUTION

3.01 HOT AND COLD-WATER PIPING SYSTEMS

- A. For general piping insulation, see Section 220719.
- 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, WASTE, VENT AND STORM 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 of 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 221005

**SECTION 221006
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 220500 – Common Work Results for Plumbing.
- B. Section 220548 – Vibration and Seismic Controls for Plumbing.
- C. Section 220553 – Identification for Plumbing Piping and Equipment.
- D. Section 221005 – Plumbing Piping.
- E. Section 312316 – 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.
Trefice (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.
Trefice (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), prevent 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.

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, Nibco T-111-LF.
 2. Flanged Ends 2-1/2 inches and larger: Class 125, iron body bronze mounted, bolted bonnet, rising stem, OS&Y, solid wedge, Nibco F-617-0.
- D. For Fire Protection Service:
1. Threaded Ends 2 inches and smaller: Class 125, 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 125, 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, Nibco T-211-Y.
 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, Nibco F-718-8.
- 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, stainless steel ball, bronze extended stem, Apollo 77C-14X-04.
- 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.
 4. Apollo Valves.

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, Nibco T-413-LF.
 2. Flanged Ends 2-1/2 inches and larger: Class 125, iron body bronze mounted, bolted cap, horizontal swing, cast-bronze disc, Nibco F-918-B.
- 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 125, 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 MANUFACTURERS
 - 1. Watts.
 - 2. Wilkins.
 - 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 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.
- L. All domestic hot and coldwater piping shall have gate valves with threaded ends, solder ends not acceptable. Ball valves shall not be substituted for gate valves or plug valves. Install ball valves only where shown on drawings.

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.
- B. Pipe discharge drain to nearest floor drain.

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 centerlines. 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 22 1006

SECTION 230500
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 230548 – Vibration and Seismic Controls for HVAC Piping and Equipment.
- B. Section 233100 – HVAC Ducts and Casings.
- C. Division 23 – All Sections.
- D. Section 312316 – 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 insure 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:

<u>Type of Piping Fluid Conveyed</u>	<u>System Component</u>	<u>Length for 1" Fall</u>	<u>Direction of 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 ensuring 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. Spine of each binder shall have the following lettering done in silk-screen –

OPERATION AND MAINTENANCE MANUAL
FOR MECHANICAL SYSTEMS OF
CAMPUS DISTRICT LOOP & CHILLER PLANT
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 indicating 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 235000

SECTION 230513

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 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 236416 – Water-Cooled, Centrifugal Chiller
- B. Section 236500 – Factory Assembled Cooling Tower

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. Re-greaseable, 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 "Premium Efficiency" 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 230513

SECTION 230516
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 230548 – Vibration and Seismic controls for HVAC Piping and Equipment.
- B. 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.
- 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 230516

SECTION 230519
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 232113 – Hydronic Piping.

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 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.
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 threadolet. 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 Fluidyne's Hydro-Flow, Model 1300-1-2-1, 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 230519

SECTION 230548
VIBRATION AND SEISMIC CONTROLS FOR HVAC SYSTEMS

PART 1 GENERAL

1.01 SCOPE

- A. The requirements for seismic protection measures to be applied to HVAC 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 2021 Arkansas Fire Prevention Code. The HVAC 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
Ductwork larger than five (5) square feet
Air terminals weighting more than 75 pounds
Air Handling Units
Boilers
Pumps
Fans

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Basic Requirements - Section.

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 2021 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** Square head 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.
- 3.04** Sway bracing shall be provided for ductwork over six (6) square feet in cross sectional area supported more than 12" from structure.
- 3.05** All air terminals that weight more than 75 pounds shall have a safety chain or safety cable in addition to its other support.
- 3.06** Air handling units, boilers, pumps and fans shall be bolted to the housekeeping pads in accordance with Paragraph 3.01.
- 3.07** Powder-activated fasteners (shot pins) shall not be used for anchorage.
- 3.08** Vibration isolators shall have a bumper restraint in each horizontal direction, and vertical restraints shall be provided where required to resist overturning.

- 3.09** 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 230548

SECTION 230553
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 232113 – 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.
 - (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 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-23 sections for identification requirements at central-station mechanical control center; not work of this section.
- G. Refer to Division-26 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 23 0553

SECTION 230593
TESTING, ADJUSTING AND BALANCING FOR HVAC

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 230500 – Common Work Results for Heating, Ventilating and Air Conditioning.
- B. Section 230548 – Vibration and Seismic controls for HVAC Piping and Equipment.
- C. Section 232113 – Hydronic Piping.
- D. Section 230923 – Direct Digital Control 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 230500.
- 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 Section 230500.
- 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 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 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 Engineer.

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 deflectrols 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 Engineer's approval the form on which the measurements specified herein. Furnish all required record forms. Submit for the Engineer'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 Engineer 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 Engineer 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 Engineer. 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 Engineer: Following the successful completion of first operating

tests by the Contractor, the Owner and Engineer 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 Engineer, the Engineer 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 connections to the systems and notify the Engineer 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 Engineer 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 Engineer for approval and subsequent transmittal to the Owner.

END OF SECTION 230593

SECTION 230713
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 233100 – 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 230500.
- 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 230500.
- 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

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

END OF SECTION 230713

SECTION 230716
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 099100.
- B. Identification for HVAC Piping and Equipment - Section 230553.
- C. HVAC Piping Insulation - Section 230719.

1.03 SUBMITTALS

- A. Submit under provisions of Section 013000 and Section 230500.

1.04 QUALIFICATIONS

- A. Applicator: Company specializing in performing the work of this section.

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. Finish with PVC jacket
- 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 230716

**SECTION 230719
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 232113 – 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 Section 230500.
- 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 230500.
- 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 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 Glass:
 - 1. Pittsburgh Corning Foamglas.
 - 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.	Heating Systems	
	Heating Water Supply and Return	2 inches
B.	Cooling Systems	
	Chilled Water Supply and Return	2 inches

3.05 CELLULAR GLASS INSULATION SCHEDULE

	PIPING SYSTEMS	THICKNESS
A.	Condenser Water (out of doors)	2 inches

END OF SECTION 230719

SECTION 23 08 00

COMMISSIONING OF HVAC SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. The work under this Section is subject to requirements of the Contract Documents including the Owner's General Conditions and articles of the Construction Manager's General Conditions.
- B. The commissioning process does not reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product in accordance with the Contract Documents.
- C. This section shall in no way diminish the responsibility of the Division 23 Contractors, Subs and Suppliers in performing all aspects of work and testing as outlined in the contract documents. Any requirements outlined in this section are in addition to requirements outlined in Division 01 and 23 Specifications.

1.02 RELATED DOCUMENTS

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

1.03 HVAC EQUIPMENT AND SYSTEMS TO BE COMMISSIONED

- A. The following equipment and systems shall be commissioned as part of this project. All general references to equipment and systems within this document refer only to those identified below:
 - 1. Building Automation and Controls System
 - 2. Chillers
 - 3. Cooling Towers
 - 4. Plate-Frame Heat Exchangers
 - 5. Pumps
 - 6. Exhaust Fans
 - 7. Ductless Split-Systems
 - 8. Blower Coils

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL NOTES

- A. Upgrade and modify the existing campus Building Control System (BCS) as required to support the new chilled water plant and district loop.
- B. The BCS shall implement the sequences of operation in this document and provide operating, monitoring, trending, and alarm functions as indicated on the plans and herein.

- C. The chilled water system shall operate continuously upon command from operating personnel via schedule or manual enable. When enabled, the condenser water system shall also be enabled.

3.02 CONTROLS COORDINATION

- A. Representatives from the chiller manufacturer and BCS contractor shall coordinate setup of stable chiller operation when a chiller is brought online with others already running, or taken offline while others continue to operate.
- B. Coordination shall include confirmation of minimum flow, bypass valve operation, chiller staging thresholds, and alarm sequences.

3.03 ROLES AND RESPONSIBILITIES

- A. General Contractor Responsibilities
 - 1. Include costs for all commissioning requirements in contract price.
 - 2. Coordinate and oversee commissioning agent interactions with subcontractors.
 - 3. Ensure Pre-functional Test Forms and Functional Performance tests are completed to the satisfaction of the commissioning agent.
- B. Mechanical Contractor Responsibilities
 - 1. Include costs for all commissioning requirements in contract price.
 - 2. Coordinate and oversee commissioning agent interactions with subcontractors.
 - 3. Complete Pre-functional Test Forms.
 - 4. Perform Functional Performance tests as directed by the commissioning agent.
- C. Controls Contractor Responsibilities
 - 1. Include costs for all commissioning requirements in contract price.
 - 2. Review and provide feedback on the FPT test procedures developed by the CxA.
 - a. Ensure all test procedures are executable with the control system as programmed. This includes overriding all points as indicated.
 - b. Verify all graphics, trend logs and alarms are programed and active as indicated in the contract documents and FPT test procedures.
 - 3. Any tasks indicated within the FPT scripts do not override any other start-up and checkout tasks identified in Division 23. It is the CC responsibility to ensure the system is fully operational and operating in automatic mode prior to execution of FPTs.
 - 4. Provide trained and certified technician familiar with the project programming to execute the FPT test procedures at the direction of the CxA.

3.04 TESTING, ADJUSTING AND BALANCING

- A. The GC/CM shall provide the CxA with signed and dated copy of completed TAB Plan documents prior to scheduling of FPTs. Only individuals having direct knowledge that a line-item task was actually performed shall complete the documentation.
- B. The TABC shall clearly list outstanding items or initial TAB tasks that are not completed successfully. Completed forms documenting any outstanding deficiencies shall be provided to CxA within two (2) working days of completion.

3.05 FUNCTIONAL PERFORMANCE TESTS

- A. Each test form should include: pre-requisites, test steps, expected results/acceptance criteria, measured values, and sign-off. The scripts below follow the sequences of operation in Document 1 – Chiller Plant Sequences of Operation and Control Points.
- B. General functional test requirements
 - 1. Pre-functional checklists for all equipment (chillers, pumps, towers, FPHX, valves, sensors, and BCS points) shall be fully complete with deficiencies addressed before functional testing.
 - 2. Pre-functional checklist will be developed in accordance to manufacture installation and operational specifications plus the project architectural and engineering design teams. Maintenance accessibility will be included as pre-functional requirements.
 - 3. Chiller manufacturer and BCS contractor shall be present as required during integrated tests to adjust control parameters and confirm stable operation.

END OF SECTION 23 08 00

SECTION 230923
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 Vendor Qualifications - The controls vendor shall be Alerton or Schneider Electric.
- 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 (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.
 - 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.
- C. All building / global controllers shall be capable of operating standalone operation in case of loss of communications.

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.
- B. All field / unit controllers shall be capable of operating standalone operation in case of loss of communications.

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 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

- 7. have a manual crank for this purpose.
 - 8. All field installed modulating actuators will have an external, built-in switch to allow the reversing of direction of rotation.
 - 9. 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.
 - 10. All field installed actuators will be Underwriters Laboratories Standard 873 listed.
 - 11. 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.

2.05 APPROVED PRODUCT LINES

- A. Building / Global Controller
1. Schneider Electric: AS-P / ASB (BACnet IP)
 2. Alerton: ACM (BACnet MS/TP)
- B. Field / Unit Controller
1. Schneider Electric: MPC / RPC (BACnet IP) or MNB (BACnet MS/TP)
 2. Alerton: VIP363 with Expanders (BACnet MS/TP)
- C. VAV Terminal Controller
1. Schneider Electric: MPV (BACnet IP) or SE8000 (BACnet MS/TP)
 2. Alerton: VAVSD2A (BACnet MS/TP)

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 3/4" 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.

- D. All field IP cabling shall be CAT6.
- E. All IP / MS/TP routers shall be securely mounted in accessible panels.
- F. Enclosed panels / control boxes shall be provided for all unit controllers.
- G. RSTP topology shall be provided for field IP controllers.
- H. All managed switches shall be panel mountable and provided with an enclosed panel.

3.02 SEQUENCE OF OPERATIONS – REFER TO DRAWINGS

END OF SECTION 230923

**SECTION 232113
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 230500 - Common Work Results for Heating, Ventilating, and Air Conditioning.
- B. Section 230548— 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.
- K. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- M. ASTM B32 - Solder Metal.
- N. 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 230500.
- B. Store and protect products under provisions of Section 230500.
- 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.
 - b. 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. CHILLED WATER PIPING, BELOW GRADE
 - 1. Chilled water distribution piping to be SDR 11 HDPE pipe and fittings.
- D. CONDENSER 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.
 - b. Joints: Screwed for pipe 2 inch and under; ANSI/AWS D1.1 welded for pipe over 2 inch.
- E. CONDENSER WATER PIPING, BELOW GRADE
 - 1. Steel Pipe: ASTM A53 or A120, Schedule 40, for sizes 2½ inches and over, black. Provide factory applied epoxy protective coating.
 - a. Fittings: ANSI/ASTM B16.3, malleable iron or ASTM A234, forged steel welding type.

- b. Joints: Screwed or ANSI/AWS D1.1 welded. Field apply X-Tru coat protective covering for all below grade joints. Follow manufacturer's instructions for installation.
- F. 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.
- G. 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. 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.
- I. 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-22 "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. McDonnel 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 232500.

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.
- 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 9100.
- 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. Weld pipe joints in accordance with recognized industry practice. All welding shall be done by experienced craftsmen.
- B. All welding shall be of ripple type and shall be made so that the welded joint is stronger than the adjacent pipe.
- C. Weld pipe joints only when ambient temperature is above 0 degrees F where possible.
- D. Bevel pipe ends at a 37.5-degree angle where possible, smooth rough cuts, and clean to remove slag, metal particles and dirt.
- E. Install welding rings and backing for each welded joint. Ring shall be as manufactured by Tube Turn, Inc., or approved equal.
- F. 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.
- G. 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 insure elimination of unsound or unfused metal, cracks, oxidation, blow-holes and non-metallic inclusions.
- H. Do not weld-out piping system imperfections by tack-welding procedures; re-fabricate to comply with requirements.
- I. 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 232113

SECTION 232114
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 230500 – Common Work Results for Heating, Ventilating, and Air Conditioning Controls.
- B. Section 230548 – Vibration and Seismic Controls for HVAC Piping and Equipment.
- C. Section 232113 – 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 Conval Inc.
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 (no substitutions) 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 (No substitutions).

- 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; pre-charge 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 tappings 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: Combination Separator/Strainer: Install external combination
1. Combination Separator/Strainer: Install external combination separators /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 air flow.

END OF SECTION 232114

**SECTION 232123
HYDRONIC PUMPS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Basic Requirements for Hydronic Pumps for HVAC Systems.

1.02 RELATED SECTIONS

- A. Section 230500 – Common Work Results for Heating, Ventilating, and Air Conditioning.
- B. Section 230548 – Vibration and Seismic Controls for HVAC Piping and Equipment.
- C. Section 232113 – Hydronic Piping.

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 with minimum three years experience.
- 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 Section 230500.
- 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 Section 230500.

1.06 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 230500.
- 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 230500.
- B. Store and protect products under provisions of Section 230500.

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 SEPARATELY COUPLED, VERTICALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS

- A. Description: Factory-assembled and tested, centrifugal, overhung-impeller, separately coupled, in-line pump; designed for installation with pump and motor shafts mounted vertically.
- B. Pump Construction
 - 1. Casing: Radially split, ASTM A48/A48M, cast iron, with replaceable bronze wear rings, drain plug at bottom, threaded gauge tapings at inlet and outlet, and flanged connections.
 - 2. Impeller: ASTM B584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps that are not variable-frequency-drive controlled, trim impeller to match specified performance.
 - 3. Pump Shaft: Type 416 stainless steel
 - 4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPDM bellows and gasket.
 - 5. Shaft Coupling: Rigid, aluminum alloy 6061-T6, capable of absorbing vibration.
 - 6. Motor: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - a. Enclosure: Open, drip proof
 - b. NEMA Premium Efficient motors as defined in NEMA MG 1.
 - c. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - d. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
 - e. Variable-frequency motor
 - f. Provide integral pump motor variable- frequency controller.

2.03 APPROVED MANUFACTURERS

- A. Taco.
- B. Armstrong.
- C. Grundfos
- 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. Qualified millwright shall check, align, and certify base mounted pumps prior to start-up.

END OF SECTION 232123

**SECTION 232500
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 230500.
- B. Testing, Adjusting and Balancing - Section 230593.

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 232500

**SECTION 233100
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 230500 – Common Work Results for Heating, Ventilating, and Air Conditioning System.
- B. Section 230548 – Vibration and Seismic Controls for HVAC Piping and Equipment.
- C. Section 230593 – Testing, Adjusting and Balancing.
- D. Section 230713 – 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 fabricate ductwork of gauges and reinforcement complying with SMACNA "HVAC Duct Construction Standards.
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-23 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.

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 of 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 23 - 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 233100

SECTION 233300
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 230500 – Common Work Results for Heating, Ventilating, and Air Conditioning Controls.
- B. Section 230548 – Vibration and Seismic controls for HVAC Piping and Equipment.
- C. Section 230593 – Testing, Adjusting and Balancing.
- D. Section 233100 – 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 or multiblade type, constructed in accordance with SMACNA "Low Pressure Duct Standards".
- B. Control Dampers: Refer to Division-23 section "Automatic Temperature Controls" for control damper actuators; 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

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 233300

SECTION 233700
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 230500 – Common Work Results for Heating, Ventilating, and Air Conditioning System.
- B. Section 230548 – Vibration and Seismic Controls for HVAC Piping and Equipment.
- C. Section 230593 – Testing, Adjusting and Balancing.
- D. Section 233100 – 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 230500.
- 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 LOUVERS (ALUMINUM)

- A. Frame shall be 6-inch-deep channel of .081-inch-thick 6063-T6 extruded aluminum alloy.
- B. Blades shall be constructed of .081-inch-thick aluminum. Blades shall be drainable.
- C. Bird screen shall be aluminum mesh, removable type. Screen shall be mounted on interior of louver.
- D. Finish shall be as selected by Architect, and shall have a minimum of 20-year warranty.

2.03 APPROVED MANUFACTURERS

- A. Air Devices
 - 1. Titus.
 - 2. Price.
 - 3. Tuttle & Bailey.
 - 4. Architect Approved.
- B. Louvers
 - 1. American Warming and Ventilating.
 - 2. Ruskin.
 - 3. Greenheck.
 - 4. Architect Approved.
- C. Hooded Intake/Relief Ventilator
 - 1. Cook.
 - 2. ACME.
 - 3. Greenheck.
 - 4. 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.

3.02 INSTALLATION (LOUVERS)

- A. Locate and place louver units plumb, level and in proper alignment with adjacent work.
- B. Use concealed anchorages wherever possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joints fillers, as indicated.
- D. Repair finishes damaged by installation operations. Restore finishes so that there is no evidence of corrective work. Return items which cannot be refinished in the field to the shop, make the required alterations and refinish the entire unit, or provide new unit, at contractor's option.
- E. Protection non-ferrous metal surfaces from corrosion or galvanic action by application of a heavy coating of bituminous paint on surfaces which will be in contact with concrete, masonry or dissimilar metals.
- F. Provide concealed gaskets, flashings, joint fillers, and insulations, and install as work progresses to make the installations weathertight.
- G. Refer to Division 7, Section 07900, for sealants in connection with installation of louvers.
- H. Field verify exact opening dimensions and coordinate mounting requirements with General Contractor.

END OF SECTION 233700

SECTION 236416
WATER COOLED, CENTRIFUGAL CHILLER

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Section includes design, performance criteria, refrigerants, controls, and installation requirements for three water cooled centrifugal chillers to be purchased by the University of Central Arkansas. Two of the three chillers will be optimized for full load performance and the third chiller will be optimized for part load performance. The purchase order will be transferred to the installing Contractor after the installation contract is awarded.

1.02 SUBMITTALS

- A. Acceptable refrigerants on which chiller performance can be based are R-153A, R-514A, and R-1233zd. All proposals for chiller performance must include an AHRI approved selection method for the specified refrigerants.
- B. Submit drawings indicating assembled dimensions, operating weight, load distribution, and required service and access clearances.
- C. Submit product data indicating options and specialties, electrical requirements, wiring diagrams, control diagrams, and connections.
- D. Submit rigging, installation, and startup procedures. Include operations and maintenance data for both the chiller and starter or variable-speed drive. Include location, size, and type of field piping connections.
- E. Submit performance data indicating energy input versus cooling load output from 100 to 25 percent of full load with constant entering condenser water temperature.

1.03 REGULATORY REQUIREMENTS

- A. Conform to AHRI Standard 550/590 code for rating and testing of water chillers.
- B. Conform to UL (1995, 60335-2-40) for Safety for Heating and Cooling Equipment. In the event the unit is not UL approved, the manufacturer shall, at manufacturer expense, provide for a field inspection by an UL representative to verify conformance to UL standards. If necessary, contractor shall perform modifications to the unit to comply with UL, as directed by the UL representative.
- C. Conform to ANSI/ASME SECTION VIII Boiler and Pressure Vessel Code for construction and testing of centrifugal chillers as applicable.
- D. Conform to latest revision of ANSI/ASHRAE STANDARD 15 code for construction and operation of centrifugal chillers.
- E. Unit shall bear the AHRI Certification Label for the specific type of water chiller as applicable.
- F. Chiller shall be Environmental Product Declaration (EPD) certified.
- G. The chiller shall comply with ASHRAE 90.1 2022 minimum efficiency requirements for energy efficiency.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's installation instructions for rigging, chiller loading, local transportation requirements, unloading, storage, and final setting.

- B. Protect chiller and controls from physical damage. Leave factory shipping covers in place until installation. The entire unit must be shrink wrapped with an environmentally recyclable material. The material shall include an imbedded desiccant to minimize/eliminate internal moisture.
- C. The chiller shall ship with a dry nitrogen charge to eliminate potential charge loss during delivery and construction. The refrigerant must be shipped separately from the chiller.
- D. The chiller should ship with a full charge of oil.
- E. Storage: Per ASHRAE Standard 147, positive pressure units must have a pump down capability that isolates the refrigerant charge for storage in a suitable vessel. If pump down capability does not exist, then the charge must be removed during long idle periods.

1.05 WARRANTY

- A. X
- B. The original equipment purchase shall provide an optional refrigerant warranty for the duration of the 1st year. This warranty will provide for replacement refrigerant, if needed. If the reason for refrigerant loss is found to be a defect in material or workmanship, the proper refrigerant charge shall be restored, with replacement parts and labor covered under this warranty.
- C. Beginning at the expiration of the standard warranty, the original equipment owner shall be provided optional extended warranties.
 - 1. These warranties shall include:
 - a. Whole unit parts for Years 2 to 10, including the starter/driver.
 - b. Whole unit labor for Years 2 to 10, including the starter/driver.
 - c. Refrigerant quality for Years 2 to 10.
- D. Leak Tight Warranty: Provide as part of the chiller scope a refrigerant loss warranty for the lesser of 120 months from initial start-up or 126 months from date of shipment. During this period, manufacturer shall furnish replacement refrigerant which is lost due to a leak in the machine. Once a leak is determined, action must be taken (acceptable to the manufacturer) to eliminate the source of the leak. Replacement parts and labor are not covered under this warranty. If the chiller is placed under a comprehensive service and maintenance agreement from the original equipment manufacturer prior to the expiration of the standard refrigerant loss warranty, the refrigerant loss coverage shall continue as long as an active service and maintenance agreement from the manufacturer remains in effect without interruption. If a 10-Year Parts, Labor and Refrigerant Warranty is purchased from the original equipment manufacturer and if the chiller is placed under a comprehensive service and maintenance agreement from the original equipment manufacturer prior to the expiration of the 10-Year Parts, Labor and Refrigerant Warranty, the refrigerant loss coverage shall continue as long as an active service and maintenance agreement from the manufacturer remains in effect without interruption.

1.06 MAINTENANCE SERVICES

- A. Maintenance of the chiller in accordance with manufacturer's recommendations as published in the installation and maintenance manuals shall be the responsibility of the Owner. Owner will be provided training and certifications to maintain and operate the chillers.

1.07 VERIFICATION OF CAPACITY AND EFFICIENCY

- A. PERFORMANCE TOLERANCES
 - 1. The following allowable tolerances must be followed:
 - a. The tolerance on allowable capacity must be as defined by AHRI Standard 550/590.
 - b. The IPLV/NPLV and full load tolerances are as defined by AHRI Standard 550/590, and the tolerances at full load and all part load test points must also be as defined by AHRI Standard 550/590 if applicable.

PART 2 - PRODUCTS

2.01 SUMMARY

- A. The equipment vendor shall furnish three chillers as herein specified. The units will be supplied in accordance with this specification. Chiller performance shall be per specification section 3.02 schedule.
- B. The units shall produce the specified tonnage per the scheduled data in accordance with the latest revision of AHRI 550/590. The unit shall bear the AHRI certification label as applicable.
- C. The three chillers purchased shall initially be purchased by the Owner, and the purchase order will be transferred to the installing Contractor once the installation work has been bid. The Contractor may choose to have the chillers delivered to their bonded warehouse rather than the construction site.
- D. Approved Manufacturers:
 - 1. Trane
 - 2. Daikin.
 - 3. York/JCI.
- E. Unit shall be painted in accordance with the manufacturer's standard procedures and practices.

2.02 COMPRESSOR AND MOTOR

- A. The compressor shall be centrifugal with single or multiple stages.
- B. Low or medium pressure refrigerant machines shall be provided when available.
- C. Chiller should be able to unload to 25.00 % of design tonnage with constant entering water temperature. The minimum unloading point shall be able to be demonstrated if a factory performance test is required. The machine shall be modified to include hot gas bypass if the minimum load cannot be met.
- D. Compressor assembly shall be vibration tested at the factory. Vibration shall not exceed 0.15 inches per second at full load design compressor speed as measured on the motor housing. The test data shall be recorded and provided to the customer for approval.
- E. The motor shall be hermetic and either suction or liquid refrigerant cooled. Hot gas motor cooling is not acceptable.
- F. Additionally, if an open drive motor is provided, a motor-compressor shaft seal leakage containment system shall be provided.
- G. Motors shall have winding, 100 ohm, platinum RTDs for temperature sensing on each phase. Thermistors and thermal overloads are not acceptable. These temperatures shall be furnished to the unit control panel for monitoring and alarm.
- H. Manufacturers with speed increasing transmissions shall not exceed 10,000 RPM compressor speeds and shall annually inspect the gears and all bearings. A report shall be forwarded to the owner each year over the first five years to confirm completion.

- I. The impellers shall be fully shrouded and made of a high strength aluminum alloy. Impellers shall be dynamically balanced and over-speed tested at 1.25 times impeller shaft speed.

2.03 EVAPORATOR

- A. The evaporator and condenser shall be built in accordance with ANSI/ASHRAE 15-2001 Safety Code for Mechanical Refrigeration and ASME section VIII as applicable. Per the ASME Code Boiler & Pressure Vessel Code VIII Division 1, as long as the refrigerant side of the chiller operates at or below 15 PSIG and the water side operates at or below 300 PSIG, the design does not fall within the scope of ASME Division 1. ASME construction and stamping is not required per paragraph U-1.
- B. Evaporator tubes shall be internally and externally enhanced with a 1.00" outer diameter. The tubes shall be securely supported at intermediate supports and physically expanded into both ends of the tube sheets. The evaporator tubes must also be removable from both ends to provide easy access for tube cleaning.
 1. The minimum evaporator tube wall thickness, root-to-root across the entire tube length shall be 0.025". It is unacceptable to provide this thickness at the intermediate supports only.
- C. The evaporator water piping connections shall be grooved.
- D. The unit shall be factory insulated.
- E. Units with multi-stage compressors shall incorporate an interstage flash vessel "economizer". All units with single stage compressors shall have the condensers circuited for liquid subcooling and be provided with a thermometer well to monitor the amount of subcooling.
- F. Adjustable or float type refrigerant metering devices and thermal expansion valves shall be inspected and adjusted by the manufacturer at the end of each year for the first five years of operation to assure equivalent reliability and maintenance to a fixed orifice system. A written report shall be forwarded to the owner each year to confirm completion.

2.04 CONDENSER

- A. The condenser shall be built in accordance with ANSI/ASHRAE 15-2001 Safety Code for Mechanical Refrigeration and ASME section VIII as applicable. Per the ASME Boiler & Pressure Vessel Code VIII Division 1, as long as the refrigerant side of the chiller operates at or below 15 PSIG and the water side operates at or below 300 PSIG, the design does not fall within the scope of ASME Division 1. ASME construction and stamping is not required per paragraph U-1.
- B. Condenser tubes shall be internally and externally enhanced with a 0.75" outer diameter. The tubes shall be securely supported at intermediate supports and physically expanded into both ends. The condenser tubes must also be removable from both ends to provide easy access for tube changeouts or tube cleaning.

1. The minimum condenser tube wall thickness, root-to-root across the entire tube length shall be 0.028". It is unacceptable to provide this thickness at the intermediate supports only.
- C. The condenser water piping connections shall be grooved.
- D. The condenser water boxes shall be marine style. Side connections shall be provided such that the water piping of both the entering and leaving sides shall not be disconnected for mechanical cleaning. The water piping connections shall be in a direction perpendicular to the shells to allow full unblocked access to the tubes.
- E. Supply and return head water boxes shall be designed for a working pressure of 150 psi and shall be factory hydrostatic pressure tested at 150 percent of the design pressure. Provide drain and vent connections in water boxes.

2.05 REFRIGERANT

- A. Acceptable refrigerants on which chiller performance can be based are R-153A, R-514A, and R-1233zd. All proposals for chiller performance must include an AHRI approved selection method for the specified refrigerants.
- B. Refrigeration Transfer: Provide service valves and other factory-installed accessories required to facilitate transfer of refrigerant from the chiller to remote systems.
 1. See Section 1.04 for additional details on refrigerant shipment.
- C. Refrigerant Flow Control: Fixed orifice plates at the entrance and exit of the economizer shall be used to control refrigerant flow.
- D. Low pressure chillers: Chillers that operate at low pressures must have a high efficiency purge system to ensure that any potential non-condensable leakage into the vessel is immediately eliminated. The purge run time shall be monitored by the main unit controller to act as a leak detector if required, and must have the following specifications:
 1. The manufacturers of low-pressure machines must provide a purge system.
 2. The purge efficiency must meet ASHRAE Standard 147.
 3. The purge shall be capable of operating when the chiller is idle in accordance with ASHRAE Standard 147.
- E. Provide refrigerant monitoring system for the three chillers with BACnet interface to the Building Automation System.

2.06 ELECTRICAL

- A. Chiller shall be installed, wired, and functionally tested at the factory before being shipped.
- B. Single point power connection - A control power transformer internal to the motor starter or frequency drive and of sufficient size to power all chiller mounted auxiliary loads shall be supplied. No separate power connection shall be required for chiller mounted equipment. The control power transformer shall tap from the main power connection.
- C. Terminal blocks numbered to match the wiring diagram must be included.

2.07 CONTROLS

- A. The chiller shall be controlled by a unit mounted, stand-alone Direct Digital Control (DDC) system. A dedicated chiller microprocessor control panel is to be supplied with each chiller by the chiller manufacturer.
- B. Enclosure shall be unit mounted NEMA 250 Type 1.
- C. The chiller manufacturer shall include a pressure, non-mechanical based flow switch that is of the thermal dispersion type for each evaporator and condenser to verify flow through the unit.
- D. A color, touch sensitive liquid crystal display (LCD) shall be unit mounted with a minimum of 12.1" diagonal. The display shall be fully adjustable in height and viewing angle. Animated graphical representations of chiller subsystem operation shall be used to enhance the user interface.
- E. Display shall consist of a menu driven interface with easy touch screen navigation to organized sub-system reports for compressor, evaporator, condenser, purge and motor information as well as associated diagnostics. The controller shall display all active diagnostics and a minimum of 20 historical diagnostics. Touch-screen display shall display data in either inches and pounds (I-P) or standard international (SI) units. Animated color graphics shall indicate the status of the chiller. User IDs and passwords shall allow for additional security for different levels of user access.
- F. The chiller control panel shall provide control of chiller operation and monitoring of chiller modules, sensors, actuators, relays, and switches. The chiller control panel shall include controls to safely and efficiently operate the chiller.
- G. Control authority must be capable of handling at least four conditions: Off, local manual at the chiller, local automatic at the chiller, and automatic control through a remote source.
- H. Provide capability to connect a laptop to service utility with applicable software from manufacturer and obtain enhanced set-up and diagnostics.
- I. The front of the chiller control panel shall display the following in clear language, without the use of codes, look-up tables, or gauges:
 - 1. Run time.
 - 2. Number of starts.
 - 3. Current chiller operating mode.
 - 4. Chilled water set point and set point source.
 - 5. Electrical current limit set point and set point source.
 - 6. Entering and leaving evaporator water temperatures.
 - 7. Entering and leaving condenser water temperatures.
 - 8. Saturated evaporator and condenser refrigerant temperatures.
 - 9. Evaporator and condenser refrigerant pressure.
 - 10. Oil tank temperature.
 - 11. Oil tank pressure.

12. Oil pump discharge pressure.
 13. Differential oil pressure.
 14. Compressor motor current per phase.
 15. Compressor motor percent RLA.
 16. Compressor motor voltage per phase.
 17. kW energy consumption and power factor.
 18. Compressor motor winding temperatures per phase.
 19. Purge operating mode.
 20. Purge operating status.
 21. Time until next purge run.
 22. Daily pumpout - 24 hours.
 23. Average daily pumpout - 7 Days.
 24. Purge refrigerant compressor suction temp.
 25. Purge liquid temp (chiller condenser saturated refrigerant temperature).
 26. Daily pumpout limit/alarm.
- J. The chiller control panel shall provide password protection of all setpoints.
- K. The controller shall have the ability to display all primary sub-system operational parameters on dedicated trending graphs.
- L. The operator must be able to create up to 6 additional custom trend graphs, choosing up to 10 unique parameters for each graph to trend log data parameters simultaneously over an adjustable period and frequency polling.
- M. The chiller control panel shall provide individual relay outputs to start/stop the evaporator and condenser water pumps. The condenser water pump relay output shall be capable to be used to enable the cooling tower temperature controls.
- N. The chiller control panel shall provide leaving chilled water temperature reset based upon return water temperature.
- O. Safeties - the chiller control panel shall provide the following safeties:
1. Low chilled water temperature.
 2. Low evaporator refrigerant temperature or pressure.
 3. High condenser refrigerant pressure.
 4. Evaporator and condenser water flow status.
 5. Low oil pressure.
 6. Low oil temperature.
 7. High oil temperature.
 8. High motor winding temperatures.
 9. High motor current.

10. Starter/VFD function faults.
 11. Sensor faults.
 12. Unit controls operation.
 13. The chiller control panel or starter shall incorporate advanced motor protection to safeguard the motor throughout the starting and running cycles from the adverse effects of:
 - a. Current phase loss.
 - b. Current phase unbalance.
 - c. Current phase reversal.
 - d. Under/Over voltage.
 - e. Motor current overload.
 - f. Distribution fault protection with auto restart consisting of three-phase current sensing devices that monitor the status of the current.
 - g. Starter contactor fault protection.
 - h. Starter transition failure.
- P. The chiller control panel shall provide evaporator freeze protection and low limit control to avoid low evaporator refrigerant temperature trip-outs during critical periods of chiller operation. Whenever this control is in effect, the controller shall indicate that the chiller is in adaptive mode. If the condition exists for more than 30 seconds, a limit warning alarm relay shall energize. Adaptive mode means that the chiller controls will unload chiller automatically to prevent it from exceeding its limits and to keep the chiller online.
- Q. The chiller control panel shall be capable of providing short cycling protection.
- R. The chilled water controller of each chiller shall include variable water-flow capability to allow the chiller to respond quickly to accelerating or decelerating water, and have the following features:
1. The variable water-flow compensation capability shall allow control of the leaving chilled water temperature to within +/- 1.0°F (0.6°C) at a water flow rate change of 10% per minute and will stay online at a water flow rate change of 30% per minute.
- S. The chiller, upon power loss restoration, must be able to start the compressor within 20 seconds. The chiller time to fully load up to 80% shall be no longer than 5 minutes. The manufacturer shall supply documentation to support the ability to do this.
1. If the documentation is not adequate, the manufacturer must demonstrate this in the factory on an AHRI approved loop.
- T. The chiller control panel shall provide hardwire connections for the following binary and analog signals:
1. Compressor Running.
 2. Detection by the panel of a fault requiring manual reset.
 3. Chiller operation at maximum capacity.

4. Chiller operation in condenser limit mode and thereby requesting condenser water temperature relief.
- U. The chiller control panel shall have capability to provide an analog 2 - 10VDC or 4 - 20mA output signal that shall indicate the Compressor Motor Percent RLA.
- V. The chiller should have capability to provide a condenser pressure output signal of 0 - 10VDC or 4 - 20mA that may be used for head pressure control if required.
- W. The chiller control panel shall allow for an analog input for a chilled water setpoint and an electrical current limit set point. These setpoints can be in the form of 4-20 mA or 2-10 Vdc signals from a remote source (i.e. generic building automation system).
- X. Building Automation System (BAS) Interface.
 1. Factory mounted DDC controller shall support operation on a BACnet network via BACnet MS/TP.
 2. The information communicated between the BAS and the factory mounted unit controllers shall include the reading and writing of data to allow unit monitoring, control, and alarm notification.
 3. All communication from the chiller unit controllers shall be via BACnet objects. Proprietary BACnet objects shall not be allowed. BACnet communications shall conform to the BACnet protocol (ANSI/ASHRAE 135-2001). A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided along with the unit submittal.

2.08 FREQUENCY DRIVES AND STARTERS

- A. LOW VOLTAGE, UNIT MOUNTED, WYE DELTA STARTER (CH-2 and CH-3)
 1. Motor starter shall be a Star (Wye)-Delta Closed Transition starter and shall have a NEMA 1A gasketed enclosure. The starter shall be UL 508 approved.
 2. Motor starters shall include incoming line provisions for the number and size cables shown on the drawings. Incoming line lugs shall be copper mechanical type.
 3. Contactors shall be sized properly to the chiller full load currents.
 4. Each motor starter shall include a 4 KVA control power transformer with fused primary and secondary. Control relays shall be provided within the motor starter to interface with the control panel.
 5. If the chiller main processor does not include an advanced motor protection system, the starter shall include an advanced motor protection system incorporating electronic three phase current overloads and current transformers. This electronic motor protection system shall monitor and protect against the following conditions:
 - a. Current phase loss.
 - b. Current phase unbalance.
 - c. Current phase reversal.

- d. Under/Over line voltage.
 - e. Motor current overload during startup and running.
 - f. Momentary power loss protection with auto restart consisting of three-phase current sensing devices that monitor the status of the current. Restart inhibit shall be active and looks at motor RTDs to maximize starts/hour.
 - g. Starter contactor fault protection.
 - h. Starter transition failure.
 - i. Distribution fault protection.
- 6. The starter shall be able to operate in temperatures up to 104°F (40°C)
 - 7. All field supplied wires, bus bars, and fittings shall be copper only.
 - 8. The starter enclosure shall have a starter short circuit current rating (SCCR) of 65kA. If the starter enclosure does not have this SCCR rating, then a device shall be provided upstream of the starter to limit the fault current at the starter to be equal or less than the starter short circuit rating.
 - 9. The following optional starter features shall be provided:
 - a. Circuit Breaker - Starter shall contain a circuit breaker capable of breaking currents up to its interruption capacity. Operating handle and trip indicator shall be located on the door. This handle shall be capable of being padlocked.

B. LOW VOLTAGE, VARIABLE FREQUENCY DRIVE (VFD), UNIT MOUNTED (CH-1)

- 1. The centrifugal water chiller shall be furnished with a refrigerant cooled variable frequency drive (VFD). The VFD shall be factory mounted on the chiller and shipped completely factory assembled, wired and tested.
- 2. The VFD will be specifically designed to interface with the centrifugal water chiller controls and allow for the operating ranges and specific characteristics of the chiller. The VFD control logic shall optimize chiller efficiency by coordinating compressor motor speed and compressor inlet guide vane position to maintain the chilled water setpoint while avoiding surge. If a surge is detected, VFD surge avoidance logic shall make adjustments to move away from and avoid surge at similar conditions in the future.
- 3. The VFD efficiency shall be 97% or better at full speed and full load. Fundamental displacement power factor shall be a minimum of 0.96 at all loads.
- 4. The VFD shall be solid state, microprocessor based, pulse-width modulated (PWM) design. The VFD shall be voltage and current regulated. Output power devices shall be IGBT transistors.
- 5. Power semi-conductor and capacitor cooling shall be from a liquid cooled heatsink.
- 6. The VFDs shall each be furnished in a NEMA 1 metal enclosure having as minimum a short circuit current rating (SCCR) of 65,000 amps per UL 508. It shall include three phase

input lugs plus a grounding lug for electrical connections, output motor connection via factory installed bus bars, and all components properly segregated and completely enclosed in a single metal enclosure.

- a. Enclosure shall include a padlockable, door-mounted circuit breaker with shunt trip and AIC rating of 65,000 amps.
 - b. The entire chiller package shall be UL/CUL listed.
7. The VFD shall be tested to ANSI/UL Standard 508 and shall be listed by a Nationally Recognized Testing Laboratory (NRTL) as designated by OSHA.
8. The VFD design shall include a standard integrated active rectification control system to limit total demand distortion (TDD) in current at the VFD to less than or equal to 5% as measured at the VFD input, in compliance to recommendations stated in IEEE 519-1992.
 - a. If optional active or passive filters are used to meet the less than or equal to 5% TDD, then the losses associated with the filter shall be included in the chiller performance on the selection (adjust penalties accordingly).
 - b. If a remote mounted filter is used to meet the less than or equal to 5% TDD, then the losses associated with the filter shall be included in the chiller performance on the selection (adjust penalties accordingly). Additionally, the remote filter must be brought in and tested along with the chiller for all applicable tests.
 - c. If a remote mounted filter is used and is required to be tested, the Contractor shall be responsible for all associated installation costs of the remote filter for testing.
9. Input shall be nominal 460. V, three phase, 60. Hz AC power, +/- 10 percent of nominal voltage.
10. Motor frequency range 38-60 hertz.
11. The VFD shall include the following features:
 - a. All control circuit voltages shall be physically and electrically isolated from power circuit voltage.
 - b. 150% instantaneous torque available for improved surge control.
 - c. Soft start, adjustable linear acceleration, coast-to-stop.
 - d. Insensitivity to incoming power phase sequence.
 - e. Adjustable current limiting and U.L. approved electronic motor overload protection.
 - f. Output line-to-line short circuit protection.
 - g. Line-to-ground short circuit protection.
 - h. Protection from phase loss at VFD input.
 - i. Protection from phase reversal/imbalance.

- j. Protection from over/under-voltage.
 - k. Protection from over-temperature.
12. The following VFD status indicators shall be available to facilitate startup and maintenance:
- a. Input line voltage.
 - b. Output/load amps.
 - c. Fault.
 - d. Output speed in hertz and rpm.
 - e. Input line kW.
 - f. Average current in percent RLA.
 - g. Load power factor.
 - h. VFD transistor temperature.
13. Service Conditions - at full output power:
- a. No external venting or heat exchangers shall be required.
 - b. Operating ambient temperature of 32°F - 104°F (0°C - 40°C).
 - c. Room ambient up to 95% relative humidity.
 - d. Elevation up to 3300 feet (1000 meters). For every 300 feet (90 meters) above 3300 feet, the rated output current shall be decreased by 1%.

PART 3 - EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

- A. Manufacturer shall furnish a factory trained service engineer without additional charge to provide start-up for each chiller. Chiller manufacturers shall maintain service capabilities no more than 100 miles from the jobsite.
- B. A start-up log shall be furnished by the manufacturer to document the start up date for each chiller. The start-up logs shall be signed by the Owner or his authorized representative prior to commissioning the chillers.
- C. The manufacturer shall furnish complete submittal wiring diagrams of the chillers and interlocks as applicable.
- D. Prestart instructions and coordination is to be provided by senior lead technician or supervisor to:
 - a. Review installation checklist with installing Contractor.
 - b. Review startup procedures and required support.
 - c. Review training requirements, timing and logistics with the installing contractor.
- E. Provide a minimum of eight hours of training that is a combination of classroom and hands on instruction.

3.02 SCHEDULE

Chiller: CH-1

Manufacturer:	Trane
Model Number:	CVHF
Cooling Capacity:	670.0 tons
Evaporator:	
Flow Rate:	1143 gpm
Minimum Flow Rate:	490.6 gpm
Entering Fluid Temperature:	56.0 F
Leaving Fluid Temperature:	42.0 F
Pressure Drop:	14.2 ft H2O
Fouling Factor:	0.000100 hr-sq ft-deg F/Btu
Fluid Type:	water
Condenser:	
Flow Rate:	1876.0 gpm
Minimum Flow Rate:	734.8 gpm
Entering Fluid Temperature:	85.0 F
Leaving Fluid Temperature:	95.0 F
Pressure Drop:	25.8 ft H2O
Fouling Factor:	0.000250 hr-sq ft-deg F/Btu
Fluid Type:	water
Electrical:	
Voltage:	460 V / 3 PH
LRA:	3,687
MCA:	609
MOP:	1000
Compressor:	
Maximum Power Input:	368.7 kW
kW/ton:	0.5504
NLPV:	0.3650
Starter:	
Type:	VFD
Incoming RLA:	488.3
Operating Weight:	30,524 lb
 Chiller: CH-2 and CH-3	
Manufacturer:	Trane
Model Number:	CVHF

Cooling Capacity:	670.0 tons
Evaporator:	
Flow Rate:	1143 gpm
Minimum Flow Rate:	294.7 gpm
Entering Fluid Temperature:	56.0 F
Leaving Fluid Temperature:	42.0 F
Pressure Drop:	15.9 ft H2O
Fouling Factor:	0.000100 hr-sq ft-deg F/Btu
Fluid Type:	water
Condenser:	
Flow Rate:	1876.0 gpm
Minimum Flow Rate:	655.3 gpm
Entering Fluid Temperature:	85.0 F
Leaving Fluid Temperature:	95.0 F
Pressure Drop:	31.3 ft H2O
Fouling Factor:	0.000250 hr-sq ft-deg F/Btu
Fluid Type:	water
Electrical	
Voltage:	460 V/3 PH
LRA:	3,687
MCA:	677
MOP:	1200
Compressor:	
Maximum Power Input:	362.0 kW
kW/ton:	0.5403
NLPV:	0.4525
Starter:	
Type:	WYE Delta
Incoming RLA:	542.5
Operating Weight:	27,685 lbs

END OF SECTION 236416

SECTION 236500
FACTORY ASSEMBLED COOLING TOWER

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Cooling Tower
- B. Accessories

1.02 SUBMITTALS

- A. Submit shop drawings and product data.
- B. Submit suggested structural steel support including dimensions, sizes and locations for mounting bolt holes. Include weight distribution drawings showing point loads.
- C. Submit schematic details showing capacity controls.
- D. Submit manufacturers operation and maintenance instructions.
- E. Submit manufacturers certificates of warranty for equipment and thermal performance.

1.03 DELIVERY

- A. Factory assemble entire unit. For shipping, disassemble into as large as practical sub-assemblies so that minimum amount of field work is required for re-assembly.

1.04 QUALITY ASSURANCE

- A. Each unit is manufactured under closely-controlled conditions using standardized parts to ensure each unit is built precisely to the same high-quality design and construction standards. The design, manufacture, and business processes of Baltimore Aircoil Company are ISO 9001 compliant.

1.05 CERTIFICATIONS

- A. Each unit is manufactured thermal performance of this BAC unit has been certified through performance tests conducted by the Cooling Technology Institute in accordance with their standard STD-201 RS. Your equipment may be selected for factory-testing to verify CTI certified performance. Such certification by an independent third party assures engineers and users that the published thermal capacities accurately reflect the actual unit performance. CTI certification eliminates the additional costs of on-site, individual unit testing, oversizing the equipment or operating cost penalties from deficient equipment.

1.06 WARRANTY

- A. Provide a standard unit parts and labor warranty for one year from startup, but not more than 18 months from shipment. The guarantee shall provide for repair or replacement due to failure by material and workmanship that prove defective within the above period.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Manufacturers:

1. Baltimore Air Coil (BAC)
 2. Marley
 3. EVAPCO
- B. Cooling tower physical size envelope is limited to dimensions shown on plans.
- C. Tower shall be guaranteed to meet design capacity of 1,876 GPM of water cooled from 95F to 85F at 80F design wet bulb temperature. Cooling tower performance shall be CTI certified. Tower equipment shall be Factory Mutual Insurance approved and listed. Tower shall be selected to operate at maximum sound levels per cell not to exceed 77 dBA at 5' from air inlets with both cells operating.

2.02 GENERAL

1. Provide units suited for outdoor use, factory-assembled, induced draft with vertical discharge of air, and fan assemblies built into casing.
2. Provide units suited for outdoor use, induced draft with vertical discharge of air. Units will be shipped disassembled in protective crates. Crates and components must be clearly labeled with part numbers. Assembly of units will be completed onsite. Cold water basins will not have welded seams when shipped knocked down.

2.03 MATERIALS OF CONSTRUCTION

- A. Steel panels and structural members are constructed of galvanized steel with type 304 stainless steel hot and welded cold water basin.
- B. Structural steel components are constructed from g-235 (z700 metric) hot-dip galvanized steel. The edges of the hot-dip galvanized steel components are given a protective coat of zinc-rich compound. The areas of the cold-water basin in contact with the water will be constructed of type 304 stainless steel. All factory seams in the cold-water basin will be welded to ensure watertight construction and shall be warranted against leaks for a period of five (5) years from date of shipment. Cold water basin includes a depressed section with drain/clean-out connection and the area under the fill sections is sloped toward the depressed section for easy cleaning. Hot water distribution basins are gravity type constructed of heavy gauge, type 304 stainless steel. The unit is supplied with a weir dam in each hot water basin to accommodate water flow rates down to 50% of the design flow. Polypropylene metering orifices are provided to assure even distribution of water over the wet deck surface. Heavy gauge, type 304 stainless steel covers are furnished to prevent the accumulation of debris and algae in the hot water distribution basins.

2.04 FAN & DRIVE SYSTEM

- A. The fan is driven by a one-piece multi-groove, neoprene/polyester belt designed specifically for evaporative cooling equipment service. Motor is mounted on an adjustable motor base. Fan and motor sheaves are non-corrosive cast aluminum. The fan drive system, including fan motor, is warranted against defects in materials and workmanship for five (5) years from date of shipment. Fan and steel fan shaft are supported by heavy-duty, self-aligning, grease-packed, relubricatable ball bearings with special seals for protection against dust and moisture. All bearings are designed for minimum L10 life of 80,000 hours (280,000 hours average life).

2.05 FAN GUARD

- A. A heavy gauge, hot-dip galvanized steel wire fan guard is provided over the fan cylinder. The fan guard is shipped loose for field installation.

2.06 CASING PANELS

- A. Casing panels are constructed of fiberglass-reinforced polyester (FRP), UV protected panels. Hinged access doors are provided on both side walls of the tower for access to eliminators and fan plenum section for all cells. The doors are made of a steel frame matching the unit construction, with an exterior overlay of FRP.

2.07 INLET LOUVERS

- A. Air inlet louvers are wave-formed, fiberglass-reinforced polyester (FRP), spaced to minimize air resistance and prevent water splash-out.

2.08 FILL

- A. The fill and integral drift eliminators are formed from self-extinguishing (per ASTM D-568) polyvinyl chloride (PVC), having a flame spread rating of 5 per ASTM Standard E84-77a, and are impervious to rot, decay, and fungus or biological attack. The fill is elevated above the cold-water basin floor to facilitate cleaning. This fill is suitable for a maximum entering water temperature of 130°F (54.44°C). The eliminators are designed to effectively strip entrained moisture from the leaving airstream with a minimum of air resistance.

2.09 EQUIPMENT STRUCTURE

- A. The structure of this product has been designed and analyzed in accordance with the wind and seismic load requirements of the 2006 IBC, 2009 IBC, 2012 IBC, 2015 IBC, ASCE/SEI 7-05, and ASCE/SEI 7-10. Seismic qualification is based on analysis. For more information and specific wind and seismic load capacity ratings, please see the Certificate of Wind and Seismic Load Capacity.

2.10 WATER INLET(S)

- A. Two (2) hot water inlet flange pattern connections, suitable for ASME Class 150 Flat Face flanges, are located at the top of the designated cell(s). A butterfly valve for each inlet connection is shipped loose for field mounting by others.

2.11 WATER OUTLET(S)

- A. The depressed sump box(es) is fabricated of the same material as the cold-water basin and provided with a bolt hole pattern for mating with an ASME Class 150 flat face flange. The pattern is appropriately sized for the design flow. Side outlet depressed sump box(es) ships loose for field installation by others. The flat face flange, full face gasket, and hardware are supplied and installed by others. A large area, lift out strainer is provided which matches the cold-water basin material of construction and has perforated openings sized smaller than the water distribution nozzle orifices. Strainer includes anti-vortexing baffle to prevent air entrainment. Please see the submittal package for the connection size.

2.12 EQUALIZER / BYPASS CONNECTION

- A. The unit will be provided with a bypass connection on face b. Please see the submittal drawing package.

2.13 BASIN WATER LEVEL CONTROL

- A. A make-up valve with unsinkable polystyrene filled plastic float arranged for easy adjustment. The corrosion resistant make-up valve is suitable for water supply pressures between 15 psig (103 kpa) and 50 psig (345 kpa). For the size and location of the connection.

2.14 BASIN HEATER(S)

- A. A minimum number of high-watt-density electric immersion heater elements, sized to maintain +40°F (+4°C) basin water at 0°F (-18°C) ambient with a 15 mph (24.1 km/h) wind speed, is provided. Electrical requirements match fan motor. Wiring is not included.

2.15 HEATER ELEMENT MATERIAL OF CONSTRUCTION

- A. The unit is supplied with stainless steel heater elements.

2.16 BASIN HEATER CONTROL

- A. An electric immersion heater control package which includes a control panel in a /NEMA 4x enclosure is provided. It includes contactor(s), disconnect, thermostat, 24v transformer, and type 316 stainless steel probe for water level and water temperature sensing. Panel ships loose for field mounting and wiring by others.

2.17 VIBRATION CUTOFF SWITCH

- A. Fan system is provided with a vibration cutoff switch to limit damage to the unit in the event of a high vibration condition. The vibration switch is mechanically tripped with a frequency range of 0 to 3,600 RPM and trip point of 0.2 to 2.0 g's. No input power is required. Switch rating is 10 amperes at a maximum 480 VAC, and 1/4 ampere at 250 Vdc.

2.18 AIR DISCHARGE OPTION

- A. A 1'-9" (534 mm) tall fan cylinder extension constructed of G-235 (Z700 metric) hot-dip galvanized steel is included to increase the height of the air discharge. Field installation is by others.

2.19 SAFETY RAILINGS

- A. Perimeter safety railing constructed of 1-1/4" (32 mm) galvanized steel pipe is provided to facilitate access to the top of the unit. Railings meet pertinent OSHA standards and ship loose for field assembly and installation by others.

2.20 FAN DECK EXTENSION

- A. A fan deck platform extension with 1-1/4" (32 mm) galvanized steel pipe safety railing complying with OSHA standards and regulations provides a means of safe and convenient access to the fan deck for routine maintenance of the water distribution system. The supports for the fan deck platform are constructed of G-235 (Z700 metric) galvanized steel. Field assembly and installation is by others.

2.21 EXTERNAL LADDER TO TOP OF UNIT

- A. An aluminum ladder is provided to access the top of the unit. The ladder meets pertinent OSHA standards and ships loose for field installation by others.

2.21 ACCESS DOOR PLATFORM

- A. External service platforms with aluminum access ladder(s) and 1-1/4" (32 mm) galvanized steel pipe safety railing complying with OSHA standards and regulations provides safe and convenient access to the access doors when the equipment is installed above grade. Supports are compatible with the basic unit material of construction. Field installation is by others.

2.22 SAFETY GATE(S) FOR LADDER(S)

- A. A fully assembled, hot-dip galvanized steel hinged swing gate is provided for each ladder to the fan deck to meet OSHA standards. Gate is self-closing and includes a positive stop plate. Field installation is required.

2.23 INTERNAL ACCESS OPTION

- A. A type 304 stainless steel walkway complying with OSHA standards and regulations provides access to the plenum to facilitate servicing the unit.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Receive, off-load, and store as required, cooling tower and accessories before installation.
- B. Provide installation of cooling tower and accessories, complete in accordance with manufacturer's installation instructions.
- C. Adjust tower in alignment of structural supports. Level and bolt in place.
- D. Clean tower thoroughly. Comply with manufacturer's instructions for filling and start-up of operation to include not less than: verify lubrication of rotating parts; verify fan direction of rotation; verify that motor amperage measured at motor junction box is in accordance with manufacturer's data; balancing condenser water flow; adjust and verify operation of controls; coordinate all electrical requirement with Electrical Contractor. Schedule and coordinate initial water treatment with chemical treatment supplier.

END OF SECTION 236500

SECTION 238219
TERMINAL HEAT TRANSFER UNITS-FAN/BLOWER COIL UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fan Coil Units.
- B. Blower Coil Units.

1.02 RELATED SECTIONS

- A. Direct Digital Control System for HVAC – Section 230923.
- B. Hydronic Piping - Section 232113.
- C. Hydronic Specialties - Section 232114.
- D. Equipment Wiring Systems: Electrical supply to units - Division 26.

1.03 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's data for fan coil units, 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.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Protect units from physical damage by storing in protected areas and leaving factory covers in place.

PART 2 PRODUCTS

2.01 FAN COIL UNITS

- A. Configuration:
 - 1. General:
 - a. Factory assembled Hi-Performance horizontal and vertical fan coil units complete with coil, fan, motor, drain pan, and all required wiring, piping and controls.
 - b. Cabinet shall be made of heavy 18-gauge galvanized steel.
 - c. The interior surfaces shall be lined with 1/2" thick standard fiberglass insulation. Insulation and adhesive shall meet NFPA-90A requirements for flame spread and smoke generation.
 - d. Adhesive shall be certified according to the GREENGUARD Indoor Air Quality (IAQ) Certification for Low Emitting Products. Reference Standard: GGPS.001 GREENGUARD IAQ Standard for Building Materials, Finishes,

and Furnishings. Reference Standard: GGPS.002 GREENGUARD Children and SchoolsSM Standard.

- e. Units shall have a stainless-steel drain pan extending the entire width of the coil with “telltale” second drain connection. Drain pan shall comply with ASHRAE 62.1-2019.
 - f. Stainless steel pans shall be externally coated with 2-part closed cell foam insulation.
2. HPY Horizontal Hideaway with Plenum Units:
- a. Units shall be supplied with a collar for supply duct connection.
 - b. A heavy gauge steel plenum shall enclose the blower/motor assembly with bottom or rear return as indicated on the plans.
 - c. Units shall have pleated MERV 8 filter.
 - d. Unit shall have front supply/rear return, bottom filter access.
- B. Certification:
1. Safety Agency:
Units shall be listed by ETL indicating the units comply with the minimum requirements of the U.S. and Canadian national product safety standard, ANSI/UL Standard 1995, and with CAN/CSA C22.2 No. 236.
2. Capacities:
Fan coil capacities are certified and listed in accordance with AHRI Standard 440-2019.
- C. Materials:
1. Coils:
- a. All coils shall have 1/2” copper tubes, and aluminum fins, galvanized end sheet 10 fins per inch spacing, galvanized end sheets. Coil fins shall be mechanically bonded to copper tubes.
 - b. Copper tubes must comply with ASTM B-75.
 - c. Fin thickness shall be 0.0045”.
 - d. Tube thickness shall be 0.016”.
 - e. Coil rows shall be as indicated on the drawings.
2. Valves:
- a. For installation in a 4-pipe system, unit shall be equipped with:
 - 1) Valve size shall be as shown on the drawings.
 - 2) 4 manual ball valves for service.
 - 3) 2 motorized control valve, 300 psig service.
 - a) Primary - 35 psid proportional with quick-release actuator.
 - b) Secondary - 35 psid proportional with quick-release actuator.
 - b. Valve package shall be equipped with specialty devices as indicated on the drawings.
 - 1) Coil connections – unions at the coil.
 - 2) Flow Controls:
 - a) Primary - Return fixed flow control shall be specified on the equipment schedule.
 - b) Secondary - Return fixed flow control shall be specified on the equipment schedule.
 - 3) Service Fittings:
 - a) Primary - Supply P-T port.
 - b) Secondary - Supply P-T port.
 - 4) Strainer:
 - a) Primary - Y-Strainer with blowdown.
 - b) Secondary - Y-Strainer with blowdown.

3. Fans:
 - a. Fans shall be direct-drive, double-width fan wheels with forward-curved blades.
 - b. Blower wheels shall be statically and dynamically balanced.
 - c. Scrolls and fan wheels shall be constructed of galvanized steel.
 - d. Shall be easily removable.
4. Motors:
 - a. Motors shall be 3-speed, single phase, 60 Hz constant-torque ECM motors with means for potentiometer field adjustment of each speed.
 - b. Motors shall be connected with quick connect electrical plugs.
 - c. Motors shall have internal thermal overload protection with automatic reset.
5. Controls:
 - a. Controls Voltage:
 - 1) Unit shall be equipped with 24VAC control.
 - b. Control Package shall be equipped with specialty devices listed below:
 - 1) 24VAC condensate overflow switch.
 - 2) Controls by DDC Contractor.
6. Operating Characteristics:
 - a. A 4-pipe system shall be capable of providing heating and cooling on demand.
7. Electrical Requirements:
 - a. Standard unit shall operate on 115 volts, single phase, 60 Hz electrical power.
8. Options and Accessories:
 - a. Service switch with lock-out & tag-out features shall be factory installed. Circuit shall be non-fused.
9. Inlet plenums shall be constructed of 18-gauge galvanized steel. The inlet plenum shall enclose the motor and fan and include a filter rack.

2.02 FAN COIL UNITS

- A. Configuration
 1. General:
 - a. Factory assembled horizontal fan coil units complete with coil, fan, motor, drain pan, and all required wiring, piping and controls.
 - b. Cabinet shall be made of heavy 18-gauge galvanized steel.
 - c. The interior surfaces shall be lined with 1/2" thick standard fiberglass insulation. Insulation and adhesive shall meet NFPA-90A requirements for flame spread and smoke generation.
 - d. Adhesive shall be certified according to the GREENGUARD Indoor Air Quality (IAQ) Certification for Low Emitting Products. Reference Standard: GGPS.001 GREENGUARD IAQ Standard for Building Materials, Finishes, and Furnishings. Reference Standard: GGPS.002 GREENGUARD Children and SchoolsSM Standard.
 - e. Units shall have a removable stainless steel drain pan extending the entire width of the coil. Drain pan shall comply with ASHRAE 62.1-2019.
 - f. Stainless steel pans shall be externally coated with 2-part closed cell foam insulation.
 2. CPY, Horizontal Hideaway with Plenum Units:
 - a. Units shall be supplied with a collar for supply duct connection.
 - b. A heavy gauge steel plenum shall enclose the blower/motor assembly with bottom or rear return as indicated on the plans.
 - c. Units shall have a pleated MERV 8 filter.
 - d. Unit shall have front supply/rear return.

3. CXB Horizontal Cabinet Units:
 - a. The unit shall have a stamped discharge grille.
 - b. Units shall have removable bottom access panel with stamped return air grille and filter rack.
 - c. Units shall have pleated MERV 8 filter.
 - d. Cabinet shall be painted with a Bright White powder-coat finish.
 - e. Bottom panel shall be interlocking with cabinet and fastened with tamper proof quarter-turn fasteners.

- B. Certification:
 1. Safety Agency:

Units shall be listed by ETL indicating the units comply with the minimum requirements of the U.S. and Canadian national product safety standard, ANSI/UL Standard 1995, and with CAN/CSA C22.2 No. 236.
 2. Capacities:

Fan coil capacities are certified and listed in accordance with AHRI Standard 440-2019.

- C. Materials:
 1. Coils:
 - a. All coils shall have 1/2" copper tubes, manual air vent(s), and aluminum fins, galvanized end sheet, 10 fins per inch spacing, galvanized end sheets. Coil fins shall be mechanically bonded to copper tubes.
 - b. Copper tubes must comply with ASTM B-75.
 - c. Fin thickness shall be 0.0045".
 - d. Tube thickness shall be 0.016".
 - e. Coil rows shall be as indicated on the drawings.
 2. Valves:
 - a. For installation in a 4-pipe system, unit shall be equipped with:
 - 1) Valve size shall be as shown on the drawings.
 - 2) Manual ball valves for service.
 - 3) Motorized control valve, 300 psig service:
 - a) Primary 35 psid proportional with quick-release actuator.
 - b) Secondary 35 psid proportional with quick-release actuator.
 - b. Valve package shall be equipped with specialty devices as indicated on the drawings:
 - 1) Coil connections –unions at the coil.
 - 2) Flow Controls:
 - a) Primary - Return fixed flow control shall be specified on the equipment schedule.
 - b) Secondary - Return fixed flow control shall be specified on the equipment schedule.
 - 3) Service Fittings:
 - a) Primary - Supply and Return P-T port.
 - b) Secondary - Supply and Return P-T port.
 - 4) Strainer:
 - a) Primary - Y-Strainer with blowdown.
 - b) Secondary - Y-Strainer with blowdown.
 3. Fans:
 - a. Fans shall be direct-drive, double-width fan wheels with forward-curved blades.
 - b. Blower wheels shall be statically and dynamically balanced.
 - c. Scrolls and fan wheels shall be constructed of galvanized steel.
 - d. Shall be easily removable.

4. Motors:
 - a. Motors shall be 3-speed, single phase, 60 Hz EC motors for 115 volts, permanently lubricated ball bearings.
 - b. Motors shall be connected with quick connect electrical plugs.
 - c. Motors shall have internal thermal overload protection with automatic reset.
5. Controls:
 - a. Controls Voltage:
 - 1) Unit shall be equipped with 24VAC control.
 - b. Control Package shall be equipped with specialty devices listed below:
 - 1) 24V condensate overflow switch.
 - 2) Thermostat and controls by DDC Contractor.
6. Operating Characteristics:
 - a. A 4-pipe system shall be capable of providing heating and cooling on demand.
7. Electrical Requirements:
 - a. Standard unit shall operate on 115volts, single phase, 60 Hz electrical power, and all exposed wiring shall be in flexible conduit.
8. Options and Accessories:
 - a. Service switch with lock-out & tag-out features shall be factory installed. Circuit shall be non-fused.

2.03 BLOWER COIL UNITS (VBA)

- A. Configuration:
 1. General:
 - a. Factory assembled belt drive blower coil units complete with DX (R-454B) coil, hot water coil, fan, motor, drive, drain pan, and all required wiring, piping and controls.
 - b. Cabinet shall be made of heavy 18-gauge galvanized steel.
 - c. Units shall be supplied with a duct collar for supply duct connection.
 - d. The interior surfaces shall be lined with 1" closed cell insulation. Insulation and adhesive shall meet NFPA-90A requirements for flame spread and smoke generation.
 - e. Adhesive shall be certified according to the GREENGUARD Indoor Air Quality (IAQ) Certification for Low Emitting Products. Reference Standard: GGPS.001 GREENGUARD IAQ Standard for Building Materials, Finishes, and Furnishings. Reference Standard: GGPS.002 GREENGUARD Children & SchoolsSM Standard.
 - f. Units shall have a removable, double-sloped stainless steel drain pan extending the entire width of the coil, with "telltale" second drain connection. Primary drain connection shall be 3/4" male NPT and "tell-tale" connection shall be 1/2" male NPT stainless steel fittings. Primary and secondary drain connections shall be located on the same end as coil connections.
 - g. Stainless steel pans shall be externally coated with 2-part closed cell foam insulation.
 - h. Units shall have 2" pleated MERV 8 filter.
 2. VBA Vertical Belt Drive Units:
 - a. Units shall be supplied with a duct collar for supply duct connection.
 - b. Access panels on both sides of the cabinet shall be removable with tool.
 - c. Filter shall be removable from either side of the filter rack. Additional access shall be top filter access.
- B. Certification:
 1. Safety Agency:

Units shall be listed by ETL indicating the units comply with the minimum requirements of the U.S. and Canadian national product safety standard, ANSI/UL Standard 1995, and with CAN/CSA C22.2 No. 236.

2. Capacities:

Blower coil capacities are tested in accordance with AHRI Standard 440-2019.

C. Materials:

1. Coils:

- a. All coils shall have 1/2" copper tubes, manual air vent(s), and aluminum fins, galvanized end sheets, 10 fins per inch spacing. Coil fins shall be mechanically bonded to copper tubes.
- b. Copper tubes must comply with ASTM B-75.
- c. Fin thickness shall be 0.0045"
- d. Tube thickness shall be 0.016"
- e. Coil rows shall be indicated on the drawings.
- f. DX coils shall be supplied with a thermostatic expansion valve to provide refrigerant metering. The expansion valve shall be dual port balanced types with external equalizer for optimum refrigerant metering. Units shall be tested for operating ranges of entering temperatures from 20F to 120F.

2. Valves:

- a. For installation in a 4-pipe system, unit shall be equipped with:
 - 1) Valve size shall be as shown on the drawings.
 - 2) Manual ball valves for service.
 - 3) Motorized control valve, 300 psig service:
 - a) Primary 35 psid proportional with quick-release actuator.
 - b) Secondary 35 psid proportional with quick-release actuator.
- b. Valve package shall be equipped with specialty devices as indicated on the drawings:
 - 1) Coil connections –unions at the coil.
 - 2) Flow Controls:
 - a) Primary - Return fixed flow control shall be specified on the equipment schedule.
 - b) Secondary - Return fixed flow control shall be specified on the equipment schedule.
 - 3) Service Fittings:
 - a) Primary - Supply and Return P-T port.
 - b) Secondary - Supply and Return P-T port.
 - 4) Strainer:
 - a) Primary - Y-Strainer with blowdown.
 - b) Secondary - Y-Strainer with blowdown.

3. Blowers:

- a. Blowers shall be belt-driven, double-width fan wheels with forward-curved blades.
- b. Blower wheels shall be statically and dynamically balanced.
- c. Scrolls and fan wheels shall be constructed of galvanized steel.
- d. Blower housing shall be isolated from the cabinet and motor.
- e. Bearings shall be ball bearing type (no sleeve bearings allowed), permanently lubricated and sealed for life. Bearings shall be isolated from the blower housing by rubber mounts set into heavy gauge metal support system.
- f. Shaft shall be of solid steel (no hollow shafts allowed), keyed to drive components.

4. Drive:

- a. Drive shall consist of variable pitch motor pulley, fixed diameter blower

- sheave with keyed shaft and drive belt.
 - b. Drive shall be designed for 120% of rated fan horsepower.
- 5. Motors:
 - a. Motors shall be single speed with permanent split capacitor type, open drip proof, resilient mounted NEMA frame motor.
 - b. Motors shall be connected with quick connect electrical plugs.
 - c. Motor shall have internal thermal overload protection with automatic reset or fused overload protection.
 - d. Motor service access shall be on same side as coil connections.
 - e. Motor shall be mounted on adjustable base for belt tensioning and alignment.
- 6. Controls and Safeties:
 - a. Control Voltage:
 - 1) Unit shall be equipped with 24VAC control.
 - b. Control Package shall be equipped with specialty devices listed below:
 - 1) Condensate overflow switch.
 - c. Refrigerant leak detection sensor for field installation
- 7. Options and Accessories:
 - a. Unit shall be furnished with unit-mounted, factory-installed and interlocking fused disconnect switch. Fuses shall comply with NFPA 70E/IP20.

2.04 CONTROLS AND VALVES

- A. Each unit shall be provided with thermostat with integral fan speed switch. Coordinate with controls.
- B. Units shall be provided with factory mounted 2-way (3-way where noted) electrically operated control valves for the chilled water piping, and heating water piping.
- C. A combination ball shutoff valve, with automatic flow control device, T&P port and union shall be provided in the leaving water piping for each unit.
- D. A combination ball shutoff valve with T&P port and union shall be provided in the supply piping to each unit.

2.05 MANUFACTURERS:

- A. Fan/Blower Coil Units:
 - 1. Trane.
 - 2. Carrier.
 - 3. International (IEC).
 - 4. Engineer Approved.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work and opening dimensions are as indicated on shop drawings.
- B. Verify that required utilities are available, in proper location and ready for use.

3.02 INSTALLATION

- A. Install fan coil units in accordance with manufacturer's instructions.
- B. Provide riser support at each floor level as recommended by unit manufacturer.
- C. Hang fan coil units from building structure, with hangers anchored to building, not from piping. Mount as high as possible to maintain greatest headroom unless otherwise indicated.
- D. Install vertical blower coil units on 4" concrete equipment pad.
- E. Protect units with protective covers during balance of construction.

3.03 CLEANING

- A. Clean work under provisions of Division 1.
- B. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.
- C. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.
- D. Install new filters at substantial completion. Provide one complete set of replacement filters to Owner.
- E. Provide one complete set of replacement belts to Owner.

END OF SECTION 238219

**SECTION 260500
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, 2000 Edition.
 - 9. Local, City and State Codes and Ordinances.
 - 10. National Electrical Code, 2005 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 occur, 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 insure 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 260500

SECTION 260502
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 0519 – Low-Voltage Electrical Power Connectors and Cable.
- B. Section 26 0529 – Hangers and Supports for Electrical Systems.
- C. Section 26 0533 – Raceway and Boxes for Electrical Systems.
- D. Section 26 2816 - Enclosed Switches and Circuit Breakers.
- E. Section 26 2913 - Enclosed Motor Controllers.

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.

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 260502

SECTION 260519
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 260529 – Hangers and Supports for Electrical Systems.
- B. Section 260533 – Raceway and Boxes for Electrical Systems.
- C. Section 260553 – 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 260500.
- 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 is 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. 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).

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.
- U. On single phase, three wire systems do not use a common neutral for more than 2 circuits.
- 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:

<u>208Y120 Volts</u>	<u>Switchlegs</u>	
Phase A	Black	Violet
Phase B	Red	Pink
Phase C	Blue	
Ground	Green	
Neutral	White	
Isolated Ground	Green with Yellow Stripe	

- 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.
- B. Wire nuts in damp or wet locations.
- C. Copper-clad aluminum conductors.

END OF SECTION 260519

SECTION 260526
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 260519 – Low Voltage Electrical Power Conductors and Cables.
- B. Section 260533 – 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 260519.

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 260533.

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 260526

SECTION 260529
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 260500.
- 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 260529

SECTION 260533
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. PVC conduit.
- F. Fittings and conduit bodies.
- G. Wall and ceiling outlet boxes.
- H. Pull and junction boxes.

1.02 RELATED SECTIONS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 – Hangers and Supports for Electrical Systems.
- C. Section 260548 – Vibration and Seismic Controls for Electrical Systems.
- D. Section 260553 - Identification for Electrical Systems.
- E. Section 262726 - Wiring Devices.
- F. Section 260502 - 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 260500.
- 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. 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".
- 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 15 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 15 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.

2.07 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 260526.
- T. Identify conduit under provisions of Section 260553.
- 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 260548.
- 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 seal-offs 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 floor boxes 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 locknutt 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 cover clips 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 260533

SECTION 260548
VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SCOPE

- A. The requirements for seismic protection measures to be applied to electrical 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 2021 Arkansas Fire Prevention Code. The electrical equipment shall include the following items to the extent required on plans or in other sections of the following specifications:

Conduit, 2-1/2 inches or larger
Panelboards
Cable Trays
Switches
Light Fixtures
Switchboards
Communication Racks

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Basic Electrical Requirements - Section 26 0500.

1.03 APPLICABLE PUBLICATIONS

- A. American National Standards Institute, Inc. (ANSI):
1. B18.2.1-1981
 2. B18.2.2-1972
- B. American Society for Testing and Materials (ASTM):
1. A36-84a
 2. A307-84
 3. A325-85
 4. A501-84
 5. A576-81
- C. Federal Specifications:
1. RR-W-410D
- D. NEMA
1. 250 Enclosures for Electrical Equipment
 2. IC56

1.04 REGULATORY REQUIREMENTS

- A. Conform to NFPA 70 - National Electrical Code and International Building Code.
- B. Conform to 2021 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. Vibration isolation devices shall be selected so that the maximum movement of equipment from the static deflection point shall be 0.5 inches.

- 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** All recessed fluorescent light fixtures shall have seismic clips firmly situated over tops of ceiling grid tees or plaster frames.
- 3.04** Sway bracing shall be provided for all 2-1/2 inch or larger conduits, not individually supported with hangers 12 inches or less in length.
- 3.05** All 2-1/2 inch or larger conduits entering or leaving a building or structure shall have a flexible seismic

expansion fitting installed within the earth prior to entering the building or after leaving the building. Fitting shall be within 5'-0" of building or structure. Fitting shall be equal to Appleton Type DF.

- 3.06** All light fixtures that weight more than 50 pounds shall have a safety chain or safety cable in addition to its other support.
- 3.07** Sway bracing shall be provided for all cable trays.
- 3.08** Communications racks shall be bolted to floor. Tops of racks shall be bolted to walls.
- 3.09** Cable trays and conduits shall be independently supported and braced independently of the ceiling.
- 3.10** Powder-activated fasteners (shot pins) shall not be used for anchorage.
- 3.11** Vibration isolators shall have a bumper restraint in each horizontal direction, and vertical restraints shall be provided where required to resist overturning.
- 3.12** Internal coils of dry type transformers shall be positively attached to their supporting substructure within the transformer enclosure.
- 3.13** Slide-out components in electrical equipment shall have a latching mechanism to hold contents in place.
- 3.14** Electrical cabinet design shall conform to NEMA 250 and NEMA IC56.
- 3.15** The attachment of additional items weighing more than 100 pounds to electrical equipment is prohibited.
- 3.16** Friction clips shall not be used for anchorage attachments.
- 3.17** 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 260548

SECTION 260553
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 099100 - Painting: Boxes.

1.04 SUBMITTALS

- A. Submit under provisions of Division 1 and Section 260500.
- 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 background.
- 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. Legend:
 - 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:

<u>Application</u>	<u>Color</u>	<u>Caution Wording</u>
Electrical	Red	"Caution – Electric Line Buried Below"
- 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 260533

SECTION 260573
ARC FLASH HAZARD ANALYSIS
SHORT-CIRCUIT/COORDINATION STUDY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. The contractor shall furnish short-circuit and protective device coordination studies as prepared by Square D Engineering Services, Cutler Hammer Engineering Services or Siemens Engineering Services.
- B. The contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in the current version of NFPA 70E-Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE Standard 1584 – 2002, the IEEE Guide for Performing Arc-Flash Calculations.

1.02 REFERENCES

- A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
 - 2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 - 3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
 - 4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
 - 5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
 - 6. IEEE 1584 -Guide for Performing Arc-Flash Hazard Calculations
- B. American National Standards Institute (ANSI):
 - 1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
 - 2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
 - 3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
 - 4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
- C. The National Fire Protection Association (NFPA)
 - 1. NFPA 70 -National Electrical Code, latest edition
 - 2. NFPA 70E – Standard for Electrical Safety in the Workplace

1.03 SUBMITTALS

- A. The studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the study may cause delays in equipment shipments, approval from the Engineer may be obtained for a preliminary submittal of

data to ensure that the selection of device ratings and characteristics will be satisfactory to properly select the distribution equipment. The formal study will be provided to verify preliminary findings.

1.04 SUBMITTALS FOR CONSTRUCTION

- A. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. A minimum of five (5) bound copies of the complete final report shall be submitted. For large system studies, submittals requiring more than five (5) copies of the report will be provided without the section containing the computer printout of the short-circuit input and output data. Electronic PDF copies of the report shall be provided upon request.
- B. The report shall include the following sections:
 - 1. Executive Summary including Introduction, Scope of Work and Results / Recommendations.
 - 2. Short-Circuit Methodology Analysis Results and Recommendations
 - 3. Short-Circuit Device Evaluation Table
 - 4. Protective Device Coordination Methodology Analysis Results and Recommendations
 - 5. Protective Device Settings Table
 - 6. Time-Current Coordination Graphs and Recommendations
 - 7. Arc Flash Hazard Methodology Analysis Results and Recommendations including the details of the incident energy and flash protection boundary calculations, along with Arc Flash boundary distances, working distances, Incident Energy levels and Personal Protection Equipment levels.
 - 8. Arc Flash Labeling section showing types of labels to be provided. Section will contain descriptive information as well as typical label images.
 - 9. One-line system diagram that shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location, device numbers used in the time-current coordination analysis, and other information pertinent to the computer analysis.

1.05 QUALIFICATIONS

- A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the responsible charge and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.
- B. The Registered Professional Electrical Engineer shall be an employee of the equipment manufacturer or an approved engineering firm.
- C. The approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analyses it has performed in the past year.

1.07 COMPUTER ANALYSIS SOFTWARE

- A. The studies shall be performed using SKM Systems Analysis Power*Tools for Windows (PTW) software program.

PART 2 PRODUCTS

2.01 STUDIES

- A. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D. This study shall also include short-circuit and protective device coordination studies. All studies to be prepared by Square D Engineering Services.

2.02 DATA

- A. Contractor shall furnish all data as required for the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- B. Source combination may include present and future motors and generators.
- C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner, or Contractor.
- D. If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.03 SHORT-CIRCUIT ANALYSIS

- A. Transformer design impedances shall be used when test impedances are not available.
- B. Provide the following:
 - 1. Calculation methods and assumptions
 - 2. Selected base per unit quantities
 - 3. One-line diagram of the system being evaluated that clearly identifies individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis
 - 4. The study shall include input circuit data including electric utility system characteristics, source impedance data, conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.
 - 5. Tabulations of calculated quantities including short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings and notes regarding adequacy or inadequacy of the equipment rating.
 - 6. Results, conclusions, and recommendations. A comprehensive discussion section evaluating the adequacy or inadequacy of the equipment must be provided and include recommendations as appropriate for improvements to the system.
- C. For solidly-grounded systems, provide a bolted line-to-ground fault current study for applicable buses as determined by the engineer performing the study.

- D. Protective Device Evaluation:
 - 1. Evaluate equipment and protective devices and compare to short circuit ratings
 - 2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses
 - 3. Square D shall notify Owner in writing, of any circuit protective devices improperly rated for the calculated available fault current.

2.04 PROTECTIVE DEVICE TIME-CURRENT COORDINATION ANALYSIS

- A. Protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
- B. Include on each TCC graph, a complete title with descriptive device names.
- C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
- D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- E. Plot the following characteristics on the TCC graphs, where applicable:
 - 1. Electric utility's overcurrent protective device
 - 2. Medium voltage equipment overcurrent relays
 - 3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
 - 4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
 - 5. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves
 - 6. Medium voltage conductor damage curves
 - 7. Ground fault protective devices, as applicable
 - 8. Pertinent motor starting characteristics and motor damage points, where applicable
 - 9. Pertinent generator short-circuit decrement curve and generator damage point
 - 10. The largest feeder circuit breaker in each motor control center and applicable panelboard.
- F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.
- G. Provide the following:
 - 1. A One-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known.
 - 2. A sufficient number of log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.
 - 3. Computer printouts shall accompany the log-log plots and will contain descriptions for each of the devices shown, settings of the adjustable devices, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.
 - 4. The study shall include a separate, tabular printout containing the recommended settings of all adjustable overcurrent protective devices, the equipment

designation where the device is located, and the device number corresponding to the device on the system one-line diagram

5. A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices, along with recommendations as required for addressing system protection or device coordination deficiencies.

2.05 ARC FLASH HAZARD ANALYSIS

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D. The arc flash hazard analysis shall be performed in conjunction with the short-circuit analysis (Section 2.03) and the protective device time-current coordination analysis (Section 2.04)
- B. The flash protection boundary and the incident energy shall be calculated at significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
- C. Circuits 240V or less where available bolted short circuit current is less than 10 kA may be omitted from the computer model and will be assumed to have a hazard risk category 0 per NFPA 70E Table 130.7(C)(9)(a), including footnote 3.
- D. Circuits 240V or less fed by transformers 112.5 kVA or less may be omitted from the computer model and will be assumed to have a hazard risk category 0 per IEEE 1584.
- E. Working distances shall be based on IEEE 1584. The calculated arc flash protection boundary shall be determined using those working distances.
- F. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.
- G. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location in a single table. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum. Conversely, the maximum calculation will assume a maximum contribution from the utility. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable as well as any stand-by generator applications.
The Arc-Flash Hazard Analysis shall be performed utilizing mutually agreed upon facility operational conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.
- H. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors should be decremented as follows:
 1. Fault contribution from induction motors should not be considered beyond 5 cycles.

- I. For each piece of ANSI rated equipment with an enclosed main device, two calculations shall be made. A calculation shall be made for the main cubicle, sides, or rear; and shall be based on a device located upstream of the equipment to clear the arcing fault. A second calculation shall be made for the front cubicles and shall be based on the equipment's main device to clear the arcing fault. For all other non-ANSI rated equipment, only one calculation shall be required and it shall be based on a device located upstream of the equipment to clear the arcing fault.
- J. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
- K. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- L. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. A maximum clearing time of 2 seconds will be used based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.
- M. Provide the following:
 - 1. Results of the Arc-Flash Hazard Analysis shall be submitted in tabular form, and shall include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, working distances, personal-protective equipment classes and AFIE (Arc Flash Incident Energy) levels.
 - 2. The Arc-Flash Hazard Analysis shall report incident energy values based on recommended device settings for equipment within the scope of the study.
 - 3. The Arc-Flash Hazard Analysis may include recommendations to reduce AFIE levels and enhance worker safety.

PART 3 EXECUTION

3.01 FIELD ADJUSTMENT

- A. Contractor shall adjust relay and protective device settings according to the recommended settings table provided by the coordination study.
Field adjustments to be completed by switchgear manufacturer services under the separate Startup and Acceptance Testing contract portion of project specifications.
- B. Contractor shall make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

3.02 ARC FLASH LABELS Square D Engineering Services shall provide a 4.0 in. x 4.0 in. Brady thermal transfer type label of high adhesion polyester for each work location analyzed.

- A. The labels shall be designed according to the following standards:
 - 1. UL969 – Standard for Marking and Labeling Systems
 - 2. ANSI Z535.4 – Product Safety Signs and Labels
 - 3. NFPA 70 (National Electric Code) – Article 110.16
- B. The label shall include the following information:

1. System Voltage
 2. Flash protection boundary
 3. Personal Protective Equipment category
 4. Arc Flash Incident energy value (cal/cm²)
 5. Limited, restricted, and prohibited Approach Boundaries
 6. Study report number and issue date
- C. Labels shall be printed by a thermal transfer type printer, with no field markings.
- D. Arc flash labels shall be provided for equipment as identified in the study and the respective equipment access areas per the following:
1. Floor Standing Equipment-Labels shall be provided on the front of each individual section. Equipment requiring rear and/or side access shall have labels provided on each individual section access area. Equipment line-ups containing sections with multiple incident energy and flash protection boundaries shall be labeled as identified in the Arc Flash Analysis table.
 2. Wall Mounted Equipment – Labels shall be provided on the front cover or a nearby adjacent surface, depending upon equipment configuration.
 3. General Use Safety labels shall be installed on equipment in coordination with the Arc Flash labels. The General Use Safety labels shall warn of general electrical hazards associated with shock, arc flash, and explosions, and instruct workers to turn off power prior to work.
- E. Label Installation
1. Labels shall be field installed by Square D Services. The technician providing the installation shall have completed an 8-Hour instructor led Electrical Safety Training Course with includes NFPA 70E material including the selection of personal protective equipment.

3.03 ARC FLASH TRAINING

- A. The vendor supplying the Arc Flash Hazard Analysis shall train the owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET) or equivalent. The trainer shall be an authorized OSHA Outreach instructor.
- B. The vendor supplying the Arc Flash Hazard Analysis shall offer instructor led and online NFPA 70E training classes.

END OF SECTION 260573

SECTION 262413 SWITCHBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Main switchboard.
- B. Distribution switchboard.

1.02 RELATED SECTIONS

- A. Section 03300 - Cast-in-Place Concrete: Concrete pads.
- B. Section 09900 - Painting: Touchup.
- C. Section 260553 - Identification for Electrical Systems: Engraved nameplates.
- D. Section 262700 – Low-Voltage Distribution Equipment: Utility metering equipment.
- E. Section 260548 – Vibration and Seismic Controls for Electrical Systems.

1.03 REFERENCES

- A. ANSI C39.1 - Electrical Analog Indicating Instruments.
- B. ANSI C57.13 - Instrument Transformers.
- C. ANSI/IEEE C12.1 - Code for Electricity Metering.
- D. ANSI/NFPA 70 - National Electrical Code.
- E. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
- F. NEMA KS 1 - Enclosed Switches.
- G. NEMA PB 2 - Deadfront Distribution Switchboards.
- H. NEMA PB 2.1 - Proper Handling, Installation, Operation and Maintenance of Deadfront Switchboards Rated 600 Volts or less.
- I. UL 891 - Deadfront Switchboards.
- J. UL 1558 - Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear.

1.04 SUBMITTALS

- A. Submit under provisions of Division 1 and Section 260500.
- B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral, and ground; and switchboard instrument details.

- C. Product Data: Provide electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of all equipment and components.
- D. Test Reports: Indicate results of factory production tests.
- E. 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 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

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 DELIVERY, STORAGE, AND HANDLING

- A. Accept switchboards on site. Inspect for damage.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with NEMA PB 2.1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Conform to NEMA PB 2 service conditions during and after installation of switchboards.

1.09 EXTRA MATERIALS

- A. Provide three of each size and type of fuse installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Eaton.
- B. Square D.

Note: No alternate manufacturers will be accepted.

2.02 SWITCHBOARD

- A. Description: NEMA PB 2 with electrical ratings and configurations as indicated.

- B. Main Section Devices: Individually mounted and compartmented with ground fault protection for 480Y277 volt switchboards.
- C. Distribution Section Devices: Group-mounted.
- D. Auxiliary Section Devices: Group-mounted.
- E. Bus Material: Copper, standard size.
- F. Bus Connections: Bolted, accessible from front for maintenance.
- G. Ground Bus: Extend length of switchboard.
- H. Molded Case Circuit Breakers: NEMA AB 1, integral thermal, and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
- I. Solid-state Molded Case Circuit Breakers: NEMA AB 1, provide with electronic sensing, timing and tripping circuits for adjustable current settings; ground fault trip; instantaneous trip; and adjustable short time trip. Provide stationary mounting. Provide ground fault sensing integral with circuit breaker. Provide zero sequence type ground fault sensor.
- J. Line and Load Terminations: Accessible from the front only of the switchboard, suitable for the conductor materials and sizes indicated.
- K. Ground Fault Sensor: Zero sequence type.
- L. Ground Fault Relay: Adjustable ground fault sensitivity from 200 to 1200 amperes, time delay adjustable from 0 to 15 seconds. Provide monitor panel with lamp to indicate relay operation, TEST and RESET control switches.
- M. Future Provisions: Fully equip spaces for future devices with bussing and bus connections, suitably insulated and braced for short circuit currents. Provide continuous current rating as indicated.
- N. Enclosure: Type 1 - General Purpose.
 - 1. Align sections at front and rear.
 - 2. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.
 - 3. Mimic Bus: Show bussing, connections and devices in single line form on the front panels of the switchboard using blue color factory painting, fastened flat against the panel face with screws or rivets.
- O. Interrupting Rating: Rating shall be fully rated in RMS symmetrical amperes. Series rated equipment will not be accepted.

2.03 POWER METER

- A. Manufacturers:
 - 1. Square D.
 - 2. General Electric.
 - 3. Siemens - ITE.
 - 4. Cutler-Hammer.

- B. The information provided by the Power Meter shall include the following quantities:
1. Current, per-phase and neutral.
 2. Volts, phase-to-phase and neutral.
 3. Real Power (kW), per phase and three-phase total.
 4. Reactive Power (kVAR), per phase and three-phase total.
 5. Apparent Power (kVA), per phase and three-phase total.
 6. Power Factor (true), per phase and three-phase total.
 7. Frequency.
 8. Demand Current, per phase and neutral, present and peak.
 9. Real Power Demand (kWd), three-phase total, present and peak.
 10. Reactive Power Demand (kVARd), three-phase total, present and peak.
 11. Apparent Power Demand (kVAd), three-phase total, present and peak.
 12. Real Energy (kWh), three-phase total.
 13. Reactive Energy (kVARh), three-phase total.
 14. Apparent Energy (kVAh), three-phase total.
 15. Energy Accumulation modes, signed, absolute, energy in, energy out.
 16. Total Harmonic Distortion (THD), voltage, and current, per phase
 17. Date and Time Stamping, peak demands power up/restart and resets
- C. The Power Meter shall be accurate to 0.35 percent of reading plus 0.05 percent of full scale for voltage and current sensing, and 0.5 percent of reading plus 0.05 percent of full scale for power and energy, accurate through the 31st harmonic.
- D. Meter shall have BACNET IP and MSTP Conversion outputs for remote monitoring.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surface is suitable for switchboard installation.
- B. Verify that housekeeping pad is level.

3.02 PREPARATION

- A. Provide and install 4-inch-high concrete housekeeping pad.

3.03 INSTALLATION

- A. Install switchboard in locations shown on Drawings, in accordance with manufacturer's written instructions and NEMA PB 2.1.
- B. Tighten accessible bus connections and mechanical fasteners after placing switchboard. Torque bus connections to manufacturer's specified foot-pounds with a torque wrench.
- C. Install fuses in each switch.
- D. Install all screws and bolts in coverplates.
- E. Install nameplates at each circuit breaker or switch.
- F. Level switchboard.
- G. Ground non-service equipment switchboards with equipment grounding conductor in

switchboard feeder. Where switchboard is the main service equipment, verify switchboard enclosure is bonded to equipment ground bus.

- H. Install switchboard designation nameplate.
- I. Neatly form all wires in the switchboard.

3.04 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed.
- B. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.
- C. Measure insulation resistance of each bus section phase to phase and phase to ground for one minute each, at test voltage of 1000 volts; minimum acceptable value for insulation resistance is 2 megohms.
- D. Check tightness of accessible bolted bus joints and conductor lugs using calibrated torque wrench.
- E. Physically test key interlock systems to insure proper function.
- F. Bolt switchboard to floor in accordance with Section 26 0548.

3.05 ADJUSTING

- A. Adjust all operating mechanisms for free mechanical movement.
- B. Tighten bolted bus connections in accordance with manufacturer's instructions.
- C. Adjust circuit breaker trip and time delay settings to values as instructed by the Engineer.

3.06 CLEANING

- A. Touch up scratched or marred surfaces to match original finish.

END OF SECTION 262413

SECTION 262600
LOW-VOLTAGE ELECTRICAL DISTRIBUTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Arrangement with Utility Company for permanent and temporary electric services, including payment of Utility Company charges for service.
- B. Underground service entrance.
- C. Metering equipment.

1.02 RELATED SECTIONS

- A. Section 033000 - Cast-In-Place Concrete for pad mounted transformers and/or free-standing C.T. cabinets.
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
- C. Section 260529 – Hangers and Supports for Electrical Systems.
- D. Section 260533 – Raceway and Boxes for Electrical Systems.
- E. Section 312100 – Earth Moving.
- F. Section 312316 - Trenching.
- G. Section 312323 - Backfilling.

1.03 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.
- B. NETA – National Electrical Testing Association.

1.04 SYSTEM DESCRIPTION

- A. Utility Company: Entergy of Arkansas.
- B. System Characteristics: 208 volts, three phase, four- wire, 60 Hertz.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with Utility Company written requirements.
- B. Maintain one copy of each document on site.

1.06 REGULATORY REQUIREMENTS

- A. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.
- B. Conform to the requirements of NFPA 70 - National Electrical Code, ANSI/IEEE C2 - National Electrical Safety Code, and Arkansas Public Service Commission rules and regulations.

1.07 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on Utility Company drawings.

PART 2 PRODUCTS

2.01 UTILITY METERS

- A. Meters will be furnished and installed by Utility Company.

2.02 UTILITY METER BASES

- A. Meter bases will be purchased by Contractor from Utility Company and installed by the Contractor.

2.03 UTILITY CURRENT TRANSFORMER CABINET

- A. Current transformer cabinet shall be purchased by Contractor from Utility Company and shall be installed by Contractor per directions from Utility Company.

2.04 TRANSFORMER PAD

- A. Description: Concrete transformer pad with cable pit sized as indicated on Drawings.

2.05 GROUND GRID

- A. Stranded copper conductors, exothermic connections, and copper clad steel ground rods as directed by Utility Company.

2.06 LUGS

- A. Contractor shall provide lugs to the Utility to connect underground service conductors to pad-mounted transformer secondary terminals.

2.07 CONDUITS

- A. Above ground conduit shall be threaded rigid steel.
- B. Underground conduit shall be Schedule 80 with IMC elbows.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that service equipment is ready to be connected and energized.

3.02 PREPARATION

- A. Make arrangements with Utility Company to obtain permanent and temporary electric services to the Project.
- B. Coordinate location of Utility Company's facilities to ensure proper access is available.
- C. Pay all fees for electrical service to Utility Company.

3.03 INSTALLATION

- A. Install service entrance conduits and conductors from Utility Company's transformer to building service entrance equipment.

- B. Provide cast-in-place concrete pad and ground grid for Utility Company transformer and/or free-standing C.T. cabinet, under the provisions of Section 03 300.
- C. Provide buried PVC conduit from primary compartment of transformer pad to Utility Company's pole as directed by Utility Company.
- D. Install meter and current transformer cabinet as directed by Utility Company.
- E. Provide and install secondary lugs at transformer and lugs at current transformer cabinet.
- F. Level concrete pads.
- G. Dress up areas of excavation.
- H. Ground enclosures, current transformers, and meter.
- I. Install conduit hubs when exiting the top or sides of a NEMA 3R enclosure.
- J. Install weatherheads on ends of conduits for overhead services.
- K. Install meters, current transformer cabinets, and outdoor service equipment on 1-1/2-inch channels.

3.04 FIELD QUALITY CONTROL

- A. Torque lugs to NETA specifications.

END OF SECTION 262600

SECTION 262726 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 260533 - Boxes.
- B. Section 260553 - 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 260500.
- 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 (NO SUBSTITUTIONS)

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 typewriter 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 260533 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 262726

SECTION 262816
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fusible switches.
- B. Non-fusible switches.
- C. Fuses.
- D. Enclosed circuit breakers.

1.02 REFERENCES

- A. ASME A17.1 - Safety Code for Elevators and Escalators.
- B. NECA (National Electrical Contractors Association) "Standard of Installation".
- C. NEMA AB 1 - Molded-Case Circuit Breakers.
- D. NEMA KS 1 - Enclosed Switches.
- E. NFPA 70 - National Electrical Code.
- F. UL 50 - Enclosures for Electrical Equipment.
- G. UL 98 - Enclosed and Dead-Front Switches.
- H. UL 198C - High Interrupting Capacity Fuses; Current Limiting Type.
- I. UL 198E - Class R fuses.
- J. UL 363 - Knife Switches.
- K. UL 489 - Molded-Case Circuit Breakers and Circuit Breaker Enclosures.
- L. UL 1066 - Low Voltage AC and DC Power Circuit Breakers Used in Enclosures.
- M. UL 1332 - Organic Coatings for Steel for Outdoor-Use Electrical Equipment Enclosure.

1.03 RELATED SECTIONS

- A. Section 099100 - Painting: Touchup.
- B. Section 260529 – Hangers and Supports for Electrical Systems.
- C. Section 260548 – Vibration and Seismic Controls for Electrical Systems.
- D. Section 260553 - Identification for Electrical Systems.

1.04 SUBMITTALS

- A. Submit under provisions of Division 1 and Section 260500.
- B. Product Data: Provide switch ratings and enclosure dimensions.

- 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 QUALITY ASSURANCE

- A. Perform Work in accordance with NECA Standard of Installation.

1.06 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by UL as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Disconnect switches shall be heavy duty, as manufactured by,
 - 1. Square D
 - 2. General Electric
 - 3. Siemens ITE
 - 4. Cutler-Hammer

2.02 ENCLOSED SWITCHES

- A. Fusible Switch Assemblies: NEMA KS 1, Type HD load interrupter enclosed knife switch, with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate Class R fuses.
- B. Non-fusible Switch Assemblies: NEMA KS 1, Type HD load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- C. Enclosures: NEMA KS 1.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R.

2.03 ENCLOSED CIRCUIT BREAKERS

- A. Enclosures: NEMA KS 1.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R, lockable.
- B. Minimum integrated short circuit rating as indicated on the Drawings shall be fully rated rating. Series-Rated equipment will not be accepted.
- C. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
- D. Cabinet: Finish in manufacturer's standard gray enamel.
- E. 480Y277 volt main circuit breakers rated 1000 amperes or more shall have ground fault protection.

2.04 FUSES

- A. Manufacturers:
 - 1. Bussman.
 - 2. Gould-Shawmut.
 - 3. Little.
- B. Description: Dual element, current limiting, time delay, one-time fuse, 600 volt, UL 198E, Class RK 1.
- C. Interrupting Rating: 200,000 rms amperes.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install the electrical device where indicated.
- B. Install fuses in fusible disconnect switches.
- C. Install equipment ground bus in enclosed circuit breaker / switch.
- D. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.
- E. Provide label on outside cover as directed by Section 26 0553 - Identification for Electrical Systems.
- F. Provide three (3) spare fuses of each type utilized.
- G. Bolt enclosed circuit breaker / switch to mounting surface in accordance with Section 26 0529.
- H. Where wall-mounted circuit breaker / switches are mounted to be operated from floor or grade, install switch with middle of switch at 48 inches, if switch is less than 6'-6" tall. If switch is taller than 6'-6" tall, install switch with top of switch at 7'-6".
- I. When the electrical devices are installed on exterior basement walls or outside, the switches shall be mounted on 1-1/2 inch channels.
- J. Enclosed switches for wall-mounted exhaust fans installed higher than 8' from the floor, shall be installed high on the wall next to the exhaust fan.
- K. Install nameplate on disconnect switch with designation of equipment being served by switch. If main switch, install "Main Disconnect" nameplate.
- L. Touchup scratched or marred surfaces to match original finish.
- M. Connect elevator battery lowering device to auxiliary contact of elevator disconnect switch.
- N. Neatly form wires inside switches.

3.02 FIELD QUALITY CONTROL

- A. Check tightness of conductor lugs using calibrated torque wrench.

END OF SECTION 262816

**SECTION 262913
ENCLOSED MOTOR CONTROLLERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manual motor starters.
- B. Magnetic motor starters.

1.02 RELATED SECTIONS

- A. Section 033100 - Cast-In-Place Concrete for freestanding enclosures.
- B. Section 099000 - Painting: Touchup.
- C. Section 260529 – Hangers and Supports for Electrical Systems.
- D. Section 260548 – Vibration and Seismic Controls for Electrical Systems.
- E. Section 260553 - Identification for Electrical Systems.

1.03 REFERENCES

- A. NECA "Standard of Installation," published by National Electrical Contractors Association.
- B. NEMA AB 1 - Molded Case Circuit Breakers.
- C. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
- D. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- E. NEMA KS 1 - Enclosed Switches.
- F. NFPA 70 - National Electrical Code.
- G. UL 198C - High-interrupting Capacity Fuses; Current Limiting Type.
- H. UL 508 - Industrial Control Equipment.

1.04 SUBMITTALS

- A. Submit under provisions of Section 260500 and Division 1.
- B. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protection devices, short circuit ratings, dimensions and enclosure details.
- C. Test Reports: Indicate field test and inspection procedures and test results.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation and starting of Product.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with NECA Standard of Installation.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.07 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by Underwriters' Laboratories, Inc. as suitable for purpose specified and indicated.

1.08 EXTRA MATERIALS

- A. Provide three (3) of each size and type fuse installed.
- B. Provide three (3) of each size and type of overload heater elements installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Square D.
- B. General Electric.
- C. Siemens - ITE.
- D. Cutler-Hammer.

2.02 MANUAL CONTROLLERS

- A. Manual Motor Controller: NEMA ICS 2, AC general-purpose Class A manually operated, full voltage controller with overload element, red pilot light, 1 N.O. and 1 N.C. contact and pushbutton operator.
- B. Fractional Horsepower Manual Controller: NEMA ICS 2, AC general-purpose Class A manually operated, full voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light, and toggle switch.
- C. Enclosure: NEMA ICS 6, Type 1.

2.03 AUTOMATIC CONTROLLERS

- A. Magnetic Motor Controllers: NEMA ICS 2, AC general purpose, Class A magnetic controller for induction motors rated in horsepower, full voltage, non-reversing type. Reduced voltage auto-transformer (65% tap), closed transition type for 460-volt motors 25 HP and larger, and 208/240-volt motors 15 HP and larger.
- B. Two Speed Controllers: Include integral time delay transition between FAST and SLOW speeds.
- C. Coil Operating Voltage: As indicated on Drawings.
- D. Overload Relay: NEMA ICS; melting alloy.

- E. Enclosure: NEMA ICS 6, Type 1 or 3R as indicated on Drawings, sized for all housed pilot protective devices and control power transformer.
- F. Phase Failure and Undervoltage Protection Relay: UL listed, connected to de-energize controller coil circuit upon any of the following abnormalities:
 - 1. Phase Loss.
 - 2. Phase Unbalance (10 percent or greater).
 - 3. Phase Reversal.
 - 4. Undervoltage (adjustable from 75 percent to 100 percent of normal voltage),
 - 5. Relay to be equipped with LED indicating relay has been energized. Relay to be track mounted within the controller enclosure. Relay to be equal to Square D Class 8430, Type MPD.

2.04 PRODUCT OPTIONS AND FEATURES TO BE PROVIDED AS INDICATED

- A. Auxiliary Contacts: NEMA ICS 2, 2 each normally open, closed, field convertible contacts in addition to seal-in contact. (Provide with all automatic controllers.)
- B. Cover Mounted Pilot Devices: NEMA ICS 2, standard duty type. (As applicable.)
- C. Pilot Device Contacts: NEMA ICS 2, Form Z, rated A150. (As applicable.)
- D. Pushbuttons: Unguarded type. (When directed by controls contractor.)
- E. Indicating Lights: LED type. (Provide with all automatic controllers.)
- F. Selector Switches: Rotary type (H-O-A). (Provide with all automatic controllers.)
- G. Relays: NEMA ICS 2. (When directed by controls contractor.)
- H. Control Power Transformers: 120 volt secondary, 100 va minimum extra capacity, in each motor starter or as scheduled. Provide fused primary and secondary, and bond unfused leg of secondary to enclosure. (Provide with all automatic controllers.)

2.05 DISCONNECTS

- A. Combination Controllers: Combine motor controllers with non-fusible switch or fusible switch, disconnect in common enclosure as scheduled.
- B. Non-fusible Switch Assemblies: NEMA KS 1, enclosed knife switch with externally operable handle.
- C. Fusible Switch Assemblies: NEMA KS 1, enclosed knife-switch with externally operable handle. Fuse clips: Designed to accommodate Class R fuses.

2.06 FUSES

- A. Manufacturers:
 - 1. Bussman.
 - 2. Gould-Shawmut.
 - 3. Little Fuse.
- B. Description: Dual element, current limiting, one-time fuse, 600 volt, UL 198E, Class RK.
- C. Interrupting Rating: 200,000 RMS amperes.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install enclosed controllers where indicated, in accordance with manufacturer's instructions.
- B. Install enclosed controllers plumb. Provide supports in accordance with Section 260529.
- C. If enclosure is less than 6'-6" tall, install enclosure with middle of enclosure at 48 inches. If enclosure is taller than 6'-6", install enclosure with top of enclosure at 7'-6".
- D. Install fuses in fusible switches.
- E. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- F. Provide and install engraved plastic nameplates under the provisions of Section 260553.
- G. Provide neatly typed label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.
- H. Provide and install all product options and control accessories as directed by mechanical and/or controls contractor(s).
- I. Install housekeeping pad for freestanding enclosures.
- J. Bolt freestanding enclosures to floor in accordance with Section 260548.
- K. Bolt surface mounted enclosures to mounting surface in accordance with Section 260548.
- L. Level enclosure.
- M. Ground enclosure with equipment grounding conductor in controller branch circuit.
- N. Adjust doors so that doors open easily without dragging on doorframe.
- O. Where enclosed motor controllers are installed on exterior basement walls or outside, controllers shall be installed on 1-1/2-inch channels.
- P. Touchup scratched or marred surfaces to match original finish.
- Q. Neatly form wires inside motor controller enclosures.

3.02 FIELD QUALITY CONTROL

- A. Inspect and test each enclosed controller to NEMA ICS 2.
- B. Verify that each overload relay is the proper size for the motor.
- C. All motor circuits shall be coordinated with the approved Division 23 shop drawings and any required changes shall be recorded on the record drawings.
- D. Check tightness of conductor connections using calibrated torque wrench.

END OF SECTION 262913

SECTION 262923
VARIABLE FREQUENCY CONTROLLER

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Variable frequency controller.

1.02 RELATED SECTIONS

- A. Section 033100 - Cast-in-Place Concrete for freestanding enclosures.
- B. Section 099000 - Painting: Touchup.
- C. Section 260548 – Vibration and Seismic Controls for Electrical Systems.
- D. Section 260553 – Identification for Electrical Systems.

1.03 REFERENCES

- A. NEMA ICS 3.1 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- C. NFPA 70 - National Electrical Code: latest edition.
- D. UL 508 - Industrial Control Equipment.

1.04 SUBMITTALS

- A. Submit under provisions of Division 1 and Section 260500.
- B. Shop Drawings: Include front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.
- C. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details. Also include description of operation and all wiring diagrams indicating standard and optional features provided.
- D. Test Reports: Indicate field test and inspection procedures and test results.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.
- F. Manufacturer's Field Reports: Indicate start-up inspection findings.

1.05 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 1 and Section 260500.
- B. Operation Data: Include instructions for starting and operating controllers, and describe operating limits that may result in hazardous or unsafe conditions.

- C. Provide a complete wiring diagram package for each drive with a description of operation.
- D. Maintenance Data: Include routine preventive maintenance schedule.

1.06 MANUFACTURER

- A. Danfoss
- B. ABB (ACH 580).

1.07 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.
- C. The drive and all options shall be tested to ANSI/UL Standard 508 and listed by a nationally recognized testing agency such as UL or ETL.
- D. The drive and all options shall comply with the applicable requirements of the latest standards of ANSI, IEEE, and the National Electrical Code.
- E. Power line noise shall be limited to a voltage distortion factor and line notch depth as defined in IEEE Standard 519-1992, Guide for Harmonic Control and Reactive Compensation of Static Power Convertors.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 1.
- B. Accept controllers on site in original packing. Inspect for damage.
- C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure, and finish.

1.09 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

1.10 MAINTENANCE SERVICE

- A. Furnish service and maintenance of controller for one year from Date of Substantial Completion.

1.11 EXTRA MATERIALS

- A. Provide two of each air filter as required.
- B. Provide three of each fuse size and type.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ABB. (ACH 550)
- B. Engineer Approved.

2.02 DESCRIPTION

- A. Provide enclosed variable frequency controllers suitable for operating the indicated loads. Conform to requirements of NEMA ICS 3.1.

2.03 RATINGS

- A. Rated Input Voltage: See Drawings, three-phase, 60 Hertz.
- B. Motor Nameplate Voltage: See Drawings, three-phase, 60 Hertz.
- C. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.
- D. Operating Ambient: 0 degrees C to 40 degrees C.
- E. Minimum Efficiency at Full Load: 96 percent.

2.04 DESIGN

- A. The adjustable frequency controller shall convert three-phase, 60 Hertz utility power to adjustable voltage and frequency, three-phase, AC power for stepless motor speed control from 10 percent to 100 percent of the motor's 60 Hertz speed. Input voltage shall be as specified on the drawing schedules.
- B. The drive shall include a converter and an inverter section. The converter section shall convert fixed frequency and voltage AC utility power to a variable DC voltage. All drives shall be provided with input line reactors to limit harmonic distortion and add protection against line transients.
- C. The inverter section of the drive shall invert the variable DC voltage into a six-step wave form, or pulse width modulating waveform, adjusting voltage and frequency output for stepless motor speed control.
- D. Design for ability to operate controller with motor disconnected from output.
- E. The VFD and options shall be tested to ANSI/UL Standard 508. The complete system, including all specified options, shall be listed by a nationally recognized testing agency such as UL or ETL.
- F. Power line noise shall be limited to a voltage distortion factor and line notch depth as defined in IEEE Standard 519-1992, Guide for Harmonic Control and Reactive Compensation of Static Power Converters. The total current distortion shall not exceed 5 percent. The total voltage distortion shall not exceed 5 percent.
- G. The VFD shall not cause objectionable acoustical motor noise. Motor noise as a result of the VFD shall be limited to three dB-over across-the-line operation, measured at three feet from the motors center line. All critical resonant frequencies shall be field determined and permanently blocked in the drive during start-up operation. A minimum of four (4) frequency

jump points shall be provided.

- H. The VFD's full load AMP rating shall meet or exceed NEC Table 430-150.

2.05 PRODUCT OPTIONS AND FEATURES TO BE PROVIDED

- A. Display: Provide integral digital display to indicate output voltage, output frequency, and output current.
- B. Status Indicators: Separate indicators for overcurrent, overvoltage, ground fault, overtemperature, and input power ON.
- C. Volts Per Hertz Adjustment: Plus or minus 10 percent.
- D. Current Limit Adjustment: 0-100 percent of rated.
- E. Acceleration Rate Adjustment: 3-60 seconds.
- F. Deceleration Rate Adjustment: 3-60 seconds.
- G. Provide HAND-OFF-AUTOMATIC selector switch and manual speed control.
- H. Input Signal: A 4-20ma, 05VDC, 0-10VDC or a 3-15 psi pneumatic (if required).
- I. Safety Interlocks: Provide terminals for remote contact to inhibit starting under both manual and automatic mode.
- J. Control Interlocks: Provide terminals for remote contact to allow starting in automatic mode.
- K. Manual Bypass: Provide contactor, motor running overload protection, and short circuit protection for full voltage, non-reversing operation of the motor. Include isolation switch to allow maintenance of inverter during bypass operation.
- L. Disconnecting Means: Include padlockable integral fused disconnect switch or circuit breaker on the line side of each controller to remove power from drive and bypass.
- M. Separate motor overload protection for multiple motors.
- N. Internal 115 VAC control power with transformer and protective fuses.
- O. Door mounted speed indicator and ammeter.
- P. Automatic restart of drive after power failures.
- Q. A complete diagnostic panel consisting of LED indicators for the following conditions: Over Voltage, Under Voltage, Over Current, Underload Timer On, Run, Fault, Auto/Manual, Input Bus Charged, and Output Bus Charged.
- R. Provide a full 36-month warranty on all equipment.
- S. Drive shall be provided with optimal output line reactors and LC filters. Contractor shall provide and install box to house reactors and filters.

2.06 FABRICATION

- A. Wiring Terminations: Match conductor materials and sizes indicated.

- B. Enclosure: NEMA 250, Type 1.
- C. Finish: Manufacturer's standard enamel.

2.07 SOURCE QUALITY CONTROL

- A. Inspect and production-test each product specified in this section.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surface is suitable for controller installation.
- B. Do not install controller until building environment can be maintained within the service conditions required by the manufacturer.

3.02 INSTALLATION

- A. Install controller where indicated, in accordance with manufacturer's written instructions and NEMA ICS 3.1.
- B. Tighten accessible connections and mechanical fasteners after placing controller.
- C. Install fuses in fusible switches.
- D. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- E. Provide engraved plastic nameplates under the provisions of Section 260553.
- F. Provide neatly typed label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.
- G. Install all screws and bolts in coverplates.
- H. Bolt wall-mounted enclosure to wall or other vertical surface, where indicated on the Drawings, in accordance with Section 260548.
- I. Install 4-inch housekeeping pad for freestanding enclosures.
- J. Bolt freestanding enclosure to floor in accordance with Section 260548.
- K. Level enclosure.
- L. Ground enclosure with equipment grounding conductor in branch circuit to drive.
- M. Adjust doors so that they easily open and do not drag on doorframe.
- N. Neatly form wires and cables inside controller.

3.03 FIELD QUALITY CONTROL

- A. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.

- B. Check tightness of conductor connections with calibrated torque wrench.

3.04 MANUFACTURER'S FIELD SERVICES

- A. Prepare and perform start-up service in the form of a factory trained service technician.

3.05 ADJUSTING

- A. Make final adjustments to installed drive to assure proper operation of fan system. Obtain performance requirements from installer of driven loads.

3.06 CLEANING

- A. Touch up scratched or marred surfaces to match original finish.

3.07 DEMONSTRATION

- A. Provide 8 hours of system demonstration and instruction to Owner.
- B. Demonstrate operation of controllers in automatic and manual modes.

END OF SECTION 262923

SECTION 264300
TRANSIENT VOLTAGE SURGE SUPPRESSION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Main Distribution Panel.
- B. Low Voltage Electronic Grade Panel.

1.02 RELATED SECTIONS

- A. Section 099100 - Painting: Touchup.
- B. Section 260519 – Low-Voltage Electrical Power Connectors and Cable.
- C. Section 260533 – Raceway and Boxes for Electrical Systems.
- D. Section 260548 – Vibration and Seismic Controls for Electrical Systems.
- E. Section 260553 - Identification for Electrical Systems: Engraved nameplates.

1.03 REFERENCES

- A. American National Standards Institute and Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.41-1991 and C62.45-1987)
- B. Canadian Standards Association (CSA)
- C. Federal Information Processing Standards Publication 94 (FIPS PUB 94)
- D. National Electrical Manufacturers Association (NEMA)
- E. National Fire Protection Association (NFPA 70 (NEC), 75 and 78).
- F. Underwriters' Laboratories - UL1449, 2nd Edition and UL1283.

1.04 SUBMITTALS

- A. Submit under provisions of Division 1 and Section 260500.
- B. UL 1449 Suppression Ratings - Documentation of unit's UL 1449 suppression rating shall be included as required product data submittal information. Manufacturer shall make available upon request certified documentation of applicable Location Category C Testing in full compliance with ANSI/IEEE C62.41-1991 and ANSI/IEEE C62.45-1987 Guidelines.

1.05 REGULATORY REQUIREMENTS

- A. Conform to NFPA 70, 75 and 78.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.06 OPERATION AND MAINTENANCE DATA

- A. Equipment Manual - The manufacturer shall furnish an equipment manual with installation, operation and maintenance for the specified unit.

- B. Drawings - Electrical and mechanical drawings shall be provided by the manufacturer which show unit dimensions, weights, mounting provisions, connection details and layout diagram of the unit.
- C. Spare Parts - A list of customer-replaceable spare parts shall be included in the unit's installation, operation and maintenance instructions. All spare parts shall be quickly and easily field-replaceable.

1.07 QUALIFICATIONS, TESTING & WARRANTY

- A. Warranty - The manufacturer shall provide an Unlimited Replacement Five Year Warranty from date of shipment on the entire electronic grade panel (suppression filter system unit, breakers and other panel components) against failure when installed in compliance with applicable national/local electrical codes and the manufacturer's installation, operation and maintenance instructions.
- B. Quality Assurance - The unit shall be thoroughly factory-tested before shipment. Testing of each unit shall include, but shall not be limited to, quality assurance checks, MCOV, and clamping voltage verification tests.
- C. MCOV Testing - The unit shall be factory tested and burned in at the applicable MCOV for a minimum of one (1) hour.
- D. Start-Up Testing - Upon request by the engineer, and after completion of installation, a factory-certified local service technician shall perform testing services. The following tests shall be performed: (a) voltage measurements from L-G, L-N, L-L and N-G at the time of the testing procedure, (b) impulse injection to verify the system suppression voltage tolerances for all suppression paths. Test results shall be recorded, compared to factory benchmark test parameters supplied with each individual unit. A copy of the start-up test results shall be supplied to the engineer for confirmation of proper suppression filter system function. In addition, the integrity of the N-G bond shall be verified through testing.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Current Technology.
- B. Liebert.
- C. Cutler Hammer

2.02 GENERAL PERFORMANCE CRITERIA

- A. Maximum Continuous Operating Voltage (MCOV) - The maximum continuous operating voltage (MCOV) of all suppression components utilized in the unit shall not be less than 125 percent of the facility's nominal operating voltage for 120-volt nominal systems and not less than 115 percent of the facility's nominal operating voltage for 220-, 240-, 277-, 347-, 480-, 575-, and 600-volt nominal systems.
- B. High Frequency Extended Range Tracking Filter - The unit shall include a UL 1283 high - frequency, error producing transients and electrical line noise to harmless levels, thus eliminating disturbances, which may lead to system upset. The filter shall provide minimum insertion loss as follows:

Attenuation Frequency	100 kHz	1 MHz	10 MHz	100 MHz
Insertion Loss (dB)	41	31	35	53

NOTE: Standardized insertion loss data obtained utilizing MIL-STD-E220A 50-ohm insertion loss methodology.

- C. Performance Ratings - The unit's published performance ratings shall be the UL1449 Listed suppression ratings. The UL1449 Suppression Rating shall be, for each mode of protection, as follows:

VOLTAGE	L-L	L-N	L-G	N-G
120/240	800	400	400	400
120/208	800	400	400	400
277/480	1500	800	800	800
347/600	2000	1000	1000	1000

- D. Operating Frequency - The operating frequency range of the unit shall be 47 to 63 Hertz.
- E. Protection Modes - The unit's primary mode of protection shall be line-to-line (delta-configured systems) or line-to-neutral (wye-configured systems). The secondary modes of protection shall be line-to-ground and neutral-to-ground (wye configured systems) or line-to-ground (delta-configured systems).

2.03 MAIN DISTRIBUTION PANEL PROTECTION

- A. Tested Single Pulse Surge Current Capacity - Based on ANSI/IEEE C 62.41-1991's standard 8 by 20 microsecond current waveform, the single pulse surge current capacity, in amperes, of the unit (not individual module) shall be no less than as follows:

Mode of Protection	L-L	L-N	L-G	N-G
Tested Single Pulse Surge Current Capacity Per Protection Mode	100,000	100,000	100,000	100,000

In compliance with NEMA LS 1-1992, the suppression filter unit shall be single pulse tested in all modes up to 150% of the product design rating by an industry-recognized independent test laboratory.

- B. Life Expectancy Testing - The unit shall be capable of protecting against and surviving at least 2,500 ANSI/IEEE C62.41-1991 Category C3 surges without failing or degrading the UL 1449 Surge Suppression Rating by more than 10 percent. The unit shall be able to survive a steady state voltage swell in excess of 125% of nominal voltage for 60 seconds without damage to the unit.
- C. Integral Disconnect Switch - The unit shall include an integral fused and safety interlocked disconnect switch located in the unit enclosure with an externally mounted manual operator. The switch shall disconnect all ungrounded circuit conductors from the distribution system to enable testing and maintenance without interruption of power to the facility's distribution

system. The switch shall be rated for 600 VAC.

- D. Filter System - Each suppression filter system element (selenium cell, MOV, polypropene capacitor) shall be individually fused with 200 KAIC rated fuse links recognized under UL 248 in order to provide maximum fault current protection. The unit must be tested to full rated surge current without failure of any component (including fuse links).
- E. Diagnostic Monitoring Option - The unit shall be provided with the following features: Dual Form "C" dry contacts, battery powered audible alarm with disable switch, phase indicator lights, LED status indicator, transient voltage surge counter and test switch.
- F. Internal Connections - All internal wiring associated with the suppression/filter system and subject to surge currents shall utilize low impedance copper bus bar and/or #1/0 AWG copper conductor or larger. All internal connections associated with the suppression/filter system and subject to surge currents shall be made with compression solderless-type lugs and shall be bolted to the bus bars in order to reduce overall system impedance.
- G. Field Connections - The unit shall include mechanical lugs for each phase, neutral and ground, if applicable. The lugs shall accommodate up to #2 AWG copper conductor with integral fused disconnect switch.
- H. Field Installation - The unit shall be installed as close as practical to the facility's wiring system in accordance with applicable national/local electrical codes and the manufacturer's recommended installation instructions. Connection shall be with #2 AWG copper conductor or larger and not be any longer than necessary, avoiding unnecessary bends.
- I. Enclosure - Standard surface-mounted units shall be provided in a NEMA 4 metallic type enclosure. Dimensions shall not be greater than 22 inches wide by 38 inches high by 14.25 inches deep. Weight of standard surface-mounted units shall not exceed 125 lbs (maximum).

2.04 ELECTRONIC GRADE PANELBOARD

- A. Unit Operating Voltage - The nominal unit operating voltage and configuration shall be as indicated on the Drawings.
- B. High Performance Suppression System - The unit shall include an engineered solid-state high-performance suppression system, utilizing arrays of fused non-linear voltage dependent metal oxide varistors with similar operating characteristics. The suppression system's components shall optimally share surge currents in a seamless, loss-stress manner assuring maximum performance and proven reliability. The suppression system shall not utilize gas tubes, spark gaps, silicon avalanche diodes or other components which might short or crowbar the line, thus leading to interruption of normal power flow to or system upset of connected loads. The suppression system shall not incorporate any other components, which may degrade performance or reliability of the suppression system.
- C. Tested Single Pulse Surge Current Capacity - Based on ANSI/IEEE C62.41-1991's standard 8 x 20 microsecond current waveform, the tested single pulse surge current capacity, in amperes, of the unit shall be no less than as follows:

Mode of Protection	L-L	L-N	L-G	N-G
Tested Single Pulse Surge Current Capacity Per Protection Mode	80,000	80,000	80,000	80,000

- D. Life Expectancy Testing - The unit shall be capable of protecting against and surviving at least 2,500 ANSI/IEEE C62.41-1991 Category C3 surges without failing or degrading the UL 1449 Surge Suppression Rating by more than 10 percent.

- E. Trim - The unit shall be constructed with surface-mounted gray baked enamel sheet metal trim and shall be top- or bottom- fed as indicated on the drawings. A directory cardholder shall be mounted on the inside of the hinged door that includes flush-type latch/lock assembly. Multi-sectional panelboards shall be as indicated on the drawings and shall be configured with feed-through lugs in either two (2) or three (3) section configurations.
- F. Boxes - The unit's box shall be formed of galvanized metal and chemically cleansed, and all breaks in galvanizing shall be painted with metallic paint. Minimum size shall be 20 inches wide by 5.75 inches deep, unless otherwise indicated on the drawings. The unit's box shall not be less than 9 inches longer than standard panelboards.
- G. Interiors - The unit shall have a removable interior as manufactured by General Electric, Square D, Siemens, or approved equal. The interior shall be so arranged that individual branch circuit breakers may be installed or removed without disturbing adjacent units, bus structure, or insulation.
- H. Copper Main Bus - The unit shall include an all-copper main bus of the ampacity and arrangement as indicated on the drawings.
- I. Circuit Breakers - The unit shall include bolt-on main, branch or sub-feed circuit breakers with frame size, poles, trip rating, and minimum interrupting rating as indicated on the drawings. Circuit breakers shall have a minimum 10,000 amperes interrupting range for 120/240-, and 120/208-volt circuits, and 14,000 amperes for 277/480- and 347/600-volt circuits, or as indicated on the drawings. Circuit breakers shall be single handle, common trip for two and three pole units.
- J. 200 Percent Rated Copper Neutral Bus - The unit shall include a 200 percent rated, all copper neutral bus, designed for the peculiar current demands associated with non-linear loads. The neutral bus shall include AL/CU rated mechanical solderless-type lugs in sufficient quantity and capacity as indicated on the drawings.
- K. Safety Ground Bus - The unit shall include a safety ground bus with connection points equal to the number of branch breaker positions. The safety ground bus shall include AL/CU rated mechanical solderless-type lugs in sufficient quantity and capacity as indicated on the drawings.
- L. Field Connections - The unit shall include mechanical solderless-type connection points and labels for each phase, neutral, safety ground, as indicated on the drawings.
- M. Integral Circuit Breaker for Suppression/Filter System - The unit shall require an integral circuit breaker as a means of disconnecting the suppression/filter system for maintenance and/or test purposes without interruption of power to the facility's distribution system. The breaker shall be 2-pole for single phase (120/240 VAC) and 3-pole for three phase (120/208, 277/480, or 347/600 VAC) applications.
- N. Suppression/Filter System Connections - All internal wiring associated with the suppression/filter system and subject to surge currents shall utilize low-impedance copper bus bar and/or #8 AWG copper conductor or larger. All internal connections associated with the suppression/filter system and subject to surge currents shall be made with compression solderless type lugs and shall be bolted to the bus bars in order to reduce overall system impedance.
- O. Diagnostic Monitoring Option - Unit shall be provided with the following features: Form "C" contact, audible alarm silence/test, status indicator lights, transient voltage surge counter and external test capability

PART 3 EXECUTION

3.01 INSTALLATION

- A. Field Installation - The unit shall be installed in accordance with applicable national/local electrical codes and the manufacturer's recommended installation instructions.
- B. Each individual circuit shall be clearly numbered on the face of the panelboard and a typewritten directory for circuit identification shall be provided by the contractor.
- C. Bolt surface-mounted enclosures to mounting surface in accordance with Section 260548.
- D. Bolt freestanding enclosures to floor in accordance with Section 260548.
- E. Level enclosure.
- F. Ground enclosure with equipment grounding conductor with TVSS feeder.
- G. Adjust doors so that they open easily without dragging.
- H. If enclosure is less than 6'-6" tall, install enclosure with middle of enclosure at 48 inches. If enclosure is taller than 6'-6", install enclosure with top of enclosure at 7'-6".
- I. Install engraved nameplate on panels.
- J. Neatly form wires in panelboards or other enclosures.
- K. Touchup scratched or marred surfaces to match original finish.

3.02 FIELD QUALITY CONTROL

- A. Check tightness of all conductor connections with calibrated torque wrench.

END OF SECTION 264300

**SECTION 265000
INTERIOR LUMINAIRES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior luminaires and accessories.
- B. Lamps.
- C. Luminaire accessories.

1.02 RELATED SECTIONS

- A. Section 099100 - Painting: Touchup.

1.03 REFERENCES

- A. ANSI C78.379 - Electric Lamps - Incandescent and High-Intensity Discharge Reflector Lamps - Classification of Beam Patterns.
- B. ANSI C82.1 - Ballasts for Fluorescent Lamps - Specifications.
- C. ANSI C82.4 - Ballasts for High-Intensity Discharge and Low-Pressure Sodium Lamps (Multiple Supply Type).
- D. ANSI/NFPA 70 - National Electrical Code.
- E. ANSI/NFPA 101 - Life Safety Code.
- F. NEMA WD 6 - Wiring Devices-Dimensional Requirements.
- G. UL 844 - Electric Lighting Fixtures for Use in Hazardous (Classified) Locations.
- H. UL 924 - Emergency Lighting and Power Equipment.
- I. UL 1570 - Fluorescent Lighting Fixtures.
- J. UL 1571 - Incandescent Lighting Fixtures.
- K. UL 1572 - High Intensity Discharge Lighting Fixtures.

1.04 SUBMITTALS

- A. Submit under provisions of Division 0 and Section 260500.
- B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
- C. Product Data: Provide dimensions, ratings, and performance data.
- D. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.05 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of each luminaire.

1.06 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 0 and Section 260500.
- B. Maintenance Data: Include replacement parts list.

1.07 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Conform to requirements of NFPA 101.
- C. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.01 LUMINAIRES

- A. Furnish products as specified on Drawings.
- B. Install lamps, and specified accessories at factory.
- C. All factory installed wiring shall be copper.

2.02 EXIT SIGNS

- A. Manufacturers: As indicated on Drawings.
- B. Description: Self-contained exit sign fixture.
- C. Housing: High impact thermoplastic unless indicated otherwise on Drawings.
- D. Face: As indicated on Drawings.
- E. Directional Arrows: As indicated on Drawings.
- F. Mounting: As indicated on Drawings.
- G. Lamps: Manufacturers standard LED lamps.
- H. Input Voltage: 120 volts.

2.03 LAMPS

- A. LED Lamp Manufacturers:
 - 1. Cree.
 - 2. Phillips.
 - 3. General Electric.
- B. Provide lamp type specified for luminaire.

- C. LED lamps shall be of the high CRI type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrate and supporting grids for luminaires.
- B. Examine each luminaire to determine suitability for lamps specified.

3.02 INSTALLATION

- A. Install in accordance with manufacturers instructions.
- B. Support luminaires larger than 2 x 4-foot size independent of ceiling framing and as required in Section 260548.
- C. Locate recessed ceiling luminaires as indicated on Architectural reflected ceiling plan.
- D. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.
- E. Exposed Grid Ceilings: Fasten surface mounted luminaires to ceiling T using bolts, screws, rivets, or suitable clips. On non-fire rated lay-in ceilings, Contractor shall install surface-mounted fluorescent light fixtures on 1-1/2-inch spacers.
- F. Install recessed luminaires to permit removal from below. Final connections to lay-in light fixtures shall be made with 6'-0" flexible conduit from junction box to light fixture. Flexible conduit shall not go from light fixture to another light fixture.
- G. Install recessed luminaires using accessories and fire stopping materials to meet regulatory requirements for fire rating at ceiling.
- H. Install clips to secure recessed grid-supported luminaires in place.
- I. Install wall mounted luminaires, emergency lighting units and exit signs at height as indicated on Drawings as scheduled.
- J. Install all accessories furnished with each luminaire or as required for a complete installation as indicated.
- K. Connect luminaires, emergency lighting units and exit signs to outlets provided under Section 260533 as indicated.
- L. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- M. Bond products and metal accessories to branch circuit equipment grounding conductor.
- N. Install specified lamps in each luminaire, emergency lighting unit and exit sign.
- O. All fixtures shall be guaranteed for a period of one year after final acceptance and any defects in material or workmanship during this period shall be replaced or repaired to the Engineer's satisfaction without extra cost.

- P. All supports, safety chains, swivels, etc. shall be furnished as required for a complete installation.
- Q. Securely fasten all exit signs and emergency lighting units to surface to which they are mounted.
- R. Replace all broken or cracked lens.
- S. Replace all scratched or bent reflectors and doorframes.
- T. Light fixtures shall be supported by lay-in ceilings or by supports to the building structure.
- U. Light fixtures shall not be supported from conduits, duct or piping.
- V. All recessed light fixtures shall have seismic clips firmly situated over tops of ceiling grid tees or plaster rings.
- W. All light fixtures that weigh more than 50 pounds shall have a safety chain or safety cable in addition to its other support.
- X. 2 by 2 light fixtures shall have louvers and lamps oriented in the same direction.
- Y. Touchup scratched or marred surfaces to match original finish.
- Z. Surface-mounted light fixtures shall be mounted at least 80 inches above the floor to the bottom of the light fixtures.

3.03 FIELD QUALITY CONTROL

- A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.
- B. Turn off circuit breakers serving emergency self-contained ballasts, emergency lighting units, and self-contained exit signs to verify that emergency lighting is working properly.

3.04 ADJUSTING

- A. Aim and adjust luminaires as indicated on Drawings or as directed.
- B. Adjust exit sign directional arrows as indicated.
- C. Relamp luminaires that have failed lamps at Substantial Completion. Fluorescent lamps that fail within the first 90 days of operation will be considered defective and shall be replaced at no extra cost.
- D. If Owner complains of glare from light fixtures; add glare control, adjust light fixtures, or relocate light fixture as required to remove objectionable glare.

3.05 CLEANING

- A. Clean electrical parts to remove conductive and deleterious materials.
- B. Remove dirt and debris from enclosure.
- C. Clean photometric control surfaces as recommended by manufacturer.

D. Clean finishes and touch up damage.

END OF SECTION 26 5000

**SECTION 283100
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 230923 – Direct Digital Control System for HVAC.
- C. Section 260533 – Raceway and Boxes for Electrical Systems
- D. Section 260519 – Low-Voltage Electrical Power Connectors and Cable.
- E. Section 260529 – Hangers and Supports for Electrical Systems.
- F. Section 260553 - Identification for Electrical Systems: Address directory and painted boxes.
- G. Section 260548 – 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. Fire Alarm panel shall be equipped with a digital communication per UCA standards.

1.05 SUBMITTALS

- A. Submit under provisions of Division 1 and Section 260500.
- 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 260500.
- 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 260500.
- 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 fiber digital communicator for remote station monitoring. Verify all requirements with UCA.

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, hoist ways, 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 260553.
- 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 283100

**SECTION 311100
SITE PREPARATION & CLEARING**

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Removal of miscellaneous existing site appurtenances.
 - 2. Protection and/or removal of trees and other vegetation.
 - 3. Topsoil stripping
 - 4. Clearing, grubbing and mowing

1.02 RELATED REQUIREMENTS

- A. Construction Drawings

1.03 PROTECTION

- A. Provide protection necessary to prevent damage to existing improvements, trees, or vegetation light poles, power poles, fire hydrants, etc., indicated on the Contract Documents are to remain.
- B. Protect improvements on adjoining properties and on Owner's property.
- C. Restore damaged improvements to original condition as acceptable to parties having jurisdiction.
- D. Conduct site clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction. Streets and roadways shall be thoroughly cleaned and/or swept on a daily basis or more frequently as required by the governing authority.
- E. Provide traffic control as required, in accordance with the U.S. Department of Transportation "Manual of Uniform Traffic Control Devices" and the state highway department requirements.
- F. Unknown Utility Lines: All known utilities have been shown according to the information available. Contractor is responsible for coordinating with local utility companies and owner to locate and confirm all buried utilities in the construction area. Contractor is to notify Architect immediately if unknown lines, pipes, or other underground objects are encountered.
- G. Mow and remove weeds and small undergrowth vegetation in the construction area as defined on the drawings.

PART 2 PRODUCTS NOT USED

PART 3 EXECUTION

3.01 GENERAL PROCEDURE

- A. Unless otherwise indicated on the drawings, remove trees, shrubs, grass, other vegetation, improvements, or obstructions interfering with installation of new construction. Removal includes digging out stumps and roots. Dispose of off-site. Do not remove items elsewhere on site or premises unless specifically indicated. Notify Architect prior to clearing if any item called for as "removed by Owner" remains upon issuance of Notice to Proceed.
- B. Strip topsoil to whatever depths encountered to prevent intermingling with underlying subsoil or other objectionable material. Cut heavy growths of grass from areas before stripping. Topsoil shall consist of sandy clay surficial soil found in depth of not less than 6". Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones and other objects over 2" in diameter, weeds, roots, and other objectionable material.
- C. Completely remove stumps, roots, and other debris below proposed subgrade elevation. Fill depressions caused by clearing and grubbing operations with satisfactory soil material as per requirements of Section 31 23 00 unless further excavation or earthwork is required.

- D. Remove existing above grade and below grade improvements and abandoned underground piping or conduit necessary to permit construction and other work.
- E. Retain boxing and protection for items to remain in construction until finish grade is completed. Repair any damage that occurs to these items without expense to the Owner.

END OF SECTION 311100

SECTION 312200 SITE GRADING

PART 1 GENERAL

1.01 RELATED SECTIONS

- A. Section 31 23 00, Excavation and Backfill.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 GENERAL

- A. Do all cutting, filling, compacting, and rough grading required to bring entire project area within the limits of construction shown to indicated grades.
- B. Subgrades should be consistent with finish grades shown, allowing for an uniform layer of topsoil, properly graded to drain away from the building. Provide smooth ditches or swales as shown to carry water away from the project area without standing.
- C. Contractor shall be responsible for setting all grades and slope stakes; and locating all buildings, drives, parking areas, walks and other site items as shown on drawings.
- D. Control grading operations to prevent water from running into excavated areas.

3.02 ENVIRONMENTAL REQUIREMENTS

- A. Construct temporary erosion control systems as shown on Construction Drawings or as directed by "Storm Water Pollution Prevention Plan" (SWPPP) to protect adjacent properties and water resources from erosion and sedimentation.
- B. In event that site work on this project will disturb 1.0 or more acres, Contractor shall not begin construction without posting on site the "National Pollution Discharge Elimination System" (NPDES) permit governing discharge of storm water from site for entire construction period. NPDES permit requires SWPPP to be in place during construction.
- C. Contractor shall be totally responsible for conducting storm water management practices in accordance with NPDES permit and for enforcement action taken or imposed by Federal or State agencies, including cost of fines, construction delays, and remedial actions resulting from Contractor's failure to comply with provisions of NPDES permit.
- D. All grading operations are operations that are to be in strict compliance with the provisions of the Arkansas Water and Air Pollution Control Act Act 472 of 1949 as amended, AR Ann. 8-4-101 et seq.), and the Federal Clean Water Act 33 U.S.C. 1251 et. seq. Contractor shall be responsible for submitting application to state authority and obtaining permits.
- E. It shall be the Contractor's responsibility to comply with current OSHA and other local, state, and federal requirements for all excavation and fill operations, and other areas of the work.
- F. Contractor to keep dust on site to a minimum the entire duration of construction by means of regular watering. This will include dust created by grading operations, vehicular traffic, and wind.

END OF SECTION 312200

SECTION 312300 EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

- A. Furnish labor and materials for all work under this section.

1.02 RELATED SECTIONS

- A. Section 31 11 00 - Site Preparation
- B. Section 31 22 00 - Site Grading
- C. Section 32 92 23 – Sodding

1.03 SOILS VERIFICATION

- A. The Owner shall be responsible for having Terracon, the registered soils engineer, present on site to examine and conduct tests of soils preparation and construction per IBC required special inspections including filling and grading. The soils engineer shall inspect excavations for foundations, footings, and paving areas perform bearing testing, and will submit a report to general contractor with a copy to the Architect stating conditions observed meet or exceed the limits found in the specifications and are consistent with acceptable construction practices. Construction shall not begin before report is received by the Architect. Contractor shall be responsible for any costs for meeting these requirements. Contractor shall coordinate inspections, testing, and observation with soils engineer.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 TOPSOIL AND UNSUITABLE SOILS EXCAVATION

- A. Strip off topsoil and unsuitable fill material (refer to soils report), at new building, paving, drives and equipment pad areas. Remove all vegetation, rocks, and any soft soils. Haul away and dispose of unsuitable fill material and excess excavated topsoil material off site. –OR- Stock pile topsoil on-site as instructed in specification Section 31 11 00. Excavate to minimum thicknesses as recommended by the Soils Engineer.
- B. After stripping unsuitable soils as described in soils report to required depth (refer to "Preparation Of Original Earth" section), the entire building area, drives, walks, and all areas to be paved shall be proof-rolled with a loaded rubber-tired tandem-axle dump truck or scraper weighing at least 25 tons, and any soft soils are to be undercut and replaced with properly compacted fill. Soils engineer shall be present when proof rolling is being performed.
- C. After proofrolling, scarify to a depth of at least 6" adjusting the moisture content to within 2 percent of optimum moisture content, then compacted to specified density.
- D. Retain sufficient topsoil on site to accomplish final grading.
-OR-
- E. Store topsoil on site per section 31 11 00.
-OR-
- F. Store sufficient quantity of topsoil on site per section 31 11 00 to accomplish final grading for building phase. (Use for grading [portion of a 2-part contract-Delete if single building contract.]
- G. Use no topsoil for compacted fill inside building perimeter.
- H. Use no on-site excavated material for fill inside building perimeter, below footings, or behind retaining walls.
- I. If insufficient topsoil on site, furnish good topsoil, approved by Landscape Architect, for finish grading and planting areas.

3.02 EARTH EXCAVATION

- A. A. Excavation for walks, pavements, curbs, gutters, roof drainage, conductors, retaining walls, building volume below grade, underfill below slabs on grade, foundation walls, footings and other items indicated by drawings or otherwise necessary for construction.
- B. Excavate to elevations and dimensions indicated, plus minimum, yet sufficient, space to permit erection of forms, shoring, drain tile waterproofing, masonry and the inspection of foundations.
- C. Dress earth banks and bottoms for footings forms. Bear footings on engineered fill
- OR - undisturbed soil at elevations shown on drawings.
- D. Insure all exterior footing excavations are below frost line at a minimum of 24" below final finish grade.
- E. If footings occur in poor materials at footing depths indicated (as determined by soils engineer), over excavate as required and compact with approved fill compacted to 95% of standard Proctor density (ASTM D-698).
- F. Remove any existing foundations, footings, piers, and other construction found in the area of new construction.
- G. Material to be excavated is assumed to be earth and other materials that can be removed with a Caterpillar D-8 Dozer with single tooth ripper (mass grading), a Caterpillar 330B tracked excavator equipped with rock teeth (utility trenches) or equipment of similar power and capability. If unanticipated rock is encountered within limits of excavation, contractor shall immediately notify Architect and not proceed further until instructions are given and measurements made for purpose of establishing volume of rock excavation. Rock is defined as any stone or boulders that cannot be removed with the use of a Caterpillar D-8 Dozer with single tooth ripper (mass grading), a Caterpillar 330B tracked excavator equipped with rock teeth (utility trenches) or equipment of similar power and capability.
- H. Only as a last resort, should explosives be used. Should explosives be necessary, work shall be done by experienced powder men using small charges and in strict accordance with all regulations governing this work. Contractor secure permits required for such work and correct any damage to foundations and/or property caused by improper use of explosives at his expense. Architect to be notified and approval granted before explosives are allowed.
- I. Specifically notify Architect and Geotechnical Engineer to inspect excavations, and receive his approval before placing concrete.
- J. Not Used.
- K. Not Used.

3.03 PREPARATION OF ORIGINAL EARTH

- A. Floor slab areas should be stripped of all surface vegetation, topsoil and unsuitable soil to depths as called for in paragraph 3.1. Any soft or unstable materials should be removed and replaced with engineered fill. The subgrade, exposed after stripping and completing any cuts, should be scarified to a minimum depth of 8 inches and moisture conditioned to level within 2 percent of the materials' optimum moisture content. The subgrade should then be compacted to at least 98 percent of the material's maximum laboratory dry density determined in accordance with ASTM Specification D-698, the Standard Proctor procedure.
- B. Remove all topsoil below areas to receive sidewalks. Bear concrete sidewalks on natural earth or minimum 12" engineered fill as required to meet elevations as shown on grading plan.

3.04 3.4 FILL MATERIAL AND GRADING

- A. Placing of fill materials and grading shall be in accordance with the Geotech Engineer's recommendations (Terracon).
- B. Haul in additional earth required. Should there be an excess of excavated material, haul it to area off site.

- C. Haul away and dispose of any surface rubble and debris.
- D. Remove any groundwater accumulated in excavations prior to placement of concrete. Soils Engineer to verify conditions are acceptable and bearing capacity is at or exceeds specified bearing pressure

3.05 SHOT ROCK MATERIAL AND INSTALLATION

(USE ONLY WHEN RECOMMENDED BY GEOTECHNICAL ENGINEER AND APPROVED BY ENGINEER)

- A. Shotrock shall be quarried sandstone,, Limestone, or other hard durable stone with a percent wear no greater than 50% by Los Angeles Test (AASHTO T 96) with angular or fractured faces with pieces no greater than 12-14 inches in any dimension, more than 40% greater than 8 inches in size, 10-30% passing the 3 inch sieve and no more than 15% passing the 0.5 inch sieve.

Screen Size% Passing

12-14 inch 100

8 inch 60-100

3 inch 10-30

0.5 inch 0-15

- B. Excavate to the planned depth.
- C. Place first shot rock layer no deeper than the largest rock.
- D. Force the shot rock into the soft soil until it becomes buried or refuses to penetrate into the soil.
- E. Perform additional layers as described in #C and #D above until the shot rock is no longer accepted by the soil (this operation should be witnessed by the inspector).
- F. Place and compact 1 inch base rock on top of the stabilized shot rock to fill any voids present.
- G. Continue with planned construction.

3.06 CONTROLLED LOW STRENGTH MATERIAL (CLSM) / FLOWABLE FILL AND INSTALLATION

(USE ONLY WHEN RECOMMENDED BY GEOTECHNICAL ENGINEER AND APPROVED BY ENGINEER)

- A. CLSM fill to be 150 PSI minimum or meeting DOT specifications.
- B. Excavate or over-excavate unsuitable soil per soils engineer's instruction to the required depth.
- C. Following verification of required bearing by soils engineer, place CLSM to proper depth for footing bearing elevation
- D. Construction shall continue after material has taken initial set, is stable, and does not displace under equipment; minimum of 24 hours.

3.07 TOPSOIL

- A. After rough grading is completed and approved, scarify subsoil in areas to be lawns to a depth of 4" and place a layer of topsoil there over, providing additional topsoil required to give thickness specified.
- B. Topsoil material: Fertile, natural topsoil, typical of locality, free from stones, debris, clay and weeds.
- C. Topsoil minimum thicknesses: 4" seeded and sodded areas, 12" landscaped areas. (Adjust final cut and fill depth as required to accommodate lawn type.)
- D. Fill to finish grade indicated, eliminate water pockets and irregularities, ready to receive seed or sod.
- E. Finish site grading to be smooth throughout contours. Abrupt changes, uneven, or undulating grading will not be accepted unless shown as such on grading plan.

3.08 EXTENT OF FINISH GRADING

- A. Cut, fill and grade to extent of contours and elevations indicated by drawings.
- B. At building perimeter, keep finish grades generally 6" below finish floor elevation with exception of areas at drives and walks.

3.09 QUANTITY VERIFICATION

- A. Contractor to be responsible for costs incurred by Surveyor and/or Geotechnical Engineer, or other qualified individuals to verify quantity of rock or additional unsuitable soil removed.

3.10 OBSERVATION AND SPECIAL INSPECTIONS

- A. Soils cut and fill operations shall be observed periodically by the Geotechnical Engineer and Architect prior to placing of concrete footings and slabs, and paving. Inspection of soils bearing pressure, verification of soils, and cut/fill operations for conformance to the construction documents and IBC shall be performed by the designated third party Special Inspector.

TEST REQUIRED:

- 1. Contractor shall coordinate compaction tests as recommended by the geotech engineer (Terracon).

END OF SECTION 312300

SECTION 312500
STORM WATER POLLUTION PREVENTION PLAN AND EROSION CONTROL

PART 1 GENERAL

1.01 1.1 SCOPE

- A. A. PURPOSE OF SWPPP: This SWPPP covers the storm water management practices that the Construction Manager shall employ in accordance with the NPDES permit governing storm water discharges during construction, and in accordance with erosion control practices specified in other sections.
- B. B. The Construction Manager will be responsible for securing and maintaining the SWPPP Plan, if required.
- C. C. Erosion Control
 - 1. 1. The Contractor shall provide Erosion Control measures in accordance with the Construction Drawings, and requirements of the SWPPP.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 NOT USED

END OF SECTION 312500

**SECTION 313116
TERMITE CONTROL**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Soil-applied chemical treatment.

1.02 RELATED REQUIREMENTS

- A. Section 312200 - Grading.

1.03 REFERENCE STANDARDS

- A. Title 7, United States Code, 136 through 136y - Federal Insecticide, Fungicide and Rodenticide Act; 2022.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate toxicants to be used, composition by percentage, dilution schedule, intended application rate.
- C. Test Reports: Indicate regulatory agency approval reports when required.
- D. Manufacturer's Instructions: Indicate caution requirement.
- E. Executed warranty.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing this type of work and:
 - 1. Having minimum of three (3) years documented experience.
 - 2. Licensed in Arkansas.
 - 3. Contractor shall provide Arkansas State Plant Board 48 hours advance notice of anticipated application time
 - a. The Contractor shall provide the Architect with a copy of the Arkansas State Plant Board's Notice of Inspection within 48 hours of issuance
 - 1) Failure to notify the Arkansas State Plant Board and provide the Architect a copy of the Notice of Inspection will result in retreatment at the Contractor's time and expense.
 - 2) Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination" to schedule application of termiticide products.

1.06 WARRANTY

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

PART 2 PRODUCTS

2.01 MATERIALS

2.02 CHEMICAL SOIL TREATMENT

- A. Toxicant Chemical: EPA Title 7, United States Code, 136 through 136y approved; synthetically color dyed to permit visual identification of treated soil.
- B. Diluent: Recommended by toxicant manufacturer.
- C. Manufacturers:
 - 1. Bayer Environmental Science Corp: www.backedbybayer.com/pest-management/#sle.
 - 2. FMC Professional Solutions; Dragnet: www.fmcprosolutions.com/#sle.
 - 3. Syngenta Professional Products: www.syngentaprofessionalproducts.com/#sle.
 - 4. ICI Americas, Inc.; Torpedo.
 - 5. Substitutions: See Section 016000 - Product Requirements.
- D. Mixes: Mix toxicant to manufacturer's instructions.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that soil surfaces are unfrozen and dry to absorb toxicant, ready to receive treatment.
- B. Verify final grading is complete; see Section 312200.
- C. Verify utility trenches are wide enough to receive application.

3.02 APPLICATION

- A. Comply with manufacturer's written instructions.

3.03 APPLICATION - CHEMICAL TREATMENT

- A. Spray apply toxicant in accordance with manufacturer's instructions.
- B. Apply toxicant at following locations:
 - 1. Under Slabs-on-Grade.
 - 2. At Both Sides of Foundation Surface.
- C. Under slabs, apply toxicant immediately prior to installation of vapor barrier.
- D. At foundation walls, apply toxicant immediately prior to finish grading work outside foundations
- E. Apply extra treatment to structure penetration surfaces such as pipe or ducts, and soil penetrations such as grounding rods or posts.
- F. Re-treat disturbed treated soil with same toxicant as original treatment.
- G. If inspection or testing identifies the presence of termites, re-treat soil and re-test.

3.04 PROTECTION

- A. Do not permit soil grading over treated work.
- B. Protect applications from damage after completion. Repair disturbances according to manufacturer's written instructions.

END OF SECTION 313116

**SECTION 321116
AGGREGATE BASE COURSE**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop; 2025.

1.02 SCOPE

- A. This Section covers the materials for crushed stone base course to be used as a base material for paving.
- B. This material may also be used for embedment for water and sewer utility lines.

1.03 RELATED WORK

- A. Arkansas Department of Transportation Standard Specification for Highway Construction

1.04 QUALITY ASSURANCE

- A. The moisture density relations of material shall be determined in the laboratory in accordance with AASHTO T 180.
- B. Compacted base shall be tested for depth and any deficiencies corrected by scarifying, placing additional material, mixing, reshaping, and re-compacting to the specified density, as directed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Aggregate Base Course shall be in accordance with SECTION 303 and Table 303-1 of the Arkansas Department of Transportation Standard Specifications.

PART 3 - EXECUTION

3.01 BASE COURSE

- A. The base course material shall be placed on the completed and approved subgrade, that has been bladed to substantially conform to the grade and cross section shown on the Drawings.
- B. The sub-grade shall be prepared as specified and shall be free from an excess or deficiency of moisture at the time of placing the base course.
- C. The subgrade shall also comply, where applicable, with the requirements of other items that may be contained in the contract that provide for the construction, reconstruction or shaping of the subgrade or the reconstruction of the existing base course.
- D. Base course material shall not be placed on a frozen subgrade.
- E. The crushed stone shall be placed on the subgrade or previous base course layer in lifts not to exceed 4" and spread uniformly to such depth and lines that when compacted it will have the thickness as follows:
- F. The spreading shall be done the same day that the material is hauled, and shall be performed in such a manner that no segregation of coarse and fine particles nor nests or hard areas caused by dumping the crushed stone on the subgrade will exist.
- G. To insure proper mixing, the crushed stone shall be bladed across the roadbed before being spread. Care must be taken to prevent mixing of subgrade or shoulder material with the base course material in the blading and spreading operation
- H. The crushed stone shall be substantially maintained at optimum moisture during the mixing, spreading, and compacting operations, water being added or the material aerated as may be necessary.
- I. The specified grade and section shall be maintained by blading throughout the compaction operation.

- J. The material in each course shall be compacted to a density, as determined by AASHTO T 238, Method B, of not less than 95% of the maximum laboratory density determined in the laboratory by AASHTO T 180, Method D. The aggregate shall be compacted across the full width of application.
- K. The crushed stone shall be compacted across the full width of application.
- L. The compacted base course shall be tested for depth and any deficiencies corrected by scarifying, placing additional material, mixing, reshaping, and re-compacting to the specified density, as required by the Architect.
- M. Compaction testing shall be as specified in Section 31 23 00

END OF SECTION 321116

**SECTION 321313
PORTLAND CEMENT CONCRETE PAVING**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types); 2023.

1.02 SUMMARY

- A. Arkansas Highway and Transportation Department; specifications and those noted on the drawings shall supersede respective items contained in this section.
- B. Related Sections:
 - Section 31 23 00: Earthwork
 - Section 32 11 16: Aggregate Base Course

1.03 PROJECT CONDITIONS

- A. Traffic Control:
 - Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Utilize flagmen, barricades, warning signs, and warning lights as required.

1.04 REFERENCES

- A. Arkansas Department of Transportation Standard Specifications

PART 2 PRODUCTS

2.01 MATERIALS

- A. Forms:
 - 1. Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects.
 - 2. Use flexible spring steel forms or laminated boards to form radius bends as required.
 - 3. Form Release Agent: Coat forms with non-staining type coating that will not discolor or deface surface of concrete.
- B. Concrete Materials: Comply with requirements of applicable DIVISION 5, SECTION 505 of the Arkansas Department of Transportation Standard Specifications.
- C. Joint Fillers: Resilient pre-molded bituminous impregnated fiberboard units complying with ASTM D1751 FS HH-F-341, Type II, Class A; or AASHTO M 153, Type I.
- D. Curing Compound: FS TT-C-800, with a minimum of 17% solids content.

2.02 MIXING

- A. Concrete Mix, Design and Testing shall be in accordance with SECTION 802 of the Arkansas Department of Transportation Standard Specifications and Table 802-1 for Class S Concrete.

PART 3 EXECUTION

3.01 PREPARATION

- A. Surface Preparation: Remove loose material from compacted base material surface immediately before placing concrete.
- B. Proof-roll prepared base material surface to check for unstable areas. The paving work shall begin after the unsuitable areas have been corrected and are ready to receive paving. Compaction testing for the base material shall be completed prior to the placement of the paving.

3.02 CONCRETE INSTALLATION

- A. Form Construction:

1. Set forms to required grades and lines, rigidly braced and secured. Install sufficient quantity of forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.
 2. Check completed form work for grade and alignment to following tolerances:
 3. Top of forms not more than 1/8" in 10'-0".
 4. Vertical face on longitudinal axis, not more than 1/4" in 10'-0".
 5. Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage.
 6. Reinforcement: Locate, place, and support reinforcement as specified in Division 3 sections.
- B. Concrete Placement:
1. Do not place concrete until base material and forms have been checked for line and grade. Moisten base material if required to provide uniform dampened condition at time concrete is placed. Concrete shall be placed around manholes or other structures until they are at the required finish elevation and alignment.
 2. Place concrete using methods which prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement or side forms. consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.
 3. Deposit and spread concrete in continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2 hours, place construction joint.

3.03 JOINT CONSTRUCTION

- A. Provide joints as shown on drawings and as specified, but in no case exceed requirements of ACI 302.1R and 316R code requirements.
- B. Construction expansion, weakened-plane (contraction), and construction joints true-to-line with face perpendicular to surface of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
- C. Weakened-Plane (Contraction) Joints: Provide weakened-plane (contraction) joints, sectioning concrete into areas at 15'-0" o.c. maximum each way. Construct weakened-plane joints for depth equal to at least 1/4 concrete thickness, as follows:
- D. Tooled Joints: Form weakened-plane joints in fresh concrete by grooving top portion with recommended cutting tool and finishing edges with jointer.
- E. Sawed Joints: Form weakened-plane joints using powered saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into hardened concrete as soon as surface will not be torn, abraded, or otherwise damaged by cutting action.
- F. Construction Joints:
1. Place concrete joints at end of placements and at locations where placement operations are stopped for period of more than 1/2 hour, except where such placements terminate at expansion joints.
 2. Construct joints using standard metal keyway-section forms.
- G. Expansion Joints:
1. Provide pre-molded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks, and other fixed objects.
 2. Locate expansion joints at 60'-0" o.c. maximum for each pavement lane.
- H. Joint Fillers:
1. Extend joint fillers full-width and depth of joint, and not less than 1/2" or more than 1" below finished surface where joint sealer is indicated. If no joint sealer, place top of joint filler flush with finished concrete surface.
 2. Furnish joint fillers in one-piece lengths for full width being placed, wherever possible. Where more than one length is required, lace of clip joint filler sections together.
- I. Joint Sealants:

1. Exterior pavement joint sealants shall be composed of a non-priming, pourable, self-leveling type of a coal tar modified polyurethane, or a polyurethane, sealant suitable for use in pavements and sidewalks.

3.04 CONCRETE FINISHING

- A. After striking-off and consolidating concrete, smooth surface by screeding and floating. Adjust floating to compact surface and produce uniform texture.
- B. After floating, test surface for trueness with 10'-0" straightedge. Distribute concrete as required to remove surface irregularities, and re-float repaired areas to provide continuous smooth finish.
- C. Work edges of slabs, back top edge of gutter, and formed joints with an edging tool, and round to 1/2" radius. Eliminate tool marks on concrete surface.
- D. After completion of floating and troweling when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:
 1. Broom finish by drawing fine-hair broom across concrete surface perpendicular to line of traffic. Repeat operation if required to provide fine line texture. Inclined Slab Surfaces: Provide coarse, non-slip finish by scoring surface with stiff-bristled broom perpendicular to line traffic.
- E. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed.
- F. Protect and cure finished concrete paving using acceptable moist-curing methods.

3.05 CLEANING AND ADJUSTING

- A. Repair or replace broken or defective concrete, as directed.
- B. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials.
- C. Sweep concrete pavement and wash free of stains, discolorations, dirt, and other foreign material just prior to final inspection.

3.06 TESTING AND SAMPLING:

- A. Slump Tests: A minimum of two slump tests shall be made each day concrete is placed with one test being made at the time test cylinders are made. Slump tests are to be made in accordance with "Method of Test for Slump of Portland Cement Concrete" (ASTM C-143-78). Where slump exceeds five inches (5") or the average 28 day strength of the three test specimens falls below the strength specified (3000 p.s.i.) for the class of concrete tested, or below proportional minimum 7 day strengths, 2,400 psi the proportions, water content or temperature conditions shall be changed to secure the required properties, and, at the discretion of the Architect, portions of the structure containing such concrete shall be removed and replaced, or reinforced as necessary.
- B. Strength Tests: Compression strength test shall be performed in accordance with "Method of Test for Compressive Strength of Molded Concrete Cylinders" (ASTM C39-81). Samples for concrete cylinders shall be made in accordance with "Method of Sampling Fresh Concrete" (ASTM C172-82), and test cylinders shall be prepared and laboratory cured in accordance with "Method of Making and Curing Concrete Compression and Flexure Test in the Field" (ASTM C31-69).
- C. Cylinders: Three cylinders from the same batch shall be made for each 50 cubic yards or fraction thereof placed, but not less than three cylinders for each day of concrete operations shall be made. Location of batch as to placement on the subject shall be noted, and cylinders so designated. No tests shall be required for sidewalks. One cylinder shall be tested at 7 days and two at 28 days.
- D. A minimum of 3 cylinders shall be tested for each class of concrete used on the project and the average of any three consecutive strength tests at 28 days shall be equal to or greater than the

specified strength. Result of any individual strength test shall not be less than 500 p.s.i. of required fc.

- E. Contractor shall bear expense of all testing by a recognized licensed engineer.

END OF SECTION 321313

SECTION 321600 WALKS & CURBS

PART 1 GENERAL

1.01 SCOPE:

- A. Provide all materials, labor, equipment and related items necessary to complete the concrete walks and curbs as shown on the drawings.

1.02 RELATED SECTIONS

- A. Section 32 11 16: Aggregate Base Course.

PART 2 PRODUCTS/ MATERIALS

2.01 WALKS & CURBS:

- A. Concrete for Walks shall be in accordance with SECTION 633 of the Arkansas Department of Transportation Standard Specifications.
- B. Reinforcement shall be Sika-300 Fibermesh Additive (or approved equal) at a ration of 1.5 lbs. per Cubic Yard.
- C. Strength: 3,000 psi at 28 days in accordance with ACI and CRSI Standards, 3,500 for curbs.

2.02 EXPANSION JOINTS

- A. Expansion joint material shall be 1/2" pre-molded filler especially made for such use - not INSULATION or SHEATHING BOARD for all curbs and non-exposed aggregate walks and pavement.

PART 3 EXECUTION

3.01 CONCRETE WALKS

- A. Concrete walks shall be of one course construction 4 inches thick, and of widths shown on the drawings. Provide 1/8" per foot crown or cross slope in the direction of drainage. All steps are to drain freely. Provide tooled joints as shown on drawings.
- B. Expansion joints: Provide 1/2" transverse expansion joints, at walk junctions and intersections, at top and bottom of steps, and where walks abut curb returns, buildings, platforms or other fixed structures, or terminate at curbs. Expansion joints shall be at right angles to the slab and extend the full depth thereof. Pre-molded filler where called for shall extend to within 1/2" of the surface. Fill remaining void with sealant as specified in Section 07 92 00. Locate expansion joints in walks as shown on plans and nearly as practicable opposite those in abutting curbs, approximately 20' on center.
- C. Control Joints: Provide troweled joints 1/4 of slab depth where indicated on plans.
- D. Protection. Remove no forms for 24 hours after pouring concrete. Protect concrete walks and courtyards from pedestrian traffic for a period of three days after pouring.

3.02 WALKS AND CURB FINISH

- A. Finish Types shall be the following:
 - 1. 1. Light Broom Finish
- B. Light Broom Finish:
 - 1. After placing concrete paving, do not work the surface further until ready for floating.
 - 2. Begin floating when the surface water has disappeared and when the concrete has stiffened sufficiently to permit operation of a power- driven float, or both.
 - 3. Consolidate the surface with power-driven floats, or by hand-floating if the area is small or inaccessible to power units.
 - 4. Check and level the surface plane to a tolerance not exceeding 6mm in 3.28 yard when tested with a 3.28 yard straightedge placed on the surface at not less than two different angles.
 - 5. Cut down high spots and fill low spots.

6. Uniformly slope surfaces to drains where required.
7. Immediately after leveling, re-float the surface to a uniform, smooth, granular texture as approved by the Architect.
8. At this point, apply a light broom finish in one direction. Make sweeps uniform and continuous, keeping bristles clean after each sweep. Provide a small sample area for approval by Architect prior to finishing entire surface.

3.03 CONCRETE CURBS

- A. All machine poured curbs to be shape and profile shown on Drawings.
- B. Construct hand formed concrete curbs in small workable sections. Size and depth of curbs shall be generally 6" wide x 18" deep with sloped face, unless noted otherwise on Drawings.
- C. Provide 1/2 inch expansion joints, with pre-molded filler cut to shape of cross section at ends of all returns at 40 foot intervals, maximum. Align with sidewalk expansion joints where curb abuts sidewalk. Fill top 1/2" of joint with sealant as specified in section 07 92 00. Provide sawn control joints at 20' o.c., max. Fill with sealant.
- D. Tamp and screed concrete as soon as placed. Remove division plates and face forms as soon as practicable; fill any honeycombed places with 1:2 mortar and give exposed surfaces same finish as specified for concrete walks.
- E. Remove no forms, except face forms, for 24 hours after placing concrete. Protect against pedestrian traffic for three (3) days and against vehicular traffic for 14 days. Compact thoroughly and backfill behind curb. Place and compact fill behind curb as soon as practical.

3.04 CURB CUTS

- A. At streets, where indicated on Drawings, construct curbs to conform to shape and dimension as shown on the Drawings.
- B. Contractor is responsible for obtaining permit to cut curbs on highways and paying any fees associated with the same.

END OF SECTION 321600

**SECTION 323113
CHAIN LINK FENCES AND GATES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Chain link fence fabric and framework, 8 feet tall.
- B. Single swing gates with medium duty hardware, diagonal brace, bottom rail, and gate closer.
- C. Mechanical keyless gate lock hardware as specified in Section 32 31 13.16.

1.02 RELATED REQUIREMENTS

- A. Section 31 20 00 - Earth Moving: Excavation for post footings.
- B. Section 32 31 13.16 - Gate Locks: Mechanical keyless gate lock hardware.

1.03 REFERENCE STANDARDS

- A. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric; 2021.
- B. ASTM A824 - Standard Specification for Metallic-Coated Steel Marcellled Tension Wire for Use with Chain Link Fence; 2015 (2021).
- C. ASTM F626 - Standard Specification for Fence Fittings; 2020.
- D. ASTM F900 - Standard Specification for Industrial and Commercial Swing Gates; 2018.
- E. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework; 2020.
- F. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; 2023.
- G. CLFMI CLF-05 - Chain Link Fence Manufacturers Institute Product Manual; current edition.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data for fabric, framework, fittings, gate hardware, and closer.
- C. Shop Drawings: Layout plan showing post locations, gate locations, gate swing direction, and post footing details.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original bundles and rolls, labeled with product identification.
- B. Store materials off ground on blocking, protected from mud and moisture. Do not store galvanized pipe in contact with soil.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Chain Link Fence Systems:
 - 1. Merchants Metals: www.merchantsmetals.com.
 - 2. Master Halco: www.masterhalco.com.
 - 3. Ameristar Perimeter Security: www.ameristarfence.com.
 - 4. Substitutions: See Section 016000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Fence Height: 8 feet nominal, measured from finish grade to top of fence fabric.
- B. Framework: Comply with ASTM F1043 for industrial and commercial applications, Group IA (galvanized steel pipe).
- C. Coating: Hot-dipped galvanized, complying with ASTM F1083, throughout.

2.03 FENCE FABRIC

- A. Chain Link Fabric: Comply with ASTM A392, Class 1 zinc-coated (galvanized).
 - 1. Wire Gauge: 9 gauge, 0.148 inch diameter minimum.
 - 2. Mesh Opening: 2-inch diamond pattern.
 - 3. Selvage: Knuckled both top and bottom.
- B. Tension Wire: Comply with ASTM A824, Class 1 zinc-coated; 7 gauge 0.177 inch at bottom of fabric.

2.04 FENCE FRAMEWORK

- A. Posts: Hot-dipped galvanized steel pipe, complying with ASTM F1083.
 - 1. Line Posts: 2-3/8 inch O.D., Schedule 20 minimum; spaced 10 feet on center maximum.
 - 2. Terminal Posts (end, corner, and gate posts): 2-7/8 inch O.D., Schedule 20 minimum.
 - 3. Post Height: Set to achieve 8-foot nominal fence height above finish grade. Embed posts in concrete footings per shop drawings.
- B. Top Rail: 1-5/8 inch O.D. hot-dipped galvanized steel pipe, complying with ASTM F1083; continuous through line post caps, coupled at mid-span only.
- C. Fittings and Accessories: Comply with ASTM F626; hot-dipped galvanized steel.
- D. Post Footings: Concrete, 3,000 psi minimum at 28 days. Size per post manufacturer's requirements for post height and soil conditions; 24-inch diameter minimum.

2.05 GATES

- A. Gate Type: Single swing, as shown on drawings.
- B. Gate Frame: Hot-dipped galvanized steel pipe; comply with ASTM F900 and ASTM F1083.
 - 1. Frame Pipe: 1-7/8 inch O.D., Schedule 20 minimum.
 - 2. Bottom Rail: Provide horizontal bottom rail across full gate width.
 - 3. Diagonal Brace: Provide diagonal tension rod or pipe brace from top latch corner to bottom hinge corner to prevent racking.
- C. Gate Fabric: Match fence fabric specification.
- D. Gate Width and Height: As indicated on drawings.

2.06 GATE HARDWARE

- A. Hardware Duty: Medium duty, complying with ASTM F626 and ASTM F900.
- B. Hinges: Heavy malleable iron or pressed steel; offset to permit gate to open 180 degrees; provide two hinges per leaf for gates up to 6 feet tall, three hinges for gates exceeding 6 feet tall.
- C. Gate Latch: Mechanical keyless combination latch lock as specified in Section 32 31 13.16 - Gate Locks.
- D. Gate Closer: Hydraulic or mechanical gate closer, suitable for exterior use; adjust to close and latch gate from fully open position.
 - 1. Closer shall be rated for gate weight and size indicated; adjustable closing speed.
 - 2. Provide slam prevention to satisfy gate lock manufacturer's warranty requirements per Section 32 31 13.16.
- E. Finish: All hardware galvanized or otherwise corrosion-resistant; compatible with galvanized fence framework finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that layout, elevations, and underground utility locations have been confirmed before beginning work.
- B. Verify finish grades are established before setting posts. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION - FENCE

- A. Install fence in accordance with CLFMI CLF-05 and manufacturer's instructions.
- B. Set posts plumb, aligned, and at uniform spacing. Set terminal posts first; establish line post spacing from terminal posts.
- C. Install posts in concrete footings. Allow concrete to cure 72 hours minimum before applying fabric tension or gate loads.
- D. Stretch fabric taut and attach to framework. Fabric shall have no sag or waviness when installed.
- E. Install tension wire along bottom of fabric and tie to each post and fabric at maximum 24-inch intervals.
- F. Cap all open post tops with weathertight caps.

3.03 INSTALLATION - GATES

- A. Hang gates level, plumb, and true to line. Provide uniform clearance between gate frame and posts.
- B. Install hinges at locations shown, tightened securely. Adjust to allow free swing without binding.
- C. Install gate closer and adjust closing speed so gate closes and latches fully from the fully open position without slamming.
- D. Install gate lock hardware as specified in Section 32 31 13.16.

3.04 ADJUSTING

- A. Adjust gate hardware for smooth operation. Lubricate hinges and moving parts with a corrosion-inhibiting lubricant.
- B. Test gate operation: gate shall swing freely, close fully under closer action, and latch positively without manual assistance.
- C. Repair all damaged galvanized coatings with zinc-rich paint per ASTM A780.

END OF SECTION 323113

SECTION 323113.16 GATE LOCKS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Mechanical keyless gate lock hardware for chain link security fence gates.
- B. Surface-mount combination locks with keyed cylinder lockout function.

1.02 RELATED REQUIREMENTS

- A. Section 32 31 13 - Chain Link Fences and Gates.
- B. Section 08 71 00 - Door Hardware: Keying system requirements.

1.03 REFERENCE STANDARDS

- A. ANSI/BHMA A156.30 - Electromechanical Locks; 2014.
- B. ASTM B36/B36M - Standard Specification for Brass Plate, Sheet, Strip, and Rolled Bar; 2022.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware dimensions, installation requirements, and available finishes.
- C. Manufacturer's Installation Instructions: Indicate special procedures and any conditions requiring special attention.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.
- B. Maintain at project site copies of manufacturer's installation instructions relating to products specified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package hardware individually; label and identify each unit with door or gate opening number keyed to hardware schedule.
- B. Store hardware in a secure, dry location. Protect from damage, corrosion, and theft.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Gate Locks:
 - 1. LockeyUSA, distributed by Nationwide Industries: www.lockeyusa.com. Model GL2SCMGDC (Satin Chrome) or GL2JBMGDC (Jet Black).
 - 2. Substitutions: See Section 016000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Weather Resistance: Suitable for exterior installation; weather resistant construction with corrosion-resistant materials.
- B. Gate Compatibility: Suitable for use on metal, vinyl, wood, composite, and chain link gates.
- C. Strike Adjustment: Adjustable strike to accommodate gaps between gate and post up to 2 inches.
- D. Lockout Function: Keyed cylinder lockout that prevents code access when engaged.
- E. Warranty: Mechanical lifetime warranty.

2.03 GATE LOCK HARDWARE

- A. Surface Mount Mechanical Keyless Gate Lock:

1. Basis of Design: LockeyUSA SUMO® GL2-DC Double Combination as indicated on Hardware Schedule.
 2. Lock Material: Zinc-plated steel body with Teflon-coated stainless steel interior components.
 3. Chain Link Adapter: SUMO GL2LINX, as specified in Article 2.04.
 4. Minimum Gate Stile Width: 1-3/4 inches.
 5. Latch: Deadlocking spring latch to prevent tampering and forced entry.
 6. Passage Mode: Lock includes passage function allowing gate to swing freely from both sides without a code; activate during hours of operation as directed by Owner.
- B. Combination Type: Double Combination (DC); independent keypads on both exterior and interior faces with separate user codes.
- C. Slam Prevention: Provide and install a slam prevention device on the gate in accordance with manufacturer's warranty requirements.

2.04 ACCESSORIES

- A. Chain Link Gate Adapter: SUMO GL2LINX by LockeyUSA.
1. Size: GL2LINX158 - Fits 1-5/8 inch gate frame as applicable to gate frame size indicated on drawings.
 2. Fence Post Compatibility: 3 to 4 inch fence post diameter.
 3. Material: 16 gauge steel, black powder coat finish.
 4. Installation: Bolts on; no welding required.

2.05 FINISHES

- A. Finish: Jet Black Marine Grade (JBMG) as indicated on Hardware Schedule.
- B. Marine grade finish required for all exterior applications.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that gate construction, gate thickness, and gap between gate and post are compatible with hardware specified. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install gate lock hardware in accordance with manufacturer's instructions. No welding or special tools required.
- B. Install GL2LINX chain link adapter where lock is applied to chain link gate construction.
- C. Adjust strike position to achieve positive latch engagement with gap between gate and post.
- D. Set combination codes in accordance with owner's keying requirements prior to final acceptance. Provide Owner with written record of all set combinations.

3.03 ADJUSTING

- A. Adjust for smooth and positive gate locking operation.
- B. Test lockout function to confirm keyed cylinder prevents code access when engaged.

3.04 SCHEDULE

- A. Refer to Gate Hardware Schedule on the drawings.

END OF SECTION 323113.16

SECTION 329223 SODDING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preparation of subsoil.
- B. Fertilizing.
- C. Sod installation.
- D. Maintenance.

1.02 RELATED SECTIONS

- A. Section 31 23 00 – Earthwork: Topsoil material.

1.03 REFERENCES

- A. ASPA (American Sod Producers Association) - Guideline Specifications to Sodding.
- B. FS O-F-241 - Fertilizers, Mixed, Commercial.

1.04 DEFINITIONS

- A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.05 SUBMITTALS AT PROJECT CLOSEOUT

Not Used.

1.06 QUALITY ASSURANCE

- A. Sod: Minimum age of 18 months, with root development that will support its own weight without tearing, when suspended vertically by holding the upper two corners.
- B. Submit sod certification for grass species and location of sod source.
- C. Sod Producer: Company specializing in sod production and harvesting with minimum five years experience.
- D. Installer: Company approved by the sod producer.

1.07 REGULATORY REQUIREMENTS

- A. Comply with regulatory agencies for fertilizer and herbicide composition.

1.08 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver sod on pallet or in rolls. Protect exposed roots from dehydration.

1.09 DO NOT DELIVER MORE SOD THAN CAN BE LAID WITHIN 24 HOURS.

1.10 PROJECT CONDITIONS

- A. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.
- B. Coordinate with installation of underground sprinkler system piping and watering heads.
- C. Sod Installation Season: Verify with a local A.N.L. A. certified nursery or county agent.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Sod: ASPA Approved Field grown; cultivated grass sod; as noted on Landscape drawings with strong fibrous root system, free of stones, burned or bare spots; containing no more than 10 weeds per 1000 sq ft.
- B. Topsoil: As specified in Section 31 23 00.

- C. Fertilizer: 13-13-13 Time release.
- D. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass.

2.02 ACCESSORIES

- A. Wood Pegs: Softwood, sufficient size and length to ensure anchorage of sod on slope.
- B. Wire Mesh: Interwoven hexagonal plastic mesh of 2 inch size.

2.03 HARVESTING SOD

- A. Machine cut sod and load on pallets or in rolls in accordance with ASPA Guidelines.
- B. Cut sod with minimum 1/2 inch and maximum 1 inch topsoil base.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared soil base is ready to receive the work of this section.

3.02 PREPARATION OF SUBSOIL

- A. Prepare subsoil and eliminate uneven areas and low spots.
- B. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.
- C. Remove foreign materials and undesirable plants and their roots. Do not bury foreign material beneath areas to be sodded.
- D. Remove contaminated subsoil.
- E. Scarify subsoil to a depth of 4 inches where topsoil is to be placed.
- F. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.

3.03 FERTILIZING

- A. Apply fertilizer in accordance with manufacturer's instructions.
- B. Apply after smooth raking of topsoil and prior to installation of sod.
- C. Apply fertilizer no more than 48 hours before laying sod.
- D. Mix thoroughly into upper 2 inches of topsoil.
- E. Lightly water to aid the dissipation of fertilizer.

3.04 LAYING SOD

- A. Moisten prepared surface immediately prior to laying sod.
- B. Lay sod within 24 hours after harvesting to prevent deterioration.
- C. Lay sod tight with no open joints visible, and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.
- D. Lay smooth. Align with adjoining grass areas.
- E. Place top elevation of sod 1/2 inch below adjoining paving or curbs.
- F. On slopes 3:1 and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet on center. Drive pegs flush with soil portion of sod.
- G. Water sodded areas immediately after installation. Saturate soil to a depth of 4 inches.
- H. After sod and soil have dried, roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities. Roll sodded areas with roller.

3.05 MAINTENANCE

- A. Sod shall be maintained by the contractor until project closeout.

END OF SECTION 329223