

WDD ARCHITECTS
5050 NORTSHORE LN
NORTH LITTLE ROCK, AR 72118



ST JOHN CATHOLIC CENTER CAMPUS

BYRNE HALL RENOVATION

DIOCESE OF LITTLE ROCK

LITTLE ROCK, ARKANSAS

WDD PROJECT NO. 25-043

ISSUE SET

JUNE 09, 2026

WITTENBERG, DELONY & DAVIDSON, INC.
5050 NORTSHORE LN, NORTH LITTLE ROCK, ARKANSAS 72118
(501) 376-6681

Mechanical-Electrical Engineers
PETTIT & PETTIT CONSULTING ENGINEERS, INC.
201 E MARKHAM, STE 400, LITTLE ROCK, ARKANSAS 72201

Structural Engineers
LIVE OAK ENGINEERING, INC.
2509 7TH AVENUE SOUTH, BIRMINGHAM, ALABAMA 35233

Civil Engineers
WHITE-DATERS & ASSOCIATES
24 RAHLING CIRCLE, LITTLE ROCK, ARKANSAS 72223

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ST. JOHN CATHOLIC CENTER - BYRNE HALL RENOVATIONS
DIOCESE OF LITTLE ROCK
LITTLE ROCK, ARKANSAS

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- 1.01 Sealed bids for construction/addition & remodeling of Byrne Hall, 2417 N. Tyler St., Little Rock, AR, 72207 will be received digitally until 2:00 PM, Local Time on Tuesday, July 14, 2026, at the office of WDD Architects. Submit to Dustin Davis: dustin@wddarchitects.com
A. Bids will be received and reviewed by the architect privately. They will not be opened publicly and read aloud.
- 1.02 Two non-mandatory pre-bid conferences will be held at 10:00 AM on Tuesday, June 22, and 10:00 AM on Tuesday, June 29, 2026, at the project site. Subcontractors are strongly encouraged to attend this meeting but are not required to attend. **The Owner reserves the right to schedule additional meetings.**
- 1.03 The work includes Site Preparation and Improvements, General Construction, Mechanical Work, Plumbing Work and Electrical Work, all to be let under one prime contract.
- 1.04 - Not Used -
- 1.05 Copies of drawings, specification and other proposed contract documents are on file and are open to inspection at the following places.
- Wittenberg, Delony & Davidson, Inc.
Southern Reprographics Plan Room
- 1.06 Prime Bidders may obtain up to one (1) full-sized set of Bidding Documents from Southern Reprographics, Inc., 901 West 7th, Little Rock, Arkansas 72201, Tel: 501-372-4011, upon deposit by means of a credit/debit card, on account, or check in the amount of **\$100** per set, payable to Wittenberg, Delony & Davidson, Inc. Any required deposit shall be refunded to Bidders who submit a bona fide Bid and return paper Bidding Documents in good condition within ten (10) days after receipt of Bids. A Bidder receiving a Contract award may retain paper Bidding Documents, and the Bidder's deposit will be refunded. Additional sets or partial sets of Bidding Documents, including addenda, may be obtained for the actual cost of printing, shipping and handling, and will be non-refundable. Prime Bidders may also obtain Bidding Documents in electronic format through Southern Reprographics at www.sriplanroom.com for a non-refundable fee as pre-determined by level of access.
- 1.07 Bidders, sub-bidders, material suppliers and other interested parties are encouraged to obtain complete sets of Bid Documents from the Architect. Complete sets of Bid Documents should always be used in preparing bids. Neither the Owner nor Architect assumes responsibility for errors in bidding or misinterpretations of Bid Documents resulting from the use of incomplete sets of Bid Documents. The documents obtained through the Architect are considered the official version and take precedence if any discrepancies occur. The use of incomplete or inaccurate Bid Documents does not relieve the bidder of the obligation to perform all work related to his bid as detailed in a complete set of Bid Documents.

- 1.08 All bidders shall conform to the requirements of Arkansas Code Annotated 17-25-101, Arkansas State Licensing Law for Contractors.
- 1.09 The Owner reserves the right to waive any formalities in, or to reject any or all bids.
- 1.10 No bidder may withdraw his bid within 60 days after the date of the opening thereof.

END OF DOCUMENT 00 11 16

PART 1 - GENERAL

1.01 DESCRIPTION OF BID

- A. Base Bid: Work includes Site Preparation and Improvements, General Construction, Mechanical Work and Electrical Work, and Kitchen, as shown on the Drawings and described herein, all to be let under one prime contract.
- B. Bid Documents: Bidders, sub-bidders, material suppliers and other interested parties are encouraged to obtain complete sets of Bid Documents from the Architect. Complete sets of Bid Documents should always be used in preparing bids. Neither the Owner nor Architect assumes responsibility for errors in bidding or misinterpretations of Bid Documents resulting from the use of incomplete sets of Bid Documents. The documents obtained through the Architect are considered the official version and take precedence if any discrepancies occur. The use of incomplete or inaccurate Bid Documents does not relieve the bidder of the obligation to perform all work related to his bid as detailed in a complete set of Bid Documents.

1.02 EXAMINATION OF PREMISES

- A. Before submitting his bid, Contractor will be held to have examined the premises and satisfied himself as to existing conditions under which he will be obligated to operate, or that will in any manner affect Work under this contract.
- B. Bidder must inform himself fully of conditions relating to construction of project and employment of labor. Failure to do so does not relieve successful bidder of his obligation to furnish material and labor necessary to carry out provisions of his contract. Insofar as possible Contractor, in carrying out his Work, must employ such methods or means to avoid any interruption of or interference with Work of any other Contract.

1.03 CONTRACTOR'S LICENSE

- A. Parties bidding on this Work must comply with all requirements and regulations of Contractor's License Law of the State of Arkansas, as set forth in Arkansas Code Annotated § 17-25-101 et. seq.

1.04 BID FORMS

- A. Bids must be submitted on forms included in Document 00 41 13 of Project Manual. Submit one copy.
- B. Place Bid Documents in a sealed envelope and clearly label with words "**Bid Documents**". Show job name and number, name of bidder, Contractor's License Number, date and time of opening.

- C. Attention of Bidders is called to Section 01 23 00-Alternates in Division 1 - General Requirements of this Project Manual which will affect the manner of completion of the Bid Form.
- D. In case of discrepancy between written amounts shown by bidder and amounts in numerical figures on bid form, the amount written out rather than amount in numerical figures shall govern.

1.05 INTERPRETATIONS

- A. No interpretation of plans, specifications or other bid documents will be made orally to any bidder. Requests for interpretation or clarification of Bid Documents must be made in writing addressed to **Wittenberg, Delony & Davidson, Inc.,**
ATTN: Gordon Duckworth, AIA, duck@wddarchitects.com.
 - 1. **TO BE GIVEN CONSIDERATION, REQUESTS FOR INTERPRETATION MUST BE RECEIVED AT LEAST FIVE (5) WORKING DAYS PRIOR TO DATE FIXED FOR OPENING OF BIDS.**
- B. Interpretations and supplemental information will be issued in the form of written addenda issued to prospective prime contract bidders. **ADDENDA WILL NOT BE ISSUED WITHIN THREE (3) WORKING DAYS (72 hours) PRIOR TO DATE FIXED FOR OPENING OF BIDS.** Failure of bidder to receive any addendum shall not relieve bidder from obligation under his bid as submitted. All addenda so issued shall become part of Contract Documents.
- C. Should an error, inconsistency or omission be found in the Bid Documents after the Bid Opening, the Contractor will be deemed to have prepared his bid based upon the more costly or complex way of performing the Work or in accordance with the more stringent requirements.
- D. Anything mentioned in the Specifications and not shown on the Drawings or shown on the Drawings and not mentioned in the Specifications is to have the same effect as if shown or mentioned in both.
- E. Precedence **IS NOT** given to the Specifications over the Drawings or to Large Scale Drawings over Smaller Scale Drawings. All drawings and all specifications are complimentary and shall be viewed collectively when interpreting the Design Intent for the Project. The Architect is the sole judge and interpreter of Design Intent and his decision will be final and binding upon the General Contractor.

1.06 BID GUARANTY

- A. Bid must be accompanied by bid guaranty of not less than five percent (5%) of the amount of bid, and at option of bidder may be cashiers check or bid bond secured by surety company and made payable to order of Owner. Bid guaranty shall insure execution of contract and furnishing of performance and payment bond or bonds by successful bidder.

1. If a Bid Bond is provided, the Bond must be signed by an authorized agent of the Bonding Company and the agent's power of attorney must be submitted with the Bid Bond.

1.07 OPENING OF BIDS

- A. At time and place fixed for opening of bids, every bid received digitally within time fixed for receiving bids will be opened and reviewed by the architect, unless the bid contains irregularities in statutory requirements. Failure of bidder to respond to statutory requirements listed on the bid form may result in the bid being declared non-responsive and the bid will not be read nor will the bid be considered for the purposes of awarding a Contract.

1.08 WITHDRAWAL OF BIDS PRIOR TO BID OPENING

- A. Bids may be withdrawn on written or electronic request dispatched by bidder in time for delivery in normal course of business prior to time fixed for opening; provided, that written confirmation of any electronic withdrawal over signature of bidder is placed in the mail and postmarked prior to time set for bid opening. Negligence on the part of bidder in preparing his bid confers no right of withdrawal or modification of his bid after such bid has been opened.

1.09 QUALIFICATIONS OF BIDDER

- A. Owner may make such investigations as he deems necessary to determine ability of bidder to perform Work, and bidder shall furnish to Owner all such information and data for this purpose Owner may request. Owner reserves right to reject bid of any bidder who has previously failed to perform properly, or to complete on time, contracts of similar nature; who is not in position to perform contract, or who has habitually and without just cause neglected payment of bills or otherwise disregarded obligations to subcontractors, materialmen, or employees.

1.10 POWER OF ATTORNEY

- A. Attorneys-in-fact who sign bid bonds or contract bonds must file with each bond a certified and effectively dated copy of their power of attorney.

1.11 LAWS AND REGULATIONS

- A. Bidder's attention is directed to the fact that all applicable State laws, municipal ordinances, and rules and regulations of authorities having jurisdiction over construction of project shall apply to contract throughout, and they will be deemed to be included in contract the same as though written out in full.

1.12 BID FORMALITIES AND REJECTION OF BIDS

- A. Owner reserves right to waive any formalities in a bid or to reject any or all bids.

1.13 CONDITIONAL BIDS

- A. Conditional bids will not be considered.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF DOCUMENT 00 21 13

WDD Project No.: 25-043

00 41 13-1

LIST OF DEDUCTIVE ALTERNATES

(Refer to Section 01 23 00 - Alternates for detailed description)

DEDUCTIVE ALTERNATE NO. 1: Deduct the sum of _____
_____ Dollars (\$_____).

DEDUCTIVE ALTERNATE NO 2: Deduct the sum of _____
_____ Dollars (\$_____).

LIST OF UNIT PRICES

- A. The Bidder shall **include in the Base Bid** the following lump sum allowances computed based upon the quantities listed and unit costs indicated. Unit prices include all Contractor cost including labor, material, General Conditions and overhead and profit. Bidder understands that the Owner reserves the right to review and or negotiate Unit Prices that are deemed to be not in accordance with current market value of proposed services.
1. In the event the actual quantities are greater or less than the given volumes, the unit prices stated will be used to adjust the contract accordingly.
- B. List of Unit Price Items and Descriptions:
1. **Unit Price No. 1:** Soft Rock / Rippable Rock excavation, to include trench rock.

Unit Price per Cubic Yard: \$ _____ per CY

LIST OF SUBCONTRACTORS

I, the undersigned General Contractor, certify that proposals from the following subcontractors were used in the preparation of my proposal. I agree that if I am the successful bidder, and if following subcontractors are approved, I will not enter into contracts with others for these divisions of the Work without written approval from Architect and Owner.

NAME:

LICENSE NO.

ELECTRICAL: _____

MECHANICAL: _____

PLUMBING: _____

ROOFING AND SHEET METAL: _____

ELEVATOR: _____

Bidder understands that Owner reserves right to reject any or all bids and to waive any formalities in the bidding. Bidder agrees bid shall be good and may not be withdrawn for period of sixty (60) days after scheduled closing time for receiving bids.

Upon receipt of written notice of acceptance of bid, Bidder will execute formal contract within ten (10) days and deliver Surety Bond or Bonds as required by Document 00 61 13.

Bid security attached in amount of 5% of base bid is to become property of Owner in event above contract and bond are not executed within time set forth above as liquidated damages and additional expenses to Owner.

By: _____
(Typed Name)

Date: _____

(Signature)

Contractor License No. _____

(Title)

(Business Address)

(Seal - If bid is by a Corporation)

END OF DOCUMENT 00 41 13

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AGREEMENT FORM - STIPULATED SUM (SINGLE PRIME CONTRACT)

PART 1 - GENERAL

1.01 AUTHORITY

- A. The Agreement Form and Exhibit A, Insurance and Bonds, are an integral part of all sections of Project Manual. Their contents and provisions shall be carefully noted in performance of Work. Include this Agreement Form and Exhibit A in the bid documents for all building construction and renovation projects.
- B. The Agreement Form is the legal instrument which is typically signed by an owner and a contractor subsequent to contract award. A legally binding contract is actually created when accepted, without qualification, the Contractor's bid. However it is this Agreement Form, which when subsequently signed by the parties, formalizes the Contract and confirms the Contractor's intention to be bound by its provisions.

1.02 GOVERNING STANDARD DOCUMENT

- A. "Standard Form of Agreement Between Owner and Contractor", AIA Document A101 - 2017 of American Institute of Architects, 2017 Edition, Articles 1 through 9 inclusive, and AIA Document A101 - 2017 Exhibit A is hereby referenced and incorporated into these specifications and is to be used as the General Conditions for this contract.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF DOCUMENT 00 52 13

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PART 1 - GENERAL

1.01 CONTRACT BASIS

- A. Work is based upon conditions at site, Project Manual, contract Drawings for WDD Project No. 25-043, all addenda issued and the Contract executed between Owner and Contractor.

1.02 OWNER

- A. Wherever term "Owner" or "Owners" is used in the Contract Documents it refers to the Diocese of Little Rock. All papers required to be delivered to Owner shall be delivered to Jim Driedric, Property Services Manager, 2500 N. Tyler St. (Morris Hall Finance Office), Little Rock, AR 72207. Tel.: (501) 664-0340, ext. 307. Email: jdriedric@dolr.org

1.03 ARCHITECT

- A. Wherever term "Architect" or "Architects" is used in the Contract Documents it refers to **Wittenberg, Delony & Davidson, Inc., 5050 Northshore Ln, North Little Rock, Arkansas 72118.**

1.04 TIME FOR COMPLETION

- A. Time for completion shall be as stated in the Owner Contractor Agreement.

1.05 RESPONSIBILITIES OF CONTRACTOR

- A. Except as otherwise specifically stated in the contract, Contractor shall provide and pay for all materials, labor, tools, equipment, water, light, heat, power, transportation, superintendence, temporary construction of every nature, taxes legally collectible because of the Work and all other services and facilities of any nature necessary to execute Work as shown and/or specified under the contract and deliver it complete in every respect within specified time. Water, light, heat, and power sources are available for use by the owner but the contractor is responsible for any tie-ins.
- B. If, during the course of construction of this project, the Contractor discovers errors, inconsistencies or omissions in the Contract Documents, the Contractor will report them to the Architect who will issue written instructions to the Contractor. If the Contractor performs Work knowing there is an error, inconsistency or omission in the Contract Documents without giving notice to the Architect or receiving written instruction from the Architect, the Contractor assumes responsibility for the Work and will bear all costs associated with the performance or correction of the Work.

1.06 COORDINATION OF WORK

- A. General Contractor to give special attention for coordination of work by various trades to provide uniform and symmetrical layout and spacing of exposed components which affect the finished architectural design and appearance. Where spacing and related locations are not specifically shown on the drawings, or where in doubt, Contractor's Superintendent shall consult Architect's Representative prior to installation of that part of the Work. Location of electrical and telephone outlets shall be verified with Architect prior to installation.

1.07 PRECONSTRUCTION CONFERENCE

- A. Either before or soon after actual award of Contract (but in any event prior to start of construction), Contractor or his representative shall attend Preconstruction Conference with representatives of Owner and Architect. Conference will serve to acquaint participants with general plan of contract administration and requirements under which construction operation is to proceed, and will inform Contractor, in detail, of obligations imposed on him and his subcontractors.
 - 1. Hold pre-installation meetings where select specified product systems required to meet warranty or guarantee, which may include Contractor, Architect, Engineer, Consultant, Installer, Owner's Representative, and Manufacturer's Designated Representative.

1.08 CONSTRUCTION DRAWINGS AND SPECIFICATIONS

- A. General Contractor may procure hard copy contract drawings and specification project manuals, to include shipping, at cost, for use in constructing Work. General Contractor shall supply all contract drawings and specifications to his subcontractors or material suppliers. Additional sets or partial sets of Bidding Documents (including addenda) requested by General Contractor, will be furnished for actual cost of printing, handling and shipping costs at General Contractor's expense. Bidding Documents may also be obtained in electronic format through Southern Reprographics at www.sriplanroom.com for a non-refundable fee as pre-determined by level of access. All official digital electronic documentation shall be distributed by Southern Reprographics.

1.09 DEFINITION

- A. The word "Provide", as used throughout these specifications, means furnish and install.

1.10 REFERENCE STANDARDS

- A. Except as otherwise noted, references throughout Project Manual to Codes, Federal Specifications, ASTM Standards, Association or Industry Specifications and other published standards, are to latest edition or publication of such standards.

1.11 PERMITS

- A. Utilizing the contract documents (Project Manual and Drawings) prepared by the Architect and his Consultants, along with information provided by the Owner or his Consultants, the Contractor is responsible for securing permits required to successfully complete the project. This responsibility includes payment for the permit and coordination of all submittals.

1.12 INFORMATIONAL DRAWINGS

- A. Drawings bound into working drawing set and labeled as informational drawings are not part of the Contract Documents. Information on these drawings is for reference and coordination only and is not a representation or warranty of existing or proposed conditions. The Architect and Owner are not responsible for interpretations or conclusions made by the Contractor based on these drawings.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 11 00

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PART 1 - GENERAL**1.01 DESCRIPTION OF REQUIREMENTS**

- A. Definitions and Explanations: Requirements of work related to each allowance are shown and specified in contract documents. The allowance has been established in lieu of additional requirements for that work, and further requirements thereof will be issued at a later time.
- B. Cash allowances stipulated in specifications for this project shall not be made a part of any subcontract agreement by Contractor until materials, work and/or services stipulated have been selected by Owner or Architect. For allowances for materials and installation under a subcontract, Architect will issue supplemental specifications to Contractor to receive a minimum of three (3) subcontract bids for work under the allowance unless instructed otherwise by the Architect.

1.02 SCHEDULE OF ALLOWANCES

	<u>Section</u>	<u>Amount</u>
A. Testing and Inspecting Services	01 45 23	\$2,500
B. Signage - Interior (Doors Fire Stairs)	10 14 00	\$6,500
C. AV and Sound Materials + Installation (Conduit & Junction Boxes in Base Bid) [The AV Allowance shall include all AV equipment, installation, cabling, programming and any additional power, boxes, conduit or data cabling required for a complete system.]	NA	\$75,000

PART 2 - PRODUCTS (Not Applicable)**PART 3 - EXECUTION (Not Applicable)****END OF SECTION 01 21 00**

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PART 1 - GENERAL**1.01 DESCRIPTION**

- A. Unit Price quotations shall be inserted in the appropriate spaces in the Bid Form for each Unit Price item of Work described herein.
- B. Unit Prices stated in the Agreement shall be used to compute adjustments of the Contract Sum for approved Unit Price items of Work. Such adjustments shall be made by Change Order.
- C. Unit Prices shall include all labor, materials, tools, and equipment; all other direct and indirect costs necessary to complete the item of Work and to coordinate the Unit Price Work with adjacent Work; and shall include all overhead and profit. Contractor shall accept compensation computed in accordance with the Unit Prices for work installed in place as full compensation for furnishing such Work.
- D. Compensation will be paid for those items of Work described in below, Unit Prices.

1.02 SPECIFIED WORK

- A. Applicable Sections of the Specifications describe the materials and methods required under the various Unit Price items of Work.

1.03 UNIT PRICES

- A. The Bidder shall **include in the Base Bid** the following lump sum allowances computed based upon the quantities listed and unit costs indicated. Unit prices include all Contractor cost including labor, material, General Conditions and overhead and profit. Bidder understands that the Owner reserves the right to review and or negotiate Unit Prices that are deemed to be not in accordance with current market value of proposed services.
 - 1. In the event the actual quantities are greater or less than the given volumes, the unit prices stated will be used to adjust the contract accordingly.
- B. List of Unit Price Items and Descriptions:
 - 1. **Unit Price No. 1:** Soft Rock / Rippable Rock excavation @ elevator pit, to include trench rock.

Unit Price per Cubic Yard: \$ _____ per CY

1.04 ADVANCED COORDINATION

- A. Immediately notify the design professional when conditions require the use of Unit Price items of Work.
- B. The applicability of, measurement methods for, documentation of, and the final adjustment of the Contract Sum for Unit Price items of Work shall be determined by the design professional.
- C. After performing Unit Price items of Work as directed by the design professional, Contractor shall take necessary measurements in the presence of Owner's Representative and shall submit calculations of quantities to Owner's Representative for approval. Contractor shall notify Owner's Representative one day in advance of taking measurements.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 22 00

PART 1 - GENERAL**1.01 DESCRIPTION OF REQUIREMENTS**

- A. Type of Alternates: The alternates for this project are deductive type. The work described under the alternates shall be included in the Contractor's base bid and indicated as set forth on the Bid Form.
- B. Definition: An alternate is an amount proposed by the Contractor and stated in the proposal to the Owner that will be deducted to the base bid amount if the Owner decides to accept the corresponding change in either scope of work or in products, materials, equipment, systems or installation methods described in Contract Documents.
- C. Coordination: Coordinate related work and modify or adjust adjacent work as required to ensure that work affected by each alternate is complete and fully integrated into the project.
- D. Include as part of each alternate, miscellaneous devices, appurtenances and similar items incidental to or required for a complete installation whether or not mentioned as part of the alternate.

1.02 DESCRIPTION OF DEDUCTIVE ALTERNATES

- A. DEDUCTIVE ALTERNATE NO. 1 - Roller Shades:
 - 1. In Conference Room 103 and Conference Room 105 - DELETE Motorized Roller Shades at windows. PROVIDE Manual Window Shades with controls.
- B. DEDUCTIVE ALTERNATE NO. 2 - Boiler:
 - 1. In existing Basement Mechanical Room DELETE proposed NEW boiler as described in the drawings. Existing boiler is to remain.

PART 2 - PRODUCTS (Not Applicable)**PART 3 - EXECUTION (Not Applicable)**

END OF SECTION 01 23 00

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PART 1 - GENERAL**1.01 SUMMARY**

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

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section.

1.03 DEFINITIONS

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

1.04 INFORMATION SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Reference is made to CSI Form 1.5A as an example. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract

1.05 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.

- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's construction schedule.
 - 2. Preparation of the schedule of values.
 - 3. Installation and removal of temporary facilities and controls.
 - 4. Delivery and processing of submissions.
 - 5. Progress meetings.
 - 6. Pre-installation conferences.
 - 7. Project closeout activities.
 - 8. Startup and adjustment of systems

1.06 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
 - 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - b. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
 - 1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid.
 - 2. Plenum Space: Indicate sub-framing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings.

3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closer methodology, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility.

1.07 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 1. Project name.
 2. Project number.
 3. Date.
 4. Name of Contractor.
 5. Name of Architect.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
- C. **RFI Forms:** AIA Document G716 Software-generated form with substantially the same content as indicated above, acceptable to Architect. Contractor's option to use this form.

- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven (7) working days for Architect's response for each RFI.
RFIs received by Architect after 1:00 PM will be considered as received the following working day.
1. The following RFIs will be returned without action:
 - a. Requests for approval of submissions.
 - b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submissions.
 - f. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 1 Section "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. **RFI Log:** Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Reference is made to CSI Log Form 13.2B as an option.
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were dropped and not submitted.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.08 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.

2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after Notice to Proceed.
1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Procedures for processing field decisions and Change Orders.
 - f. Procedures for RFIs.
 - g. Procedures for testing and inspecting.
 - h. Procedures for processing Applications for Payment.
 - i. Distribution of the Contract Documents.
 - j. Submittal procedures.
 - k. Preparation of record documents.
 - l. Use of the premises and existing building.
 - m. Work restrictions.
 - n. Working hours.
 - o. Library's occupancy requirements.
 - p. Responsibility for temporary facilities and controls.
 - q. Procedures for moisture and mold control.
 - r. Procedures for disruptions and shutdowns.
 - s. Construction waste management and recycling.
 - t. Parking availability.
 - u. Office, work, and storage areas.
 - v. Equipment deliveries and priorities.
 - w. First aid.
 - x. Security.
 - y. Progress cleaning.
 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

- C. Pre-installation Conferences: Conduct a pre-installation conference at Project site before each construction activity that requires coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility problems.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written instructions.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at weekly intervals.
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. **All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.**

2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submissions.
 - 4) Status of documentation.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site utilization.
 - 9) Temporary facilities and controls.
 - 10) Progress cleaning.
 - 11) Quality and work standards.
 - 12) Status of correction of deficient items.
 - 13) Field observations.
 - 14) Status of RFIs.
 - 15) Status of proposal requests.
 - 16) Pending changes.
 - 17) Status of Change Orders.
 - 18) Pending claims and disputes.
 - 19) Documentation of information for payment requests.
3. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS - Not Applicable -

PART 3 - EXECUTION - Not Applicable -

END OF SECTION 01 31 00

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PART 1 - GENERAL

1.01 DESCRIPTION

- A. Make submittals required by Contract Documents; revise and resubmit as necessary to establish compliance with specified requirements. Submittals which are received from sources other than through the General Contractor's office will be returned by the Architect without action. Submit at least one original of manufacturer's product literature. The remainder of the number of copies required for submittal may be reproductions of manufacturer's literature. **FAX submittals, poor quality reproductions or illegible submittals will not be accepted.**
- B. Contractor's submittal of (and Architect's review of) shop drawings, product data or samples which relate to work not complying with requirements of Contract Documents, does not constitute an acceptable or valid request for a substitution, nor approval thereof.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section.

1.03 QUALITY ASSURANCE

- A. Coordination of Submittals: Prior to each submittal, carefully review and coordinate all aspects of each item being submitted. By affixing Contractor's approval stamp to each submittal, certify that coordination has been performed.
- B. Verify that each item and submittal for it conform in all respects with specified requirements.
- C. Certificates: Document required of Contractor, or of a manufacturer, supplier, installer, or subcontractor through Contractor. The purpose is to document procedures, acceptability of methods, or personnel qualifications for a portion of the work.

1.04 TIMING OF SUBMITTALS

- A. General: Make submittals far enough in advance of scheduled dates of installation to provide required time for reviews, securing necessary approvals, possible revision and resubmittal, placing orders and securing delivery.
- B. Owner will not bear costs of delays due to late submittals.

1.05 COORDINATION AND SEQUENCING

- A. Coordinate preparation and processing of submittals with performance of work so that work will not be delayed by submittals.
- B. Coordinate and sequence different categories of submittals for same work, and for interfacing units of work, so that one will not be delayed for coordination of Architect's review with another.

1.06 SUBMITTAL FORMAT AND TRANSMISSION

- A. Provide submittals in electronic format, with the exception of material samples. Use PDF as the electronic format, unless otherwise specified or directed by the architect.
- B. Compile the electronic submittal file as a single, complete document. Name the electronic submittal file specifically according to its contents. **Bookmark individual submittals exceeding 20 pages, and those with multiple products and systems integrated into a single submission.**
- C. Electronic files must be of sufficient quality that all information is legible. Generate PDF files from original documents so that the text included in the PDF file is both searchable and can be copied.
- D. E-mail electronic submittal documents smaller than 5MB in size to e-mail addresses as directed by the architect.
- E. Provide electronic documents over 5MB through an electronic FTP file sharing system. Confirm that the electronic FTP file sharing system can be accessed from the architect's computer network. The Contractor is responsible for setting up, providing, and maintaining the electronic FTP file sharing system for the construction contract period of performance.
- F. Provide hard copies of submittals when requested by the architect. Up to 3 additional hard copies of any submittal may be requested at the discretion of the architect, at no additional cost to the owner.

PART 2 - PRODUCTS

2.01 PROGRESS SCHEDULE

- A. Within 7 days after Notice to Proceed, submit to Architect a bar-chart type progress schedule indicating time bar for each trade or operation of work to be performed. Time bar shall demonstrate planned work, properly sequenced and intermeshed, for expeditious completion of Work. Identify phases if required.

- B. Distribute progress schedule including all updates to Architect, Owner, subcontractor, suppliers, fabricators, and others with need-to-know schedule compliance requirements. Post copy in field office.

2.02 SCHEDULE OF VALUES

- A. Immediately after execution of the Contract Documents, Contractor shall submit for approval a Schedule of Values totaling the amount of the Contract.

2.03 LIST OF SUBCONTRACTORS

- A. Immediately after execution of the Contract Documents, Contractor shall submit for approval a listing of all subcontractors to be used for the project stating portions of Work to be performed, address and telephone number of firm, and contact at firm familiar with project.
- B. If all subcontractors have not been determined, submit a partial listing with regular updates indicating newly added subcontractors.

2.04 ROOFING APPLICATOR CERTIFICATE

- A. A photocopy of the roofing membrane manufacturer's current and valid "Approved Applicator" Certificate (must be an Approved Applicator at least three months prior to the bid date) for the approved system they intend to use on this project must be submitted.

2.05 SUBSTITUTION REQUESTS

- A. Products specified herein establish a quality standard for comparison by manufacturers of similar products. Products of other manufacturers may be substituted for those specified herein on an "Approved Equal" basis. DO NOT propose the substitution of products that do not meet or exceed the quality standards established by the specified product. Products proposed as equivalent MUST be submitted through the General Contractor for review by the Architect after the Contract for Construction is awarded. **DO NOT request approval of products prior to the awarding of the contract.**
- B. Requests for substitution will be reviewed when extensive revisions to contract documents are not required and changes are in keeping with general intent of Contract Documents; when timely, fully documented and properly submitted; and when one or more of following conditions is satisfied, all as judged by Architect/Engineer. Otherwise, requests will be returned without action except to record non-compliance with these requirements.
 - 1. Where request is directly related to an "or equal" clause or other language of same effect in Contract Documents.
 - 2. Where required product, material or method cannot be provided within Contract Time, but not as a result of Contractor's failure to pursue the Work promptly or to coordinate various activities properly.

3. Where required product, material or method cannot be provided in a manner which is compatible with other materials of the Work, or cannot be properly coordinated therewith, or cannot be warranted as required, or cannot be used without adversely affecting Owner's insurance coverage on completed work, or will encounter other substantial non-compliance items which are not possible to otherwise overcome except by making requested substitution, which Contractor thereby certified to overcome such non-compatibility, non-coordination, non-warranty, non-insurable or other non-compliance as claimed.
4. Where required product, material or method cannot receive required approval by a governing authority, and requested substitution can be so approved.

C. **SUBSTITUTIONS REQUESTS MUST BE SUBMITTED WITHIN 45 DAYS**

AFTER THE DATE OF THE NOTICE TO PROCEED. Substitution requests received after that time will be returned and the Contractor will be required to provide the product specified, except in the following instances:

1. Unavailability of product, material or method, not due to the Contractor's failure to pursue the work promptly or to coordinate various activities properly.
2. Where a specified product or material contains a hazardous material, as defined in 40 CFR 261 and as defined by applicable state and local regulations and of which the Owner and Architect refuse to approve for use, based on Contractor furnished information.

- D. Submit request for substitutions in writing using the Substitution Request form found at the end of this Section. **This is the only form that will be accepted.**
- E. Submit 3 copies of substitution request, fully identified for product or method being replaced by substitution, including related specification section and drawing number(s), and fully documented to show compliance with requirements for substitutions. Include manufacturer's product data/drawings, description of installation methods, material samples where applicable, complete color and finish selection cards or samples, Contractor's detailed comparison of significant qualities between specified item and proposed substitution, statement of effect on construction time and coordination with other affected work, cost information or proposal, and Contractor's statement to the effect that proposed substitutions will result in overall work equal-to-or-better-than work originally indicated. **Proposed substitutions shall meet or exceed specified warranty requirements, to include for both materiality and prescribed installation methods.**
- F. Failure to provide the requested data and samples within the specified time frame will be grounds for rejection as a comparable product.
- G. Do not incorporate substitutions into Shop Drawings until they have been reviewed by the Architect and written permission has been issued to make the proposed substitution a part of the contract.
- H. Under no circumstances shall Architect's review of any such substitution relieve Contractor from timely, full and proper performance of Work.

- I. In the event that the substitution of a product by the General Contractor necessitates the redrawing, redesign, modification or other change to the Contract Documents, the General Contractor will bear all associated costs of these changes.

2.06 REQUEST FOR SUPPLEMENTARY INFORMATION

- A. Make timely requests of Architect for additional information required in planning and production of Work.
- B. File requests in ample time to permit appropriate action by all parties involved and avoid delay in performance of Work.
- C. Owner will not bear costs for delays due to Contractor's failure to request information in a timely manner.

2.07 SHOP DRAWINGS

- A. Provide newly-prepared information, on reproducible sheet formats, with graphic information at accurate scale (except as otherwise indicated), with name of preparer indicated (firm name). Do not duplicate and submit Architect's construction drawings as shop drawings. Show dimensions and notes which are based on field measurement. Identify materials and products in work shown. Indicate compliance with standards, and special coordination requirements. **DIGITAL SUBMISSIONS ARE ALLOWED.**
- B. Shop drawings must bear Contractor's approval stamp. This approval stamp certifies that the Contractor has reviewed the shop drawings, product data, samples or similar submittals for conformance with the Contract Documents. All deviations will be noted in writing and highlighted on the submittal for Architect's review. The Architect is not responsible for errors, omissions or deviations in the shop drawings, product data, samples or similar submittals by the Contractor.
- C. Submittals are reviewed by the Architect for design intent only. The Contractor is responsible for verification of dimensional requirements, compliance with contract documents and local codes, quantities and coordination of all affected trades.
- D. Under no circumstances shall Architect's review of shop drawings or submittals relieve Contractor from timely, full and proper performance of Work in accordance with the Contract Documents.
- E. **Contract Documents (including all drawings, specifications, addenda and supplemental information) will not be made available in any digital format or on any other reproducible media to Prime Bidders or Sub-bidders before the award of a Contract nor will they be made available to the Contractor or Sub-contractors after the award of a Contract. Prime Bidders may obtain Bidding Documents in electronic or paper format through Southern Reprographics at www.sriplanroom.com for a non-refundable fee as pre-determined by level of access.**

- F. CAD files will be available to the successful Contractor or Sub-contractors with a release letter or per AIA Document C106™ - 2013 Digital Data Licensing Agreement, after the award of a Contract.

2.08 PRODUCT DATA

- A. Collect required data into one submittal for each unit of work or system; mark each copy to show which choices and options are applicable to project AND WHICH ARE AVAILABLE FOR SELECTION BY THE ARCHITECT WITHOUT ADDITIONAL COST. NO PAYMENT WILL BE MADE FOR ADDITIONAL COST OF ANY CHOICES OR OPTIONS SUBMITTED BY THE CONTRACTOR FOR SELECTION BY THE ARCHITECT AND NOT CLEARLY SHOWN AS NOT AVAILABLE WITHIN THE CONTRACT.
- B. Include manufacturer's standard published recommendations for application and use, compliance with standards, application of labels and seals, notation of field measurements which have been checked, and special coordination requirements.
- C. Maintain one set of product data (for each submission) at project site, available for reference by Architect and others.
- D. Do not submit product data until compliance with requirements of contract documents has been confirmed by Contractor.
- E. Copies:
1. Submit 3 paper copies of product data for Architect's review for items specified in various specification sections, **unless digital submission.**
 2. Three paper copies required for mechanical and electrical data, **unless digital submission.**
- F. Installer's Copy: Do not proceed with installation of materials, products or systems until final authorized copy of applicable product data is in possession of installer.
- G. **Material Safety Data Sheet (MSDS):** MSDS provides basic information on a material or chemical product. A MSDS describes the properties and potential hazards of the material, how to use it safely, and what to do in an emergency. DO NOT PROVIDE WITHIN A SHOP DRAWING SUBMISSION UNLESS SPECIFICALLY REQUESTED BY THE DESIGN PROFESSIONAL. MSDS information shall be kept on file with the contractor and subcontractors for reference. Refer to OSHA MSDS Rules for clarification at website: <https://msdsauthoring.com/msds-safety-data-sheet-chemicals-osh-msds-rules>.

2.09 SAMPLES

- A. Unless precise color and pattern is specified in Contract Documents, submit accurate color and pattern charts or actual material samples to Architect for selection. Refer to pertinent sections of specifications for detailed submission requirements. Provide units identical with final condition of proposed materials or products for the work. Include "range" samples (not less than 3 units) where unavoidable variations must be expected, and describe or identify variations between units of each set.
- B. Make all submissions affecting color selection within sufficient time to allow selection without causing delay in Work.
- C. Submit items requiring color selection or verification AS ONE SUBMISSION to facilitate coordination of all colors at one time. Interior items may be submitted separately from exterior items.
- D. Provide full set of optional samples where Architect's selection is required. DO NOT INCLUDE OPTIONS REQUIRING ADDITIONAL COST.
- E. Samples are submitted for review and confirmation of color, pattern, texture and "kind" by Architect. Architect will not "test" samples (except as otherwise indicated) for compliance with other requirements, which are therefore the exclusive responsibility of Contractor.
- F. Submit 3 sets of samples in final submittal.
 - 1. Furnish two sets to Architect and assemble one set on site. When all samples are on site, Owner and Architect are to review. Contractor shall provide job samples indicating finished color selections for any and all items requiring finish color for project.
 - 2. Quality Control Set: Maintain returned final set of samples at project site, in suitable condition and available for quality control comparisons by Architect and Owner. Written approval from Owner is required before the work is begun for any finish requiring color review.
- G. Reusable Samples: Returned samples which are intended or permitted to be incorporated into Work must be in undamaged condition at time of use.

2.10 STRUCTURAL SUBMITTALS

- A. Structural submittals, where required, include shop drawings, design calculations, diagrams, illustrations, schedules, performance charts, nomenclature charts, samples, brochures and other data prepared by the Contractor or any subcontractor, manufacturer, supplier, fabricator, or distributor and which illustrate some portion of the Project directly related to the structural design of the project.
- B. Contractor shall make all submittals in advance of installation or construction to allow sufficient time for review.

- C. Work requiring shop drawings, whether called for by the Contract Documents or requested by the Contractor, shall not commence until the submission has been reviewed by the Architect/Structural Engineer. Work may commence if the Contractor verifies the accuracy of the Architect/Structural Engineer's corrections and notations and complies with them without exception and without requesting change in Contract Sum or Contract Time.

PART 3 - EXECUTION

3.01 SUBMITTAL PREPARATION

- A. Permanently mark each submittal to identify project, date, Contractor, subcontractor, submittal name and similar information to distinguish it from other submittals. Show Contractor's executed review and approval marking.
- B. Indicate project, date, "To:"; "From:"; names of subcontractors, suppliers, manufacturers, required references, category and type of submittal, purpose, description, distribution record and signature of transmitter.
- C. Indicate drawing number and specifications section number to which submittal applies.

3.02 ARCHITECTS ACTION ON SUBMITTALS

- A. Architect will respond to submittals from Contractor by completing the "LETTER OF TRANSMITTAL" form.
- B. Architect's Submittal Review: Submittal review does not relieve Contractor(s) of compliance with Contract Documents or local codes. Review is only for conformance with the design intent of the Project and compliance with information given in the Contract Documents. The contractor is responsible to coordinate and to confirm all dimensions for use at the site. The contractor is responsible for coordination of the work of all trades.
- C. Architect's Action: Where action and return is required or requested, Architect will review each submittal and mark per the following, and where possible return within fifteen (15) working days of receipt. When a submittal must be coordinated with submittals of other trades, Contractor is responsible for gathering all information and forwarding to Architect as a single submittal.
- D. Architect's Response:
 - 1. Final Unrestricted Release: Work may proceed, provided it complies with notations and corrections on submittal and with Contract Documents, when submittal is returned with the following: **Marking: "Reviewed"**.
 - 2. Final-But-Restricted Release: Work may proceed, provided it complies with notations and corrections on submittal and with Contract Documents, when submittal is returned with the following: **Marking: "Reviewed and Noted"**.

3. Returned for Resubmittal: Do not proceed with work. Revise submittal in accordance with notations thereon, and resubmit without delay to obtain a different action marking. Do not allow submittals with the following marking (or unmarked submittals where a marking is required) to be used in connection with performance of the Work: **Marking: "Revise and Resubmit"**.
4. Other Action: Where submittal is returned for other reasons, with Architect explanation included, it will not be marked or marked "Revise and Resubmit".

END OF SECTION 01 33 00

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WITTENBERG, DELONY & DAVIDSON, INC.

5050 Northshore Ln

North Little Rock, AR 72118

Tel: 501-376-6681 Fax: 501-372-6317

**SUBSTITUTION
REQUEST****WDD does NOT Pre-Qualify before bidding
To Be Submitted AFTER Award of Contract**

Project: Byrne Hall Renovations

WDD Project No.: 25-043

Date:

Contractor:

Contact Person:

Contractor hereby requests consideration of a product substitution as follows:

1. Refer To: Section - _____ and/or Drawing - _____

2. Item Description: _____

3. Proposed Substitution: _____

Manufacturer: _____

Model Number: _____

Description: _____

4. Reason for Substitution: _____

___ Availability ___ Quality Advantage

___ Delivery Schedule ___ Performance Advantage

___ Cost Advantage ___ Other: _____

5. Coordination: _____

Difference in dimensions between the specified and proposed substitute **(WILL)****(WILL NOT)** affect dimensions on drawings and adjacent items.

Describe the effect of the substitution on work of other trades: _____

Describe the effect of the substitution on other required new or existing materials
including electrical wiring, piping, ductwork, finishes, structure, etc.: _____Acceptance of this substitution will cause **(NO CHANGE IN)**
(A REDUCTION OF _____ DAYS FROM) the completion date of this project.Describe any required architectural or engineering design changes required to
accommodate the substitution: _____

6. Differences: _____

The proposed substitution **(MEETS) (DOES NOT MEET)** the reference standards
(ASTM, AWI, UL, etc.) as specified.The proposed substitution **(MEETS) (DOES NOT MEET)** the fire rating classification
(class, type, FM, UL, NFPA) as specified.The proposed substitution is available in the following **(COMPARABLE) (LIMITED)**
(ADDITIONAL) finishes.Note: Any additional cost associated with proposed substitute finishes will be
absorbed by the contractor if this substitution is approved and implemented.

7. Warranty:
Specified Warranty Length and Coverage: _____
Substitute Warranty Length and Coverage (Sample warranty attached): _____
8. This substitution will result in a cost savings and credit of \$ _____.
9. The proposed substitute has been used in the following installations (attached): _____
10. Service and replacement material are available from the following (attached): _____

By submitting this Request for Substitution, the Contractor accepts the following terms and conditions:

1. The proposed substitution, if accepted, will provide performance equivalent to the material or equipment specified. Should a substitution be accepted and should the substitute material or equipment prove defective or otherwise unsatisfactory for the service intended, the Contractor will replace the material or equipment with the material or equipment specified.
2. If the substitution will affect a correlated function, adjacent construction, or work of other trades or contractors, the necessary changes and modifications to affected work are considered to be part of the substitution and will be accomplished without additional cost to the Owner.
3. In the event that the substitution of materials or equipment necessitates the redrawing, redesign, modification or other change to the Contract Documents, the General Contractor will bear all associated costs of these changes.

Contractor warrants that they have verified and believe this substitute is equal or superior to the specified item in all respects. There will be no additional cost associated with coordinating installation of this substitute. Costs and effects of the substitution, as outlined herein, are certified and complete. Claims for additional costs related to acceptance of this substitution, which may become apparent later, are waived.

Manufacturer's product cut sheets, drawings, samples, data sheets, sample warranties, manufacturer's certification, etc. for the substitute are attached.

Contractor: _____

Date: _____

By: _____

Typed Name: _____

Architect's Action:

_____ Substitution is Accepted
_____ Substitution is Rejected for the following reason(s): _____

By: _____

Typed Name: _____

Date: _____

PART 1 - GENERAL**1.01 INTENT**

- A. These procedures apply to requirements for patching and repairing around new and existing work.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section.

1.03 SITE VISIT

- A. Review existing site conditions during bid period. Investigate ceiling plenums, duct shafts, wall structures and other building systems affected by the Work.
- B. Confirm dimensions of applicable existing equipment with field measurements.
- C. Use visit to note required materials which may be difficult provide and notify the owner's representative as soon as possible.

1.04 SUBMITTALS

- A. Comply with requirements of Section 01 33 00.
- B. Submit drawings of structural alterations and temporary support systems for review before proceeding with structural alterations.
- C. Provide drawings fully detailing alterations to structure, signed, and sealed by a professional structural engineer registered to practice in Arkansas.
- D. Submit, for the responsible design professional's approval, details of methods other than specified coring, drilling, or cutting.

1.05 STRUCTURAL ALTERATIONS

- A. Do not cut, cut into, or alter any building structure, or bearing walls and partitions until proposed methods and procedures for doing so, including temporary support system, are reviewed by the responsible design professional.
- B. Conform strictly to approved details. Cut or remove only to extent shown on engineer's drawing.

1.06 SPECIAL PROTECTION REQUIREMENTS

- A. Protect unaffected finishes, equipment and adjacent work from damage caused by cutting, moving, removal and patching operations. Protect surfaces which will remain as part of finished work.
- B. Notify the responsible design professional's representative immediately of damage to fireproofing coatings.
- C. Protect fireproofing coating to structural members. If damaged due to work of this Contract, restore damaged areas to original condition using materials to match existing color, texture and required fire protection rating.
- D. Protect personnel, building occupants and public from airborne dust and contaminants when cleaning spray fireproofing or contaminant-generating materials from structure.
- E. Protect area below welding work from sparks and molten metal, using wet double canvas blankets.

1.07 CUTTING, REMOVAL AND FITTING

- A. Make cuts with clean, true, smooth edges. Provide patches inconspicuous in final assembly.
- B. Use electric percussion tools to cut clay tile, plaster, and concrete blocks.
- C. Carefully remove material being cut. Do not cut services discovered.
- D. Where required, carefully remove modular, manufactured type finishes, including lay in ceiling tile in component ceiling systems.
- E. Fit alteration work airtight to pipes, sleeves, ducts, conduits, and other required penetrations through building elements.

1.08 MATERIALS

- A. Obtain new products to patch, match or extend existing products and meet or exceed quality of existing products.
- B. Quality of existing products, available for assessment during pre bid site visit, shall serve as basis for requirements for appearance and performance of materials used in the Work.
- C. Where existing material cannot be matched with new, salvaged material may be used subject to approval by the responsible design professional.
- D. Where matching materials are not available, the design professional will consider a similar product which meets the same performance requirements as existing.

- E. Obtain acceptance of the design professional before installing any materials not matching existing.

1.09 PATCHING, EXTENDING AND REPAIRING EXISTING WORK

- A. Patch, extend and make good existing work using skilled workers able to match existing quality. Quality of work shall meet technical requirements for similar components throughout Specifications.
- B. Where a portion of existing finished surface is damaged, lifted, stained, or otherwise imperfect, patch or replace with matching materials. Match existing finishes unless specified otherwise.
- C. If patched or imperfect surface was painted or coated, repaint, or recoat entire surface area.
- D. Replace damaged lay-in type ceiling tile and other components with new.
- E. Patch surfaces and materials exposed by partition removal, with finishes to match adjacent.
- F. Restore existing work damaged during construction to a condition matching existing finishes.

1.10 TRANSITIONS

- A. Make transitions as smooth as possible where new work abuts or finishes flush with existing work.
- B. Match existing adjacent work in texture and appearance, providing transition invisible to the eye from distance of 8 feet.
- C. When smooth transition is not practicable, e.g., from a smooth finish to masonry, tile, or plaster, terminate existing surface along a straight line at a natural point of division and provide trim as required.
- D. Where two or more spaces become one space and planes are nominally continuous, re-work floors and walls and ceilings to provide planes meeting without breaks, steps, or bulkheads.
- E. Where change of plane exceeds 3 inches (75 mm), obtain instructions from the responsible design professional for method of executing transition.

1.11 EXISTING SERVICES

- A. Establish location and extent of services in area of work and notify the design professional of findings before starting Work.

- B. Inform the Design Professional and/or Owner immediately of unknown services that are encountered. Confirm findings in writing.

1.12 ALTERATIONS TO MECHANICAL AND ELECTRICAL SERVICES

- A. Refer to mechanical and electrical drawings and Divisions 20-23 and 26 of the Specifications for extent of mechanical and electrical alterations.
- B. Perform alterations with minimum disturbance to existing work.
- C. Access service runs in ceiling spaces through light fixture openings and ceiling access panels where possible. Subject to the Design Professional's and/or Owner's approval, provide bulkheads to conceal services where ceiling spaces are not accessible.
- D. Except in mechanical and electrical rooms, using chases and cut outs in walls and floors, underfloor ducts, and ceiling spaces, conceal the following:
 - 1. ducts
 - 2. pipes
 - 3. raceways
 - 4. conduit runs
 - 5. junction boxes
- E. Patch and make good existing work, where damaged due to alterations to and installation of services.

1.13 CORING, DRILLING AND SAW-CUTTING CONCRETE

- A. Complete an x-ray inspection of affected concrete area before coring. Employ the services of an experienced x-ray inspector. Confirm with the Design Professional and/or Owner before coring or drilling, location of reinforcing steel and raceways that may be present.
- B. Perform coring and drilling after normal working hours, unless specified otherwise.
- C. Wet or dry core drilling and saw-cutting are acceptable. Reduce the amount of cooling water used to the minimum required and collect water used in suitable containers or use a suitable vacuum system that will collect water.

PART 2 - PRODUCTS - Not Used -

PART 3 - EXECUTION - Not Used -

END OF SECTION 01 35 16

PART 1 - GENERAL**1.01 SUMMARY**

- A. Section Includes: Testing laboratory services and inspection services.
- B. Contractor to include, in Base Bid, cost of all field and laboratory testing which is required by various sections of Technical Divisions of these specifications. This will include, but is in no way limited to the following tests:
 - 1. Soil Compaction
 - 2. Soil Bearing
 - 3. Parking Lots:
 - a. Subgrade Densities
 - b. Base Course Densities
 - c. Asphalt Densities
 - d. Core Samples to Determine Asphalt Thickness
 - 4. Concrete:
 - a. Making Test Cylinders
 - b. Compression Tests
 - c. Concrete floor moisture vapor emission, in-situ relative humidity and pH (alkalinity) testing at concrete substrates scheduled to receive finish flooring as indicated on Drawings and/or specified in various finish flooring sections. Refer to current version of ASTM F 2170.
 - 1) Testing shall be conducted based on flooring moisture and pH tolerance requirements submitted by finish flooring trades.
 - 2) Areas failed to achieve the required moisture and/or pH levels shall be re-mitigated and re-tested at no additional cost to the Owner.
 - 3) Moisture vapor and pH Test results shall be signed off by respective flooring manufacturers and installers to obtain full warranty on flooring product and installation.
 - 4) The Owner may conduct and pay for his own random moisture and pH tests at his sole discretion to verify and confirm Contractor's test results.
 - 5) Information on grout mixing and placement, and on grout testing is contained in Grouting Concrete Masonry Walls, **TEK 3-2A** and Grout Quality Assurance, **TEK 18-8B** (refs. 1,2), respectively, as published in the National Concrete Masonry Association (NCMA).
 - 5. Roofing, including Fastener Pull Out Tests per ANSI/SPRI FX-1.
 - 6. Topsoil analysis of existing and that brought in off-site
 - 7. Other tests required by Specification Sections

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALIFICATIONS OF LABORATORIES

- A. Meet "Recommended Requirements for Independent Laboratory Qualification", published by American Council of Independent Laboratories.
- B. Meet basic requirements of ASTM E329, "Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as used in Construction".
- C. Authorized to operate in state where project is located.
- D. Testing equipment must be calibrated at reasonable intervals by devices of accuracy, traceable to either National Bureau of Standards or accepted values of national physical constants.

1.05 LABORATORIES DUTIES

- A. Perform specified inspections, sampling and testing of materials and methods of construction. Comply with specified standards. Ascertain compliance of materials with requirements of projects.
- B. Promptly notify Architect and Contractor of observed irregularities or deficiencies of work or products.
- C. Promptly submit written report of each test and inspection; two copies to Architect and one copy to Contractor for record document files. Each report shall include the following:
 - 1. Date issued
 - 2. Project title and number
 - 3. Testing laboratory name, address and telephone number
 - 4. Name and signature of laboratory inspector
 - 5. Date and time of sampling or inspection
 - 6. Record of temperature and weather conditions
 - 7. Date of test
 - 8. Identification of product
 - 9. Location of sample or test in project

10. Type of inspection or test
11. Results of tests and compliance with contract documents
12. Interpretation of test results, when requested by owner or owner's representative.

1.06 LIMITATIONS OF AUTHORITY OF TESTING LABORATORIES

- A. Laboratories shall not be authorized to release, revoke, alter or enlarge on requirements of contract documents; approve or accept any portion of work or perform any duties of Contractor or Architect.

1.07 CONTRACTOR'S RESPONSIBILITIES

- A. Cooperate with laboratory personnel, provide access to work and operations.
- B. Secure and deliver to laboratory adequate quantities of representational samples of materials proposed to be used which require testing.
- C. Provide laboratory with preliminary design mix proposed to be used for concrete and other materials mixes which require control by testing laboratory.
- D. Furnish copies of manufacturer's test reports of products as required.
- E. Furnish incidental labor and facilities as follows:
 1. To provide access to work to be tested.
 2. To obtain and handle samples at project site or at source of product to be tested.

1.08 SPECIAL INSPECTIONS

- A. Special inspections shall be required in accordance with Chapter 17 of the Building Code. The construction manager (CM) shall be responsible for coordinating all inspections with relevant inspection agency.
 1. Arkansas Special Inspections Guidelines and Special Inspection Forms, revised January 01, 2023, may be downloaded from the Structural Engineers Association of Arkansas website at www.seaoar.org/resources and comply with the 2021 AFPC (2021 IBC in conjunction with the State of Arkansas Amendments), hereafter referred to as the Building Code.
- B. Special Inspector shall keep respective records of inspections. Inspection reports shall be submitted to the Building Official or Authority Having Jurisdiction (AHJ) and to the registered design professional in responsible charge.
- C. Reports shall indicate that inspected work was done in conformance to approved construction documents. Discrepancies shall be brought to the immediate attention of contractor for correction. If the discrepancies are not corrected, the discrepancies shall be brought to the attention of the Building Official (AHJ) and the registered design professional in responsible charge, prior to the completion of that phase of the work.

- D. A final report of inspections documenting required Special Inspections, and correction of any discrepancies, shall be submitted to the Owner, Building Official (AHJ) and the registered design professional in responsible charge at the completion of respective portion(s) of the work.

1.09 HAZARDOUS MATERIAL ABATEMENT

- A. During the construction of this project, if work involving hazardous material is suspected, or encountered, Contractor shall notify Owner or Owner's representative immediately and Owner, with his own forces or by separate contract is responsible for complete investigation, removal and disposition of hazard material in accordance with applicable laws and regulations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 REPAIR AND PROTECTION

- A. Upon completion of inspection, testing, sample taking and similar services performed on the work, repair damaged work and restore substrates and finishes to eliminate deficiencies, including deficiencies in the visual qualities of exposed finishes. Protect work exposed by or for testing activities and protect repaired work.

END OF SECTION 01 45 23

PART 1 - GENERAL**1.01 GENERAL SITE REQUIREMENTS**

- A. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways.
- B. Ensure safe passage of persons around areas of construction. Conduct operations to prevent injury to adjacent buildings, structures, facilities and persons.
- C. Erect temporary covered passageways as required by authorities having jurisdiction.
- D. Provide dust-proof partitions if required. If not indicated on the drawings, provide dust-proof partitions as directed by the Architect to comply with applicable sections of the Life Safety Code.
- E. Provide temporary enclosures at doors and other openings in walls as necessitated by weather conditions. Construct enclosures with fire retardant treated lumber. Tape joints and caulk to prevent dust and debris from migrating beyond construction areas. Maintain enclosures in good repair and remove when no longer needed.
- F. Provide interior and exterior shoring, bracing or support as needed to prevent movement, settlement or collapse.

1.02 PROJECT SIGNS

- A. Subject to prior approval of Owner as to size, design, type, location and to local regulations, Contractor and his subcontractors may erect temporary signs for purposes of identification and controlling traffic.
- B. Additional banner signs with grommets may be provided by the Architect to be placed as directed. Signs shall be maintained throughout the project then returned to architect's site representative or discarded.
- C. Contractor shall furnish and erect temporary construction sign at job site and remove sign at end of construction period. Paint and letter as directed by Architect to identify project, Owner, Architect and Contractor. Refer to general sign drawing (s) following this Section for reference and to Section 01 21 00 - Allowances.

1.03 JOB OFFICES AND STORAGE

- A. Contractor and his subcontractors shall maintain office and storage facilities on site as may be necessary. Locate so as to cause no interference with work to be performed on the site by Owner or with Owner's operations. Consult with Architect regarding locations. Office shall have as a minimum the following items:

1. Complete set of Construction Documents including all addenda and supplemental information.
 2. Data connection: RJ45 throughout unit to support network, voice, and telephone.
 3. Layout and meeting space for Architects or Owners representative to use when visiting the site.
 4. Complete job file with copies of all correspondence concerning the project.
 5. Other standard office equipment as is normally required to operate a business.
- B. Upon completion of project, or as directed by Architect, Contractor shall remove temporary structures and facilities from the site, same to become his property. Leave the premises in condition required by Contract.

1.04 SANITARY ARRANGEMENTS

- A. Provide and maintain within the construction area minimum field-type sanitary facilities in accordance with local health and sanitary requirements. Locate the facilities behind the construction fence or out of the public view. Clean units and empty wastes at least once a week or more frequently into a municipal, district, or station sanitary sewage system, or remove waste to a commercial facility. Remove at completion of Work.

1.05 TEMPORARY UTILITIES FOR CONSTRUCTION

- A. Provide all gas and electric service for heating, cooling, lighting and power required for construction purposes.
- B. Provide all water required for construction purposes. Run temporary lines and provide necessary standpipes.
- C. Contractor to pay all utility charges until time of substantial completion.

1.06 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise directed. Allow other entities to use temporary services and facilities without cost, including, but not limited to Construction Coordinator, Design Professional, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Pay water-service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

- E. Water Service from Existing System: Water from Owner's existing water system is available for use with metering and with payment of use charges. Provide meter connections and extensions of services as required for construction operations.

1.07 TEMPORARY HEATING

- A. Provide temporary heating, coverings and enclosures necessary to protect operations and materials against damage by dampness and cold, to dry out work, and facilitate completion of Work.
- B. Maintain critical installation temperatures required in separate Sections of the Specifications. Repair or replace at no additional cost to Owner, any materials and work damaged by dampness, insufficient or abnormal heat.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 50 00

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PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Requirements and limitations for cutting and patching of Work.

1.02 RELATED SECTIONS

- A. Section 01 11 00 - Summary of Work (Work by Owner or by separate Contractors)
- B. Section 01 35 16 -Alteration Project Procedures: Cutting and patching for alterations work.
- C. Section 01 33 00 - Submittal and Substitution Procedures
- D. Section 07 84 00 - Firestopping.
- E. Individual Product Specification Sections:
 - 1. Cutting and patching incidental to work of the section.
 - 2. Advance notification to other sections of openings required in work of those sections.
 - 3. Limitations on cutting structural members.

1.03 SUBMITTALS

- A. Submit written request in advance of cutting or alteration which 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.
- B. Include in request:
 - 1. Identification of Project.
 - 2. Location and description of affected Work.
 - 3. Necessity for cutting or alteration.
 - 4. Description of proposed Work and Products to be used.
 - 5. Alternatives to cutting and patching.
 - 6. Effect on work of Owner or separate Contractor.
 - 7. Written permission of affected separate Contractor.
 - 8. Date and time work will be executed.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Primary Products: Those required for original installation.
- B. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 33 00.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.
- B. After uncovering existing Work, assess conditions affecting performance of work.
- C. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Provide temporary supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.
- B. Provide protection from elements for areas which may be exposed by uncovering work.
- C. Maintain excavations free of water.

3.03 CUTTING

- A. Execute cutting and fitting including excavation and fill if required, to complete the Work.
- B. Remove and replace defective or nonconforming work.
- C. Remove samples of installed work for testing when requested.
- D. Provide openings in the Work for penetration of mechanical and electrical work.
- E. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

3.04 PATCHING

- A. Execute patching to complement adjacent Work. Match with existing finish where exposed to view unless noted otherwise.
- B. Fit Products together to integrate with other Work.
- C. Execute work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.
- D. Employ skilled and experienced installer to perform patching for weather exposed and moisture resistant elements, and sight exposed surfaces.
- E. Restore work with new Products in accordance with requirements of Contract Documents.
- F. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- G. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire resistant material in accordance with Section 07 84 00 to full thickness of the penetrated element.
- H. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

END OF SECTION 01 73 29

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PART 1 - GENERAL

1.01 CLEANING AND WASTE REMOVAL

A. Progress Cleaning:

1. The premises and the job site shall be maintained in a reasonable neat and orderly condition and kept free from accumulations of waste materials and rubbish during the entire construction period. Remove crates, cartons, and other flammable waste materials or trash from the work areas at the end of each working day. Do not allow debris to blow onto adjoining properties. Respond immediately to request from adjoining property owners to remove any debris that does manage to show up on adjoining properties. Collect and remove waste materials, debris, and rubbish from site weekly, daily if necessary and dispose off-site.
2. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
3. Broom and vacuum clean interior areas prior to start of surface finishing and continue cleaning to eliminate dust.

B. Final Cleaning:

1. Use cleaning materials and agents recommended by manufacturer or fabricator of surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property, or that might damage finished surfaces.
2. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit of Work to condition expected from a commercial building cleaning and maintenance program. Comply with manufacturer's published instructions.
3. Complete following cleaning operations before requesting inspection for Substantial Completion, where applicable to project scope:
 - a. Clean Project Site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste materials, litter and foreign substances. Sweep paved areas broom clean. Remove petro-chemical spills, stains, and other foreign deposits. Rake grounds to a smooth even-textured surface.
 - b. Remove tools, construction equipment, machinery, and surplus material from Project Site.
 - c. Remove snow and ice to provide safe access to building.
 - d. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - e. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - f. Broom clean concrete floors in unoccupied spaces.

- g. Vacuum clean carpet and similar soft surfaces, removing debris and excess nap. Shampoo if required.
- h. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped, scratched, or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces. Do not use razor blades to clean glass. Any scratches on the glass caused by the cleaning process will be cause for the removal and replacement of the damaged glass at the Contractor's expense.
- i. Remove labels that are not permanent labels.
- j. Touch-up and otherwise repair and restore marred exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored, or that show evidence of repair or restoration. Do not paint over "UL" and similar labels, including mechanical and electrical name plates.
- k. Wipe surfaces of mechanical and electrical equipment, and other similar equipment. Remove excess lubrication, paint and mortar droppings and other foreign substances.
- l. Plumbing fixtures are to be cleaned to a sanitary condition, free of stains, including stains resulting from water exposure.
- m. Replace all disposable filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills. Clean ducts, blowers, and coils if units were operated without filters during construction.
- n. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned out bulbs, and defective and noisy starters in fluorescent and mercury vapor fixtures.
- o. Leave Project clean and ready for occupancy.
- 4. Engage an experienced licensed exterminator to make a final inspection, and rid Project of rodents, insects, and other pests. Comply with regulations of local authorities having jurisdiction.
- 5. Remove temporary protection and facilities installed during construction to protect previously completed installations during remainder of construction.
- 6. Comply with governing regulations and safety standards for cleaning operations. Remove waste materials from Project Site and dispose of in accordance with requirements of local authorities having jurisdiction.
 - a. Extra materials of value that remain after completion of construction and have become the Owner's property are to be stored as directed by Owner.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION 01 74 23

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Upon completion of Work and prior to final payment, a digital electronic copy of the following items must be submitted to Architect, tabbed and with a Table of Contents conforming to the current version of the CSI MasterFormat. Formatted items may be submitted on a thumb drive or via Microsoft OneDrive file hosting service (OneDrive also works as the storage backend of the web version of Microsoft 365 / Office cloud storage):
1. General Contractors letter of warranty
 2. General Contractors letter stating that all deficiency list items are complete
 3. Lien releases
 4. Consent of Surety to pay final retainage
 5. List of all subcontractors and suppliers, including portions of the work performed, address and telephone number of firm, and a contact name familiar with the project. Two (2) copies. One copy in each binder.
 6. Guarantees and Warranties: Refer to specific sections of Project Manual for general requirements on warranties, product/workmanship bonds, and maintenance agreements. Furnish two (2) fully executed copies of each guarantee and warranty specified for review by Architect, one copy in each binder.
 7. Certificates: Fully executed copy of each certificate specified, where applicable:
 - a. Certificate of Occupancy
 - b. Final Termite Inspection
 - c. Final Plumbing Inspection
 - d. Final Electrical Inspection
 - e. Certificate of Air Balance
 8. Miscellaneous other inspection reports, where applicable:
 - a. Boiler and Tank
 - b. Elevators and Hoist Systems
 - c. Backflow Preventers on Potable Water
 - d. Fire Suppression System
 - e. Fire Alarm System
 - f. Security System
 - g. Backup Power Generator
 - h. Cable Test/Certification Reports and Startup Records
 9. Instructions: Operating, service and maintenance manual or instruction sheet for each item as requested by specifications and required for Owner's use.
 10. Building hardware packet as described in Section 08 71 00, if applicable.
 11. Shop Drawings: A complete file of final copies of all shop drawings used in construction of project.
 12. Complete set of all submittals for products used in construction of project.
 13. Project Record Drawings: The Contractor shall provide one (1) complete set of project record drawings of scanned images of the drawings.

- a. Cloud and reference each of the following items on the Record Drawings:
 - 1) written addendum items
 - 2) addendum drawings
 - 3) "X" drawings
 - 4) Supplemental Instructions
 - 5) Change Orders
 - 6) responses to RFI's
 - 7) any other deviations from the original drawings that are made in the field
- b. Record final locations of underground lines by depth from finished grade and by accurate horizontal offset distances to permanent surface improvements such as buildings, curbs, edges, or walks.

B. Owner or user shall bear any printing/shipping costs of as-built project drawings.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.01 EXTENDED WARRANTIES

- A. The entire project is warranted for a period of one (1) year from the date of substantial completion and several materials and systems require extended warranties. It is the responsibility of the General Contractor to review the Project Manual to determine the term of the extended warranties and provide the extended warranties required.

END OF SECTION 01 78 00

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Selective demolition of built site elements.
- B. Clearing of vegetation.
- C. Removal of debris.
- D. Abandonment and removal of existing utilities and utility structures.

1.02 RELATED SECTIONS

- A. Section 00 3110 - Geotechnical Investigation: Soil conditions and requirements for undercut and backfill.
- B. Section 01 1000 - Summary: Contractor's use of site and premises, sequencing and staging requirements.
- C. Section 01 5000 - Temporary Facilities and Controls: Site fences, security, protective barriers, protection of existing trees, and waste removal.
- D. Section 31 2316 - Excavation: Removal of unsuitable material.
- E. Section 31 2323 - Fill and Backfill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.
- F. Section 32 2213 - Grading: Topsoil removal.

1.03 REFERENCES

- A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.

1.04 PROJECT CONDITIONS

- A. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Fill Material: As specified in Section 32 2213 – Grading

PART 3 - EXECUTION

3.01 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify all utility companies before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt utilities without at least 7 days prior written notification to any adjacent properties that may be affected.
- E. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- F. Unused underground piping may be abandoned in place, provided it is completely drained and capped; remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

3.02 VEGETATION

- A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, paving, lawns, and planting beds.
- B. Install protective fences and other protection measures in accordance with Section 01500 Temporary Facilities and Project Controls to prevent inadvertent damage to trees and vegetation on adjacent properties.
- C. Vegetation Removed: Do not burn, bury, landfill, or leave on site.
 - 1. Fill holes left by removal of stumps and roots, using suitable fill material, with top surface neat in appearance and smooth enough not to constitute a hazard to pedestrians.

3.03 EXISTING BUILT ELEMENTS

- A. Scope:
 - 1. Remove existing paving, curbs, sidewalks, drainage structures, etc as required to accomplish new work.
 - 2. Remove all other paving and curbs as indicated on drawings.
 - 3. Remove other items indicated, for salvage, relocation, and recycling.
 - 4. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as required so that required rough grade elevations do not subside within one year after completion.
- B. Comply with applicable codes and regulations for demolition operations and safety of adjacent

structures and the public.

1. Obtain required permits.
2. Use of explosives is not permitted.
4. Provide, erect, and maintain temporary barriers and security devices.
5. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
6. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
7. Do not close or obstruct roadways or sidewalks without permit.

C. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.04 DEBRIS

- A. Remove all debris from site.

3.05 WASTE REMOVAL

- A. Remove from site all materials not to be reused on site; do not burn or bury.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Site preparation includes, but is not necessarily limited to:
1. Temporary fencing and protective barricades.
 2. Protection of trees and shrubs to remain.
 3. Felling of trees removed, removal of stumps, roots and debris from Work.
 4. Removal of obstructions which interfere with Work.
 5. Stripping of topsoil and vegetation from earth areas of site.
 6. Removal of concrete and removal of asphaltic concrete pavement.
 7. Abandonment and capping wells or cisterns.
 8. Demolition and removal of buildings or building elements.
 9. Protection of active utilities and removal of utilities abandoned.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are located in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

- A. Workmen Qualifications: One person present during tree clearing and grubbing operations, thoroughly familiar with types of trees involved. Direct trimming of roots and limbs where required.
- B. Codes and Standards: Comply with pertinent codes and regulations, plus requirements of insurance carriers providing coverage for Work.

1.05 JOB CONDITIONS

- A. Dust Control: Prevent spread of dust during performance of Work. Thoroughly moisten surfaces required to prevent dust nuisance to public, neighbors, and concurrent performance of other work on site.

- B. On-site Burning: Will not be permitted unless approval is given by the local jurisdiction.
- C. Protection: Protect existing objects not to be removed. In event of damage, immediately make repairs and replacements necessary to approval of Architect at Contractor's expense.

1.06 HAZARDOUS MATERIAL ABATEMENT

- A. During the construction of this project, if work involving hazardous material is suspected, or encountered, Contractor shall notify Owner or Owner's representative immediately and Owner, with his own forces or by separate contract is responsible for complete investigation, removal and disposition of hazard material in accordance with applicable laws and regulations.

PART 2 - PRODUCTS

2.01 BARRICADES AND FENCE MATERIALS

- A. Materials required for barricades, tree protection and related fencing furnished by Contractor.

2.02 FILL MATERIAL

- A. Refer to Section 31 00 10, if applicable.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Notification: Notify Architect at least two full working days prior to commencing work.
- B. Site Inspection:
 - 1. Prior to work of this Section, carefully inspect entire site and objects designated to be removed or preserved.
 - 2. Locate existing utility lines to be abandoned and determine requirements for disconnecting and capping.
 - 3. Locate existing active utility lines which are to remain and determine requirements for their protection.
- C. Clarification:
 - 1. Drawings do not purport to show all objects existing on site.
 - 2. Before commencing work of this Section, verify with Architect all objects to be removed and all objects to be preserved.
- D. Scheduling:
 - 1. Schedule work in a careful manner with necessary consideration for neighbors and public.

2. Avoid interference with use of, and passage to and from, adjacent buildings and facilities.

3.02 DISCONNECTION OF UTILITIES

- A. Before commencing demolition or removal, and if not already accomplished, disconnect or arrange for disconnection of utility service connections, including water, gas, electricity, and telephone, to buildings to be demolished complying with regulations of utility concerned. Plug sanitary sewer lines in accordance with local requirements. Conduct operations at Contractor's expense and in manner to preserve service to areas and structures not demolished. If underground utility services disconnections are required in public thorough-fares, comply with removal and restoration of pavement requirements and other pertinent matters.
- B. Preserve in operating condition active utilities bordering or traversing site designated to remain. Protect property, including, but not limited to, valve boxes, poles, guys and related appurtenances. Repair damage to active utility, due to work under contract, to satisfaction of utility concerned. Remove utility lines that are to be abandoned from building area.

3.03 STRIPPING TOPSOIL

- A. Remove existing grass and overburden before excavating topsoil.
- B. Prior to beginning excavation or fill, strip the topsoil to a depth of at least 6 inches or to a depth sufficient to remove all organic material and stockpile for future use.
- C. In general, remove topsoil where structures are to be built, trenches dug and roads, parking lots, walks and similar improvements constructed within the areas presently covered with topsoil.
- D. Store topsoil clear of the construction area.
- E. Take reasonable care to prevent the topsoil from becoming mixed with subsoil or eroding.

3.04 DEMOLITION OF STRUCTURES

- A. Demolish buildings and/or building elements designated for demolition, pulling out foundations and concrete slabs. Completely remove designated building components and any obstructions above ground level and down to bottom of footings below ground level. Salvageable materials become property of Contractor unless otherwise shown or specified and shall be promptly removed from site.
- B. Fill holes and trenches resulting from demolition and removal, to ground surface. Rock and materials from masonry construction may be used in backfilling up to a depth of 1 foot below ground surface if sufficient fine materials are mixed therewith to fill voids. Use dirt for top 1 foot of fill, free from trash, wood, pipe and debris.

- C. After clearing, perform rough grading necessary to provide complete run-off of surface water.
- D. Barricade open excavations until backfilled. Do not backfill until backfill materials have been inspected and approved by Architect's representative.
- E. Wet down masonry thoroughly during demolition to prevent spread of dust.
- F. Leave parcel site in safe and clean condition, free from rubbish, debris, materials, and equipment.
- G. When Contractor starts building demolition, excluding interior stripping of salvable items including plumbing and electrical fixtures, he is to continue work during normal working days suitable to operations until demolition and site clearance is completed, unless otherwise specifically authorized by Owner.

3.05 PROTECTION AND REPAIR

- A. Erect temporary barricades and fencing required to protect existing and new site construction including but not limited to new and existing walks, drives, roads, curb and gutter, etc. during construction.
- B. Allow no heavy traffic on new or existing paving unless authorized in writing by Owner.
- C. Contractor is responsible for restoring all existing site construction, including softscape (landscape), that is damaged during construction to new condition.
- D. If it is necessary to cut or trench across any existing paving (including walks), Contractor is responsible for restoring damaged areas to new condition.

3.06 PROTECTION OF TREES TO REMAIN

- A. At trees to remain, construct temporary barricade around tree at tree's approximate drip line. Provide barricades at least 3 feet high, consisting of 2 inch by 4 inch or larger posts set at least 18 inches into ground, no more than 6 feet on centers, joined at top by 1 inch by 6 inch or larger boards firmly nailed to posts.
- B. Trimming of Trees: In company with Architect, ascertain limbs and roots which are to be trimmed and clearly mark them to designate approved cutting point. Cut evenly, using proper tools and skilled workmen to achieve neat severance with least possible damage to tree. Promptly coat cut area with approved pruning paint complying with manufacturer's recommendations. In case of root cuts, apply wet burlap or related protection approved by Architect, to prevent drying out.

3.07 TREE/BRUSH REMOVAL

- A. Remove trees, brush and vegetation except trees which are to remain, from Project site. Material resulting from clearing becomes property of Contractor, who shall be responsible for disposal.
- B. Wet down areas where required during site clearing to prevent spread of dust.
- C. Blasting on Project site is not allowed as a means of tree removal.

3.08 STUMPS AND ROOTS

- A. Remove completely stumps and roots from areas within building walls and 5 feet outside building walls. Remove remaining stumps and roots to clear depth of not less than 2 feet below subgrade level. Material resulting from grubbing becomes property of Contractor, to dispose of by him. Burn no material on premises unless approval is given by the local jurisdiction.

3.09 OBSTRUCTIONS

- A. Remove existing obstructions from area to be occupied by Work under this Contract unless otherwise specified herein, or specifically directed by Architect to remain.

3.10 REMOVAL OF DEBRIS AND CLEANING

- A. Remove and legally dispose of rubbish and debris found on demolition area at start of the Work that resulting from demolition activities or deposited on site by others during the duration of contract. Keep project area and public right-of-way reasonably clear at all times. Upon completion of work remove temporary construction, equipment, salvaged materials, trash and debris leaving entire project area in neat condition.

END OF SECTION 02 41 13

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PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Demolition and removal work required for construction and connecting new Work to existing building and for remodeling reconstructing existing building. Work also includes barricades, temporary protection, dust protection, removal from site trash and debris from demolition work, and repairing existing hardscape/softscape damaged during the course of the work.
- B. Extent of selective demolition work is generally indicated on drawings. Selective demolition not shown on the drawings may be determined by examination of existing facilities and the proposed new and remodeled reconstructed work. Existing items not shown on the plans of proposed work and preventing the execution of proposed work are in the scope of the selective demolition work.
- C. Refer to the mechanical and electrical and plumbing drawings for extent of demolition work required in adjacent areas for accommodation of renovation work. If no drawings show the extent of demolition, the Contractor must determine the extent of work and include it in his scope of work.
- D. Degree of patching to be performed in a given area will be determined by the proposed new finish of that area.
- E. Areas of the existing floor will require patching and leveling where ceramic tile, other flooring, partitions, plumbing fixtures, and mechanical equipment are removed. Some existing partitions to be removed may extend below the floor surface which will require patching. If the floor level on one side of a partition to be removed differs from the floor level on the other side, a cementitious floor leveler will be required to transition between the two.
- F. Disconnecting, removal and/or relocation and reconnecting of existing mechanical, electrical and fire protection work including equipment, piping and wiring are included in this Contract.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SCHEDULES

- A. Before commencing any alteration work, submit for review and approval of the Architect, a schedule showing the commencement, the order, and the completion dates for the various parts of this work.
- B. Before starting any work relating to existing utilities that will temporarily discontinue service to the existing building, notify the Owner 5 days in advance and obtain the Owner's approval before proceeding with this phase of work. Do not disconnect or disrupt service without Owner's prior approval.

1.04 HAZARDOUS MATERIAL ABATEMENT

- A. During the construction of this project, if work involving hazardous material is suspected, or encountered, Contractor shall notify Owner or Owner's representative immediately and Owner, with his own forces or by separate contract is responsible for complete investigation, removal and disposition of hazard material in accordance with applicable laws and regulations.

PART 2 - PRODUCTS

2.01 BARRICADE AND SUPPORT MATERIALS

- A. Before starting demolition and removal work, furnish and erect necessary barricades. Barricades shall provide for safe passage at all times. Provide temporary protection to keep existing building weathertight. Dust proof areas that are to be kept in use in manner to permit necessary passage for personnel and the protection of equipment. During process of demolition and removal, install temporary supports and bracing, to prevent building damage.
- B. If approved by Architect, materials from demolition work may be used for construction of temporary protective barricades, temporary partitions, noise barriers and dust barriers and for temporary non-structural supports. Where suitable materials are not available from demolition work, furnish materials of proper type and construction to perform function specified above.

2.02 FIRESTOPPING IN EXISTING CONSTRUCTION

- A. Demolition may uncover unsealed penetrations in fire rated floor, wall and ceiling assemblies. Examine the site for the location of these items and provide approved firestop sealant systems.
- B. Any new penetration in fire rated floors, walls, ceilings and roof will be sealed with approved sealant to maintain fire rating.

2.03 FIREPROOFING

- A. Any fireproofing removed during construction shall be replaced with similar material to maintain proper rating.

2.04 OTHER MATERIALS

- A. Provide materials, not specifically described but required for proper completion of work of this Section, selected by Contractor subject to Architect's approval.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Make such explorations and probes as are necessary to ascertain required protection measures before proceeding with alteration work. Give particular attention to shoring and bracing requirements so as to prevent any damage to existing construction.
- B. Provide, erect, and maintain catch platforms, lights, barriers, weather protection, warning signs, and other items as required for proper protection of the workmen engaged in alteration operations, and adjacent construction.
- C. Provide and maintain weather protection at exterior openings so as to fully protect the interior premises against damage from the elements until such openings are closed by new construction.
- D. Provide and maintain temporary protection of the existing building where demolition, removal, and new work is being done, connections made, materials handled, or equipment moved.
- E. Take necessary precautions to prevent dust and dirt from rising by wetting demolished masonry, concrete, plaster, gypsum board, sprayed fireproofing and similar debris, or by other means. Protect unaltered portions of the existing building affected by the operations under this section by dust-proof partitions and other adequate means.
- F. Do not close or obstruct walkways or passageways without the authorization of the Owner. Do not store or place materials in passage-way or other means of egress. Conduct operations with minimum traffic interference.
- G. Owner will be continuously occupying areas of the building immediately adjacent to areas of selective demolition. Conduct selective demolition work in manner that will minimize need for disruption of Owner's normal operations. Provide minimum of 72 hours advance notice to Owner of demolition activities which will severely impact Owner's normal operations.

3.02 UTILITY SERVICE

- A. Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations.
- B. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services such as emergency power, fire alarm, heating and air conditioning, during interruptions to existing utilities, as acceptable to Owner and governing authorities. Allow no interruption in service unless coordinated with Owner at least 24 hours in advance.
- C. Disconnect and seal utilities serving interior area to be demolished, prior to start of demolished work.
- D. Protect smoke and fire detectors from construction damage, dust and false alarms.
- E. Request Owner to identify any data/communication wiring above the ceiling that should be removed. Remove this wiring.
- F. Remove all abandoned conduit and wiring above ceiling.

3.03 INSTALLATION/APPLICATION/PERFORMANCE

- A. Provide alteration work as indicated on the drawings or required for the work of this Contract. Be responsible for any damage that may be caused by such work to any part or parts of existing structures or items designated for reuse or salvage. Perform patching, restoration, and new work in accordance with applicable technical sections of the Specifications.
- B. Where alterations occur, or new and old work join, cut, remove, patch, repair, or refinish the adjacent surfaces or as required by the involved conditions, and leave in as good a condition as existed prior to the commencing of the work. Refinish painted surfaces from intersection to intersection unless indicated otherwise. Materials and workmanship employed in the alterations, unless otherwise indicated or specified, shall conform to that of the original work. Materials not specifically described but required for a complete and proper installation of the work, shall be new, first quality of their respective kinds, as selected by Contractor subject to the approval of the Architect. Alteration work shall be performed by the various respective trades that normally perform the particular items of work.
- C. Finish new and adjacent existing surfaces as specified for new work. Clean existing surfaces of dirt, grease and loose paint before refinishing.
- D. Where alterations occur in areas to be completed during later phases of the work only prepare adjacent surfaces as necessary and complete finishing during proper phase of the work.

- E. If it will be necessary to disrupt internal pedestrian traffic flow along means of egress from the building, the Contractor must consult the presiding code official in regards to temporary means of egress, temporary exit signage and other related items. Implementation of requirements made by the code official are the responsibility of the Contractor.
- F. If unanticipated mechanical, electrical or structural elements which conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict. Submit report to Owner's Representative in written, accurate detail. Pending receipt of directive from Owner's Representative rearrange selective demolition schedule as necessary to continue overall job progress without delay.
- G. At areas requiring demolition of finishes and items normally applied with adhesives (i.e. vinyl wall coverings, rubber/vinyl flooring, etc.) and where the original surface is to remain or receive a new finish, the Contractor shall assume the original surface will be damaged by the demolition and include in his base bid the cost for repair of these surfaces to a smooth surface, ready to receive new finish.

3.04 SALVAGE

- A. Certain items and materials removed from existing building in demolition work are to be relocated or reused by Contractor in new construction work under this Contract. Items and materials for relocation or reuse and which are damaged by careless handling in removal may be rejected by Architect if considered unsuitable for re-use. Replace rejected items at Contractor's expense. Salvable materials, removed in demolition work and not for relocation or re-use or not turned over to the Owner for disposition, become property of Contractor and shall be hauled away from site as they are removed.
- B. In all cases of interior demolition, door hardware, light fixtures, emergency lighting, art work, furniture, window treatments such as blinds, drapes, curtains and operating hardware, signage and graphics and other interior decor items are to be carefully removed and turned over to Owner unless designated to be cleaned or refurbished and reinstalled.

3.05 REMOVAL OF DEBRIS AND CLEANING

- A. Remove and legally dispose of rubbish and debris found in demolition area at start of the Work that resulted from demolition activities or were deposited on site by others during the duration of contract. Keep project area and public right-of-way reasonably clear at all times. Upon completion of work remove temporary construction, equipment, salvaged materials, trash and debris leaving entire project area in a neat and clean condition.

3.06 PROTECTION AND REPAIR

- A. Erect temporary barricades and fencing required to protect existing and new site construction including but not limited to new and existing walks, drives, roads, curb and gutter, etc. during construction activities.
- B. Allow no heavy traffic on new or existing paving unless authorized in writing by Owner.
- C. Contractor is responsible for restoring all existing site construction, including softscape (landscape) and hardscape, that is damaged during construction to new condition.
- D. If it is necessary to cut or trench across any existing paving (including walks), Contractor is responsible for restoring damaged areas to new condition.

END OF SECTION 02 41 19

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Form cast-in-place concrete required and subsequently remove forms except as otherwise specified.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. ACI 318-25: Building Code for Structural Concrete – Code Requirements and Commentary.
 - 2. ACI 347-14(21): Guide to Formwork for Concrete (Re-approved 2021).
 - 3. ACI SP-66(04): ACI Detailing Manual-2004.

1.05 QUALITY ASSURANCE

- A. Qualifications of Workmen: Provide foreman at all times during execution of this portion of the Work, thoroughly familiar with type materials being installed, referenced standards, and requirements of this work, and who shall direct work performed under this Section.
- B. Codes and Standards:
 - 1. In addition to complying with pertinent codes and regulations, comply with pertinent recommendations contained in "Recommended Practice for Concrete Formwork", publication ACI 347 of the American Concrete Institute.
 - 2. Where provisions of pertinent codes and standards conflict with requirements of this Section more stringent provisions govern.

PART 2 - PRODUCTS

2.01 WOOD FORM MATERIALS

- A. Form Lumber: Provide form lumber in contact with exposed concrete using new material except as allowed for re-use of forms. Provide form lumber as follows, a combination thereof, or an equal approved in advance by Architect:
 - 1. "Plyform", class I or II, bearing label of the American Plywood Association.
 - 2. Southern Pine or Douglas Fir, number 2 grade, seasoned, surfaced 4 sides.
- B. Form Sealers: Provide "React S" by Conspec, or approved equal.

2.02 TIES AND SPREADERS

- A. Type: Type which does not leave an open hole through concrete and which permits neat and solid patching at every hole.
- B. Design: Metal not less than one inch from surface at completion of concrete work.

2.03 EXPANSION JOINTS

- A. Non-extruding, pre-moulded filler strips conforming to ASTM D 1751 or D 1752 and compatible with sealant material used to seal joints.

2.04 FORMED JOINTS

- A. Non-staining materials; of wood, plastic, or metals, formed to be removed without spalling concrete.

2.05 KEYED JOINTS

- A. KEY-LOK® by Form-A-Key Products, BoMetals QuicKey by White Cap, Muller Construction Co. or approved equal. Top of stakes set 3/8" below slab surface so when joint form is placed on stakes, painted portion of joint is finished elevation. Finish concrete to top of joint and burn in with hand trowel.

2.06 WATERSTOPS

- A. Hydrophilic Strip Waterstop: Provide WATERSTOP-RX® Expanding Concrete Joint Waterstop as manufactured by CETCO, 800-527-9948 or approved equal product. Install per manufacturer's published recommendations, including accessory products required for a complete installation.

2.07 OTHER MATERIALS

- A. Provide materials, not specifically described but required for completion of concrete formwork as selected by Contractor subject to advance approval of Architect.

PART 3 - EXECUTION

3.01 CONSTRUCTION OF FORMS

- A. General: Construct substantial, sufficiently tight forms to prevent fins and leakage of mortar, and able to withstand deflection when filled with wet concrete.
- B. Layout:
 - 1. Form cast-in-place concrete to shapes, sizes, lines, and dimensions required.
 - 2. Exercise particular care in form layout to avoid necessity for cutting of concrete after placement.
 - 3. Make proper provision for inserts, sleeves, pipes, openings, offsets, recesses, anchorage, blocking, and related features as required.
- C. Forms for footings and related below grade concrete may be omitted when soil and workmanship permit accurate excavation to size and where omission is approved by Architect.
- D. Removal of forms: Time for removing forms is subject to weather conditions after concrete is poured. Remove form work in manner to insure complete safety of structure. Do not place building materials on slabs until they are strong enough to carry the imposed load. Contractor shall decide when to remove forms and accept full responsibility for their removal.

3.02 JOINTS

- A. If proposed layout of joints differs from layout shown on drawings, Contractor shall submit three (3) copies of alternate layout plan to Architect for review. Do not proceed with alternate layout of joints without written approval from Architect.
- B. Provide mechanical "Keyed Kold" joint screed forms used in placing concrete slabs on grade installed to comply with manufacturer's specifications.
- C. Construction Joints: Where joint is made, thoroughly clean concrete surface and remove all latence. In addition, thoroughly wet and slush vertical joints with a coat of neat cement grout immediately before placing new concrete.
- D. Expansion Joints: Do not run reinforcement, corner protection angles, or related fixed metal items, embedded in or bonded into concrete continuous through expansion joints. Provide filler strips for expansion joints between slabs on grade and all joints between slabs on grade and vertical surfaces. Construct joints 1/2-inch thick and full depth of slab, unless otherwise noted.
- E. Saw-cut Control Joints: In "Green" concrete the following tables will apply.
 - 1. Depth of cut:
 - a. Soff-Cut Saw: 1" minimum
 - b. Wet-Cut Saw: 1/4 slab thickness

2. Joint spacing based upon slab thickness, UNLESS NOTED OTHERWISE:
 - a. 4" slab equals 10'-0" o.c.
 - b. 5" slab equals 13'-0" o.c.
 - c. 6" or thicker slab equals 15'-0" o.c.

3.03 RUBBED SURFACES

- A. Construct forms for exposed cast-in-place concrete with smooth exterior grade plywood or steel with joints butted tight to prevent fins and leaking. As soon as forms are stripped, rub down concrete surface with carborundum grinders using water and Portland cement as rubbing agent. Rub exposed concrete until a uniformly even surface is obtained, with no joint marks or defects showing. Do not apply neat cement or grout to concrete as painted or plastered finish coat.

3.04 JOINT-FREE SURFACES

- A. No joint allowed in formed surfaces where joint-free surfaces are required. In forming for joint-free surfaces, use metal lined forms and cover form joints with form tape.

3.05 CHAMFERED CORNERS

- A. Chamfer corners of rectangular concrete members formed with wood forms except where flush with adjacent concrete or masonry, or where covered with other materials.

END OF SECTION 03 10 00

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Furnish and install reinforcement and associated items required for cast-in-place concrete.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
1. Furnish Shop Drawings for review by Architect, on reinforcing steel including special details, bending diagrams, schedules, bar lists, placing diagrams, and accessories. In addition to provisions in General Conditions, submit reinforcing Shop Drawings prepared by or under supervision of registered professional engineer. Reproduction (in any form) of Contract Drawings are not to be used for Shop Drawings. Furnish two prints and one sepia reproducible of Shop Drawings to Architect for review. Submit related shop drawings together. Partial submittals will not be accepted.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

- A. Qualifications of Workmen: Provide foreman at all times during execution of this portion of the Work, thoroughly familiar with type materials being installed, referenced standards, and requirements of this work, and who shall direct work performed under this Section.
- B. Codes and Standards:
1. In addition to complying with pertinent codes and regulations, comply with pertinent recommendations contained in "Manual of Standard Practice for Detailing Reinforced Concrete Structures", publication ACI 315 of the American Concrete Institute.
 2. Where provisions of pertinent codes and standards conflict with requirements of this Section more stringent provisions govern.

PART 2 - PRODUCTS

2.01 CONCRETE REINFORCEMENT

- A. Concrete Reinforcement Materials: New, free from rust, and complying with following reference standards:
 - 1. Bars for Reinforcement: "Specifications for Deformed Billet-Steel Bars for Concrete Reinforcement", ASTM A-615, grade 60 unless otherwise shown.
 - 2. Wire Fabric: ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - 3. Supports, Spacers, and Chairs: Types which will hold reinforcement in position shown in accordance with requirements of ACI CODE-318 except as specified.

2.02 OTHER MATERIALS

- A. Provide metal accessories, including spacers, chairs, ties, and devices necessary for properly assembling, placing, spacing, and supporting reinforcement (including welded wire fabric at 2" from top of slab) in place. Provide materials, not specifically described but required for complete and proper installation of concrete reinforcement, as selected by Contractor subject to approval of Architect.

PART 3 - EXECUTION

3.01 SITE CONDITIONS

- A. Inspection:
 - 1. Carefully inspect installed work of other trades and verify work is complete to point where this installation may properly commence.
 - 2. Verify that concrete reinforcement may be installed to comply with pertinent codes and regulations, reviewed Shop Drawings, and original design.
- B. Discrepancies:
 - 1. In event of discrepancy, immediately notify Architect.
 - 2. Do not proceed with installation in areas of discrepancy until discrepancies have been fully resolved.

3.02 BENDING

- A. General: Fabricate reinforcement to comply with reviewed Shop Drawings. Do not use bars with kinks and bends not shown on Drawings or on reviewed Shop Drawings. Do not bend and straighten steel in manner that will injure material.
- B. Assembly: Tack-welding not acceptable for assembly of reinforcement without specific approval of the Structural Engineer. When permitted by Engineer all welding shall conform to reinforcing steel welding code (AWS D.12.1) of the American Welding Society.

3.03 PLACING OF REINFORCEMENT

- A. Placing:
 - 1. Support and wire together reinforcing bars to prevent displacement by construction loads and placing of concrete. On ground and where necessary, supporting Normal Weight concrete blocks may be used. Provide at flat formwork, metal or plastic coated bar chairs and spacers. Provide galvanized, stainless steel or plastic coated accessories where concrete surface will be exposed to weather in finished structure and where rust would impair architectural finishes.
 - 2. Lap welded wire fabric minimum of 12" in structural slabs and minimum of 6" in slabs-on-grade. Support mesh in final position in all slabs. Lifting of mesh into final position is not permitted.
 - 3. Do not bend bars after embedded in concrete.
- B. Cleaning Reinforcement: Remove loose, flaky rust, mill scale, mud, oil, and related coatings that will destroy and reduce bond during concrete placement.
- C. Splices: Splice where shown on Drawings or reviewed Shop Drawings.
- D. Concrete Reinforcement Protection: If not detailed otherwise, where concrete is deposited against ground, reinforcement shall have minimum of 3" concrete between it and the ground. If concrete surfaces after removal of forms are to be in contact with ground or exposed to weather, protect reinforcing with minimum of 2" of concrete for bars larger than No. 5 and 1-1/2" for No. 5 bars and smaller. Provide minimum 3/4" concrete covering for reinforcing in slabs and 1-1/2" minimum cover in beams at surfaces not exposed directly to ground or weather.

END OF SECTION 03 20 00

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PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Cast-in-place, reinforced concrete required. Provisions of this Section are applicable to structural concrete at building as well as to site improvement work.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
1. Design Mix: Prior to placement of concrete, submit concrete mix designs proposed by the concrete supplier for class of concrete, including recent test results substantiating the quality of concrete produced by each mix.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

- A. Qualifications of Workmen:
1. Provide foreman at all times during execution of this portion of the Work, thoroughly trained and experienced in placing type concrete specified and who shall direct work performed under this Section.
 2. Finishing of Exposed Surfaces of Concrete: Use thoroughly trained and experienced journeyman concrete finishers.
- B. Codes and Standards:
1. In addition to complying with pertinent codes and regulations, comply with pertinent recommendations of "Building Code Requirements for Structural Concrete", publication ACI CODE-318 of latest issue of the American Concrete Institute.
 2. American Concrete Institute, ACI PRC-302.1R-04, or most current revised issue, Guide for Concrete Floor and Slab Construction.
 3. Where provisions of pertinent codes and standards conflict with requirements of this Section more stringent provisions govern.
 4. ACI MNL-66 - ACI Detailing Manual.
 5. ACI SPEC-301-20: Specifications for Concrete Construction.

1.05 LABORATORY TESTING

- A. All required testing will be performed by testing laboratory selected by Owner. Cost for laboratory services for concrete tests and mix designs paid by Contractor. Material for tests furnished by Contractor.
- B. Contractor shall submit three (3) copies of certified laboratory test reports to Architect for review.
- C. Testing Procedures:
 - 1. Material Testing: Laboratory to re-check at plant materials as often as necessary to produce concrete of specified strength and consistency including:
 - (a) Fine aggregate.
 - (b) Coarse aggregate.
 - (c) Cast-in-place concrete.
 - 2. Concrete Slump: 6 inches with allowable variation of plus or minus 1 inch. Selected target slump shall not exceed 9 inches.
 - 3. Quality Control: As work progresses testing laboratory personnel shall conduct tests of concrete in accordance with following procedures:
 - (a) Secure composite samples from the same batch complying with ASTM C 172 for each 150 cubic yards (or fraction thereof) of each concrete mixture each day.
 - (b) Perform one (1) slump test in accordance with ASTM C 143 for each set of compressive test cylinders.
 - (c) Perform (1) air content test in accordance with ASTM C 231 or C 173 for each set of compressive strength test cylinders.
 - (d) Measure concrete temperature in accordance with ASTM C 1064 every hour when ambient temperature is 40 deg F and below, or 80 deg F and above, and one temperature measurement for each composite sample.
 - (e) Measure concrete density in accordance with ASTM C 138 for each set of compressive strength test cylinders.
 - (f) Mold four (4) compressive strength test specimens in accordance with ASTM C31 from each composite sample. Protect and cure under standard moisture and temperature conditions in accordance with ASTM C 31.
 - (g) Test two (2) specimens at seven (7) days complying with ASTM C 39. If specimens for a particular batch test at or above required strength for that batch, it is not necessary to test the remaining specimens. Hold the remaining specimens for an additional ninety (90) days in case future testing is required. If the specimens tested at seven (7) days do not meet or exceed the desired strength requirements, the remaining two (2) specimens will be tested at twenty-eight (28) days. Average strength of two (2) specimens from each group tested is basis for acceptance or rejection of concrete. If tested strength falls below strength specified at twenty-eight (28) days, Architect has the right to order the removal and replacement of defective concrete at Contractor's expense. If Contractor wishes to obtain test cores from in-place concrete, cost of coring, testing and patching will be paid by Contractor.

4. Flatness: Variation in flatness within a 10' area shall not exceed 1/8" +/-.

1.06 REFERENCES

- A. Publications listed below form a part of this specification to extent referenced.
 1. ACI SPEC-117: Standard Specification for Tolerances for Concrete Construction and Materials
 2. ACI PRC-211.1: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
 3. ACI PRC-213: Guide for Structural Lightweight-Aggregate.
 4. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
 5. ASTM C1059 - Standard Specification for Latex Agents for Bonding Fresh To Hardened Concrete.
 6. ASTM C1602 - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
 7. ASTM C260 - Standard Specification For Air-Entraining Admixtures For Concrete.
 8. ASTM C1895-20 Standard Test Method for determination of Mohs Scratch Hardness Tests.
 9. ASTM D5767-18 Standard test Method for Instrumental Measurement of Distinctness of Image (DOI) Gloss of Coated Surfaces.
 10. ASTM E1155-20 Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.
 11. ASTM C33/C33M-23 - Standard Specification for Concrete Aggregates
 12. PCI - Portland Cement Association - Concrete Slab Surface Defects: Causes, Prevention, Repair, ©2001 or more current publication.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Portland Cement: Conform to ASTM C150 "Standard Specifications for Portland Cement", Type I. Use one brand of cement. Mix shall contain at least 470 lb. of Portland Cement per cubic yard of concrete. Use 520 lb. of cement if freeze thaw deicing chemicals used or required by conditions.
- B. Supplementary Cementitious Materials:
 1. Fly ash will not be allowed.
 2. Slag Cement: ASTM C 989, Grade 100 or 120.
 3. Silica Fume: ASTM C 1240.
 - a. MasterLife SF 100; Master Builders Solutions.
 4. Metakaolin: ASTM C 618, Class N.
 - a. MasterLife MK 828; Master Builders Solutions.

- C. Aggregates: Conform to ASTM C 33 "Standard Specifications for Concrete Aggregates". Provide aggregate of natural sand and gravel or prepared from stone or gravel, free from adherent coatings. Maximum size of pieces 1", except for footings and foundation walls which may be 1-1/2" maximum size.
- D. Water: ASTM C 1602. Clean and free from injurious amounts of oils, acids, alkalis, organic materials, and deleterious substances. **Non-potable water will not be used in concrete mixing.**
- E. Chemical Admixtures
1. Air Entraining Admixture: ASTM C 260. Comply with current building code.
 - a. MasterAir Series; Master Builders Solutions.
 2. Water-Reducing Admixture: ASTM C 494, Type A.
 - a. MasterPozzolith Series or MasterPolyheed Series; Master Builders Solutions.
 3. Retarding Admixture: ASTM C 494, Type B.
 - a. MasterSet R Series or MasterSet DELVO Series; Master Builders Solutions.
 4. Accelerating Admixture: ASTM C 494, Type C.
 - a. MasterSet AC 534 or MasterSet FP 20; Master Builders Solutions.
 5. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 - a. MasterSet R Series or MasterSet DELVO Series; Master Builders Solutions.
 6. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
 - a. MasterSet FP 20; Master Builders Solutions.
 7. High-Range Water-Reducing Admixture: ASTM C 494, Type F.
 - a. MasterRheobuild 1000 or MasterGlenium Series; Master Builders Solutions.
 8. Viscosity Modifying Admixture: ASTM C 494, Type S.
 - a. MasterMatrix VMA Series; Master Builders Solutions.
 9. Permeability-Reducing Admixture : ASTM C 494, Type S.
 - a. Shall be a Portland cement-based crystalline capillary waterproofing admixture that reacts in concrete to form insoluble crystalline hydration products in the capillary pores of concrete.
 - b. Shall show a reduction in permeability of concrete compared to an identical concrete mixture without the admixture, when tested in accordance with CRD-C 48 at a pressure of 200 psi.
 - c. Shall reduce or have no penetration of water compared to an identical concrete mixture without the admixture, when tested in accordance with DIN 1048 for a duration of 96 hours.
 - d. NSF-61 certified .
 - e. MasterLife 300 Series; Master Builders Solutions.
 10. Shrinkage-Reducing Admixture: ASTM C 494, Type S.
 - a. MasterLife SRA Series or MasterLife CRA 007; Master Builders Solutions.

11. Corrosion-Inhibiting Admixture: A nominal 30-percent solution of calcium nitrite or an amine/ester organic corrosion-inhibiting admixture.
 - a. MasterLife CI 30 or MasterLife CI 222; Master Builders Solutions.
12. Alkali-Silica Reaction Inhibiting Admixture: ASTM C 494, Type S.
 - a. MasterLife ASR 30; Master Builders Solutions.

F. Fibers

1. Synthetic Microfibers :
 - a. Shall be manufactured from a proprietary blend of polypropylene resins in compliance with ASTM D 7508 for micro-chopped strands.
 - b. Shall provide a minimum cracking reduction ratio (CRR) of [] percent when tested in accordance with ASTM C 1579.
 - c. Dosage shall be as recommended by the manufacturer.
 - d. MasterFiber M Series or MasterFiber F Series; Master Builders Solutions.
2. Synthetic Macrofibers :
 - a. Shall be manufactured from a proprietary blend of polypropylene resins in compliance with ASTM D 7508 for macro-chopped strands or hybrid chopped strands.
 - b. Shall provide a minimum average residual strength, (or a minimum average equivalent flexural strength, fe,) of [] psi when tested in accordance with ASTM C 1609, using the roller support system in ASTM C 1812.
 - c. Dosage shall be as recommended by the manufacturer. Dosage of fiber for composite steel deck shall not be less than 4 lb/ yd3, as recommended in ANSI/SDI C2017.
 - d. MasterFiber MAC Series; Master Builders Solutions.

2.02 CONCRETE STRENGTHS

- A. Cast-in-place Concrete: Designed to develop 3,500 psi minimum compressive strength at 28 days, unless noted otherwise on Structural Drawings. ***Refer to Division 32, EXTERIOR IMPROVEMENTS for strengths required for various concrete site improvements.***

2.03 GROUT

- A. Non-Shrink, Non-Metallic, Flowable Grout meeting ASTM C1107 (structural steel grouting, base plates, anchor bolts, tuck pointing):
1. Con-Spec CS-100
 2. W.R. Meadows Sealtight CG-86™
 3. Master® Builders Solutions MasterFlow Series
 4. L&M DURAGROUT™
 5. SikaGrout 212
 6. Kaufman Products SureGrout
 7. Euclid N.S. Grout
 8. Dayton Superior 1107 Advantage Grout
 9. Approved equal.

2.04 CONCRETE FLOOR SEALER

- A. Furnish and apply to concrete surfaces shown on finish schedule as "Sealed Concrete", polyurethane concrete sealer:
 - 1. Spec Cote Urethane by Dayton Superior. Primer to be Spec Cote WB High Performance Water-Based Epoxy Coating.
 - 2. Approved equal.
- B. Surface Preparation: Concrete floor should be sound clean and dry and free of oil, dirt, grease, paint, laitance, and the typical membrane forming curing compounds. The concrete should be at least 28 days old. Floors should be mechanically prepared i.e., shot-blast, sandblast, to result in an International Concrete Repair Institute (ICRI) Concrete Surface Profile (CSP) of between CSP #1-2, or the texture of medium grit sandpaper to ensure proper adhesion. If oils or grease are present chemical degreasers should be used to thoroughly degrease concrete before shot-blasting.
- C. Minimum of two (2) applications are required.
- D. Provide clear color for all applications.

2.05 CONCRETE CURING COMPOUND

- A. SpecChem E-Cure® Water-Based Concrete Curing Compound; non-yellowing.
 - 1. Tested per CDPH Standard Method V 1.2-2017 and complies with all LEED V.4 Requirements.
 - 2. Adhesion tested by TCNA (Tile Council) for compliance with thin-set mortar and vinyl tile adhesive. Meets the moisture retention of ASTM C 309 Type 1D, Class A & B on a hard troweled concrete surface.

2.06 UNDERSLAB DRAINAGE FILL

- A. Washed crushed stone or washed crushed gravel (AASHTO #57), uniformly graded from 3/4-inch minimum to 1-inch maximum size at depths of 4 to 6 inches. Refer to the drawings.

2.07 CONCRETE PATCH AND REPAIR

- A. Provide Adhesives Technology Crackbond® JF Joint & Crack Filler, a two-component polyurea joint filler designed for heavy duty traffic, property repairs and freezer applications. It is solvent free, flexible and with its low viscosity and self-leveling design, allows for 10-15 % movement of installed joint width. It may be used in temperatures between -40 °F to 120 °F (-40 °C to 49 °C). Excellent for the filling of active cracks in concrete in exterior horizontal applications. Polyurea formulation offers long term product adhesion and stability without cracking or deterioration.

2.08 OTHER MATERIALS

- A. Provide materials, not specifically described but required for complete and proper installation of cast-in-place concrete, selected by Contractor subject to approval of Architect.

PART 3 - EXECUTION

3.01 MIXING AND PLACING CONCRETE

- A. Preparation: Clean equipment for transporting concrete. Remove debris, water, and ice from places to be occupied by concrete. Remove laitance and unsound material from hardened concrete before additional concrete is added.
- B. Mixing: Ready-mixed concrete, mixed and delivered in accordance with following requirements only of ASTM C 94.
 - 1. Tolerances in Slump,
 - 2. Measuring Materials,
 - 3. Batching Plant,
 - 4. Mixers and Agitators,
 - 5. Mixing and Delivery,
 - 6. Use of Non-Agitating Equipment
 - 7. Inspection.
- C. Conveying: Convey concrete from mixer to place of deposit by methods that prevent separation and loss of materials.
- D. Placing:
 - 1. Deposit as nearly as practicable in final position to avoid segregation due to re-handling and flowing. Place at rate to assure concrete is plastic and flows readily into spaces between bars. Do not use concrete contaminated by foreign material or re-tempered concrete.
 - 2. When placing is started, carry a continuous operation until placement of panel or section is completed.
- E. Hot Weather Concreting: Place, handle, and cure concrete complying with ACI SPEC-305.1.
- F. Cold Weather Concreting: Provide adequate equipment for handling concrete materials and protecting concrete during freezing and near freezing weather. Concrete materials, reinforcements, forms, and ground in contact with concrete to be free of frost, snow, and ice. Details of approved procedures are available in ACI SPEC-306.1. Contractor to keep accurate thermometer on job where the work is proceeding.
- G. Porous Backfill: Crushed stone or gravel graded from 25 mm to 20 mm (1 inch to 3/4 inch).

3.02 PROTECTION OF ADJACENT SURFACES

- A. Contractor responsible for any work soiled and stained by dripping cement, water, or concrete. Protect same with tarpaulin or similar devices while pouring concrete.

3.03 CONSOLIDATION

- A. Consolidate concrete by vibration, spading, rodding, or forking. Work around reinforcement, embedded items and into corner of forms. Over-vibrating and use of vibrators to transport concrete within forms not allowed. When consolidating by vibration, keep spare vibrator on job site during concrete placing. Use vibrators of length to extend within 6 inches of bottom of freshly poured concrete, vibrator being raised with each succeeding pour.

3.04 CONCRETE CURING AND FINISHING

- A. **Curing Period:** Cure concrete for minimum period of 7 days at a temperature above 50° F. by one of approved methods listed below. Protect fresh concrete from heavy rain, flowing water, mechanical injury and from injurious action of sun. Comply with ACI SPEC-306.1 for cold-weather protection, and follow recommendations in ACI SPEC-305.1 for hot-weather protection during curing. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.
- B. **Potable Water Curing:** If cured with water, keep concrete wet by mechanical sprinklers or by any approved method which will keep surface continuously wet.
- C. **Evaporation Retarder:** Waterborne, monomolecular film forming, manufactured for application to fresh concrete. Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions prevail. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- D. **Curing Compounds: NO CHEMICAL CURING COMPOUNDS ALLOWED.**
- E. **Waterproofing Paper or Opaque Polyethylene Film:** Conform to ASTM C 171. Cover concrete immediately following final finishing operation. Anchor securely, seal edges or apply in manner to prevent moisture escaping from concrete.
- F. **Curing Blanket:** AASHTO M-182, Class II, ASTM C-171 burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- G. **Concrete Patching:** Immediately after stripping forms, examine surfaces. Patch honeycombing, defective joints, voids, tie holes, and defects before concrete is thoroughly dry. However, make no attempt to correct or fill any honeycomb spots, or any other defects until they have been examined by Architect and approval obtained as to correction to be employed. Finish of patch to match adjoining surface.

H. **Concrete Finishes (ACI SPEC-301, latest edition):**

1. Interior General: Floor slabs, including topping slabs, to be smooth and steel troweled to hard dense surface (non-burnished), except where required to be depressed. Rough float finish depressed surface. Protect concrete floors during construction period.
2. Exterior: Pads, Steps, Stairs, Slabs and other surfaces to receive light-medium broomed finish for non-slip surface.

3.05 FLOOR SLOPE TO DRAINS

- A. Slope floors to drain outlets. Low spots where pools of water can stand on finished floors are not acceptable. Slope to drains 1/8" per lineal foot unless otherwise marked.
- B. Slope floors uniformly from perimeter walls and partitions to drain outlets (unless otherwise indicated).
 1. At shower pans scheduled to receive Fluid-Applied Flooring (Section 09 67 00), account for slope transitions from both perimeter shower walls and stepless ADA threshold or raised curb.
- C. When multiple drains are shown in a room, space equally. Create dedicated area per drain outlet and slope floor uniformly from area perimeter to drain outlet (unless otherwise indicated).

END OF SECTION 03 30 00

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PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Furnish and install self-leveling, Portland Cement based, polymer modified underlayment material.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are located in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 APPLICABLE STANDARD

- A. ASTM C109

1.05 QUALITY ASSURANCE

- A. Upon completion of floor underlayment work, aggregate manufacturer or processing distributor to furnish Architect certificate signed by an authorized representative stating that applicator is approved and that cementitious underlayment was prepared and applied in compliance with specifications of manufacturer in effect at time installation was made. Take minimum of four 2" x 2" cube mold samples during each day's pour (prepared according to ASTM C 109) and submit with field reports on daily wet density checks to indicate ultimate physical qualities. Perform sampling and testing by aggregate manufacturer's representative or trained, approved, applicator's superintendent.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Dayton Superior "LeveLayer", Premium Self-Leveling Floor Underlayment, 888-977-9600.

- B. Maxxon Corporation "Level-Right", Self-Leveling Floor Underlayment, 800-356-7887.
- C. Approved Equal.

2.02 UNDERLAYMENT AND PRIMER

- A. Provide portland cement based, polymer modified, self-leveling underlayment and surface primer/bonding agent in average thickness of 1-1/2 inch maximum.
- B. Material must attain a compressive strength of 5,500 psi minimum at 28 days and must be trowelable from featheredge to 1" thickness in one pour.

PART 3 - EXECUTION

3.01 MIXING

- A. The powder and water should be mechanically mixed with manufacturer-approved mixing/pumping equipment. Application instructions are available from the manufacturer.

3.02 SUBFLOOR PREPARATION

- A. The subfloor must be fully cured, moisture free and have no efflorescence. The surface shall be broom clean and contaminant free. Wax, sealers, adhesives curing compounds or oils should be removed by mechanical or chemical stripping.

3.03 PRIMER APPLICATION

- A. Mop or broom apply in accordance with manufacturer's suggested coverage rates for the particular substrate.

3.04 METHODS OF INSTALLATION

- A. Apply in accordance with manufacturer's suggested coverage rates for the particular substrate. Do not exceed manufacturer's recommended single lift limit for product used.

3.04 CURING CONDITIONS

- A. Protect the poured mortar from wind and sun, and from freezing temperatures until final set is achieved. Floor goods can be installed when underlayment passes a manufacturer's recommended moisture test.

END OF SECTION 03 54 13

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Repair and filling of voids, holes and depressions in concrete.
 - 1. On grade, above and below grade, interior and exterior applications.
 - 2. Structural grouting of column base plates, machine base plates, anchor bolts, bearing plates, bridge seats, precast wall panels.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Dayton Superior Corporation, 1125 Byers Road, Miamisburg, OH 45342, Customer Service: 888-977-9600, Technical Services: 877-266-7732 www.daytonsuperior.com

2.02 MATERIALS

- A. Non-Shrink, Non-Metallic Grout: Provide Dayton Superior 1107 Advantage Grout, a non-shrink, non metallic, non-corrosive, cementitious grout designed to provide a controlled, positive expansion to ensure an excellent bearing area.
 - 1. Meet ASTM C1107-20: Standard Specification for Packaged Dry, Hydraulic-Cement Grout (non-shrink).
 - 2. Approved equal manufacturers:
 - a. MasterFlow® 555
 - b. NS Grout, Euclid Chemical
 - c. Sikagrout® 212
 - 3. Perform grout placement in accordance with the recommendations of ACI and the manufacturer's published specifications for mixing and placing.

- B. Patching Compound: Provide "All-Patch 20".
- C. Feather Patch: Provide Polymer Modified Mortar Conspec "Feather Patch", ChemMasters "FeatherPatch" or approved equal. For exterior (or interior) use and can be applied from feather edge to 1 inch per lift. May be used for horizontal, vertical and overhead surfaces. Install per manufacturer's written recommendations and directions. Must be sealed immediately with water based curing and sealing compound, such as Polyseal™ WB, SafeSeal™ or Safe-Cure & Seal 20.
- D. Two Component Acrylic Polymer Modified Topping and Underlayment: Provide PATCHCRETE® as manufactured by Lyons Manufacturing, Inc., 214-381-8100 or approved equal. Install per manufacturer's written recommendations and directions.

PART 3 - EXECUTION

3.01 MIXING, PLACING AND FINISHING

- A. Mix in accordance with the manufacturer's directions to consistencies required for application.
- B. Level repaired surfaces flush with adjacent surfaces and trowel to a smooth finish.

END OF SECTION 03 60 00

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Masonry restoration and cleaning includes the following:
 - 1. Removal of plant growth.
 - 2. Repairing damaged masonry.
 - 3. Repointing mortar joints.
 - 4. Cleaning exposed masonry surfaces.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are located in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 REFERENCES

- A. Technical Notes on Brick Construction No. 20 - Cleaning Brickwork as provided by The Brick Industry Association.
- B. National Park Service Preservation Brief "Dangers of Abrasive Cleaning to Historic Buildings".
- C. National Park Service Preservation Brief "Assessing Cleaning and Water-Repellent Treatments for Historic Masonry Buildings".
- D. Preservation Brief 1: Assessing Cleaning and Water-Repellent Treatments for Historic Masonry Buildings:
 - 1. Potential Hazards of Water Cleaning Despite the fact that water-based methods are generally the most gentle, even they can be damaging to historic masonry. Before beginning a water cleaning project, it is important to make sure that all mortar joints are sound and that the building is watertight. Otherwise water can seep through the walls to the interior, resulting in rusting metal anchors and stained and ruined plaster.

1.05 QUALITY ASSURANCE

- A. Work must be performed by a firm having not less than 5 years experience in comparable masonry restoration and employing personnel skilled in the restoration process and operations indicated.

1.06 PROJECT CONDITIONS

- A. Do not repoint mortar joints or repair masonry unless air temperatures are between 40° F (4° C) and 80° F (27° C) and will remain so for at least 48 hours after completion of work.
- B. Prevent grout or mortar used in repointing and repair work from staining face of surrounding masonry and other surfaces. Remove immediately grout and mortar in contact with exposed masonry and other surfaces.
- C. Protect sills, ledges and projections from mortar droppings.
- D. Clean masonry surfaces only when air temperatures are 40° F (4° C) and above and will remain so until masonry has dried out, but for not less than 7 days after completion of cleaning.

1.07 SEQUENCING OF WORK

- A. Perform masonry restoration work in the following sequence:
 - 1. Repair existing masonry including replacing existing masonry with new masonry materials.
 - 2. Rake-out existing mortar from joints indicated to be repointed.
 - 3. Repoint existing mortar joints of masonry indicated to be restored.
 - 4. Clean existing masonry surfaces.
 - 5. Apply weather sealer specified in Section 07 19 00.

PART 2 - PRODUCTS

2.01 FACE BRICK AND ACCESSORIES

- A. Provide face brick and accessories, including units for lintels, corners, and other special shapes where required to complete masonry restoration work. Provide units with color, surface texture and size to match existing brick work.

2.02 MORTAR MATERIALS

- A. Refer to Section 04 05 13 of this division for mortar materials. Aggregate for grout shall conform to requirements of ASTM C 404.

2.03 CLEANING MATERIALS AND EQUIPMENT

- A. Water for Cleaning: Clean, potable, free of oils, acids, alkalis, salts, and organic matter.
- B. Warm Water: Heat water to temperature of 140° F-180° F (60° C-82° C).
- C. Brushes: Fiber bristle only.
- D. Alkaline Pre-wash Cleaner: Manufacturer's standard alkaline cleaner for pre-wash applications only which are followed by acidic cleaner of type indicated for after-wash.
 - 1. Product: Subject to compliance with requirements, provide "Sure Klean 766 Pre-wash", by ProSoCo, Inc., or approved equal.
- E. Acidic Cleaner: Manufacturer's standard strength acidic masonry restoration cleaner composed of hydrofluoric acid blended with other acids including trace of phosphoric acid and combined with special wetting systems and inhibitors.
 - 1. Products: Subject to compliance with requirements, provide one of the following or an approved equal:
 - a. "Diedrich 101 Masonry "Restorer", Diedrick Chemicals.
 - b. "Sure Klean® ReVeal Restoration Cleaner", ProSoCo, Inc.
- F. One-Part Limestone Cleaner: Manufacturer's standard one-part acid formulation for cleaning limestone.
 - 1. Product: Subject to compliance with requirements, provide "Sure Klean Limestone Restorer", ProSoCo, Inc., or approved equal.
- G. Chemical Paint Remover: Manufacturer's standard thixotropic/alkaline formulation for removing paint coatings from masonry.
 - 1. Products: Subject to compliance with requirements, provide one of the following or an approved equal:
 - a. "Diedrich 505/606/606X Paint Remover"; Diedrick Chemicals.
 - b. "Sure Klean Heavy-Duty Paint Stripper"; ProSoCo, Inc.
- H. Water-Rinsible Chemical Paint Remover: Manufacturer's standard thixotropic water-rinsable solvent formulation for removing paint coatings from masonry.
 - 1. Product: Subject to compliance with requirements, provide "Sure Klean 509 Paint Stripper", ProSoCo, Inc., or approved equal.
- I. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film forming, strippable masking material for protecting glass, metal and polished stone surfaces from damaging effect of acidic and alkaline masonry cleaners.
 - 1. Products: Subject to compliance with requirements, provide one of the following or an approved equal:
 - a. "Diedrich Acid Guard", Diedrick Chemicals.
 - b. "Sure Klean Acid Stop"; ProSoCo, Inc.

- J. Spray Equipment: Provide equipment for controlled spray application of water and chemical cleaners, if any, at rates indicated for pressure, measured at spray tip, and for volume.
1. For spray application of chemical cleaners provide low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with cone-shaped spray-tip.
 2. For spray application of water provide fan-shaped spray-tip which disperses water at angle of not less than 15 degrees.
 3. For spray application of heater water provide equipment capable of maintaining temperature, at flow rates indicated, between 140 deg. and 180 deg.F (60 deg. and 82 deg.C).
 4. For application of steam provide a steam generator capable of delivering live steam at nozzle head.

2.04 MORTAR MIXES

- A. Measurement and Mixing: Measure cementitious and aggregate material in a dry condition by volume or equivalent weight. Do not measure by shovel, use known measure. Mix materials in a clean mechanical batch mixer.
1. Mixing Pointing Mortar: Thoroughly mix cementitious and aggregate materials together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix which will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 1 to 2 hours. Add remaining water in small portions until mortar of desired consistency is reached. Use mortar within 30 minutes of final mixing; do not re-temper or use partially hardened material.

PART 3 - EXECUTION

3.01 PREPARATION

- A. General: Comply with recommendations of manufacturers of chemical cleaners for protecting building surfaces against damage from exposure to their products.
- B. Protect persons, motor vehicles, surrounding surfaces of building whose masonry surfaces are being restored, building site, and surrounding buildings from injury resulting from masonry restoration work.
1. Prevent chemical cleaning solutions from coming into contact with pedestrians, motor vehicles, landscaping, buildings and other surfaces which would be injured by such contact.
 2. Do not clean masonry during winds of sufficient force to spread cleaning solutions to unprotected surfaces.
 3. Dispose of run-off from cleaning operations by legal means and in manner which prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.
 4. Erect temporary protection covers over pedestrian walkways and at points of entrance and exit for persons and vehicles which must remain in operation during course of masonry restoration work.

- C. Protect glass, unpainted metal trim and polished stone from contact with acidic chemical cleaners by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape. Apply masking agent to comply with manufacturer's recommendations. Do not apply liquid masking agent to painted or porous surfaces.
 - 1. Protection can be eliminated subject to Architect's approval, if testing demonstrates no detrimental effect from exposure to cleaning solutions.
- D. Protect unpainted metal from contact with alkali chemical cleaners by covering them either with liquid strippable masking agent or polyethylene film and waterproof masking tape.

3.02 MASONRY CLEANING, GENERAL

- A. Proceed with cleaning in an orderly manner; work from top to bottom of each scaffold width and from one end of each elevation to the other.
- B. Use only those cleaning methods indicated for each masonry material and location.
- C. Perform each cleaning method indicated in a manner which results in uniform coverage of all surfaces, including corners, moldings, interstices and which produces an even effect without streaking or damage to masonry surfaces.
- D. Rinse off chemical residue and soil by working upwards from bottom to top of each treated area at each stage or scaffold setting.
- E. Removal of Plant Growth: Remove plant, moss and shrub growth completely from masonry surfaces. Carefully remove creepers by cutting at roots and allowing to dry as long as possible prior to removal. Remove loose soil or debris from open masonry joints to whatever depth it occurs.
- F. Prolonged Spraying: Soak masonry surfaces by applying water continuously and uniformly to a limited area for time period indicated. Apply water at low pressures and low volumes in form of multiple fine sprays using perforated hoses or multiple spray nozzles. Erect protective enclosure constructed of polyethylene sheeting to cover areas being sprayed.
- G. Spray applications: Spray-apply water to masonry surfaces to comply with requirements indicated for location, purpose, water temperature, pressure, volume and equipment. Unless otherwise indicated, hold spray nozzle not less than 6" from surface of masonry and apply water from side to side in overlapping bands to produce uniform coverage and an even effect.
 - 1. Low Pressure Spray: 100-400 psi; 3-6 gallons per minute.
 - 2. Medium Pressure Spray: 400-800 psi; 3-6 gallons per minute.
 - 3. High Pressure Spray: 800-1200 psi; 3-6 gallons per minute.
- H. Steam Wash: Apply steam to masonry surfaces at pressures not exceeding 80 psi. Hold nozzle no less than 6" from surface of masonry and apply steam from side to side or in direction of tooling in overlapping bands to produce uniform coverage and an even effect.

- I. Chemical Cleaner Application Methods: Apply chemical cleaners to masonry surfaces to comply with chemical manufacturer's recommendations using brush or spray application methods, at Contractor's option, unless otherwise indicated. Do not allow chemicals to remain on surface for periods longer than that indicated or recommended by manufacturer.
- J. Paint Removal: Remove paint from masonry surfaces as follows:
 - 1. Apply chemical paint remover to painted masonry with brushes.
 - 2. Allow chemical paint remover to remain on surface for period recommended by paint remover manufacturer.
 - 3. Remove chemical and paint residue by rinsing with water.
- K. Paint Removal with Water Rinsable Chemical paint Remover: Remove paint from masonry surfaces as follows:
 - 1. Apply thick coating of water rinsable chemical paint remover to painted masonry with natural fiber cleaning brush, deep-nap roller, or large paint brush.
 - 2. Allow chemical paint remover to remain on surface for period recommended by paint remover manufacturer. Agitate periodically with stiff bristle brush.
 - 3. Remove chemical and paint residue by rinsing with water.

3.03 BRICK REMOVAL

- A. Carefully remove by hand any damaged, spalled or deteriorated brick. Cut out full units from joint to joint and in manner to permit replacement with full size units.
- B. Support and protect masonry indicated to remain which surrounds removal area.
- C. Salvage as many whole, undamaged bricks as possible.
- D. Remove mortar, loose particles and soil from salvaged brick by cleaning with brushes and water. Store brick for reuse.
- E. Clean remaining brick at edges of removal areas by removing mortar, dust, and loose debris in preparation for rebuilding.
- F. Brick Rebuilding: Install new or salvaged brick to replace removed brick. Fit replacement units into bonding and coursing pattern of existing brick. If cutting is required use motor driven saw designed to cut masonry with clean, sharp un-chipped edges.
- G. Lay replacement brick with completely filled bed, head and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet clay brick which have ASTM C 67 initial rates of absorption (suction) of more than 30 grams per 30 sq. in. per minute. Use wetting methods which ensure that units are nearly saturated but surface dry when laid. Maintain joint width for replacement units to match existing.
- H. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.

3.04 REPOINTING EXISTING MASONRY

- A. Rake out mortar from spalled masonry joints to depths equal to 2-1/2 times their widths but not less than 1/2" nor less than that required to expose sound, unweathered mortar.
- B. Remove mortar from masonry surfaces within rake-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum or flush joints to remove dirt and loose debris.
- C. Do not spall edges of masonry units to widen joints. Replace any masonry units which become damaged. Cut out old mortar by hand with chisel and mallet, unless otherwise indicated.
- D. Power operated rotary hand saws and grinders will be permitted but only on specific written approval of Architect based on submission by Contractor of a satisfactory quality control program and demonstrated ability of operators to use tools without damage to masonry. Quality control program shall include provisions for supervising performance and preventing damage due to worker fatigue.
- E. Joint Pointing: Rinse masonry joint surfaces with water to remove any dust and mortar particles. Time application of rinsing so that, at time of pointing, excess water has evaporated or run off, and joint surfaces are damp but free of standing water. Apply first layer of pointing mortar to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than surrounding areas. Apply in layers not greater than 3/8" until a uniform depth is formed. Compact each layer thoroughly and allow to become thumb-print hard before applying next layer. After joints have been filled to a uniform depth, place remaining pointing mortar in 3 layers with each of first and second layers filling approximately 2/5 of joint depth and third layer the remaining 1/5. Fully compact each layer and allow to become thumb-print hard before applying next layer. Where existing bricks have rounded edges recess final layer slightly from face. Take care not to spread mortar over edges onto exposed masonry surfaces, or to feather-edge mortar.
- F. When mortar is thumb-print -hard, tool joints to match original appearance of joints, unless otherwise indicated. Remove excess mortar from edge of joint by brushing.
- G. Cure mortar by maintaining in a damp condition for not less than 72 hours.
- H. Where repointing work coincides with cleaning of existing masonry, allow mortar to harden not less than 30 days before beginning cleaning work.
- I. After mortar has fully hardened thoroughly clean exposed masonry surfaces of excess mortar and foreign matter using stiff nylon or bristle brushes and clean water, spray applied at low pressure. Use of metal scrapers or brushes will not be permitted. Use of acid or alkali cleaning agents will not be permitted.

3.05 WEATHER SEALER

- A. After all masonry restoration and cleaning has been completed the exterior wall weather sealer specified in Section 07 19 00 shall be applied to all new and existing exterior masonry walls as specified.

END OF SECTION 04 01 20

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Pre-blended mortar mixes for use in indicated locations and types of masonry construction as specified.
- B. Section includes liquid polymeric admixture added to the mortar for wall construction at the time of mixing.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 REFERENCE STANDARDS

- A. ASTM International:
 - 1. ASTM C91 - Standard Specification for Masonry Cement.
 - 2. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
 - 3. ASTM C150 - Standard Specification for Portland Cement.
 - 4. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
 - 5. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
 - 6. ASTM C476 - Standard Specification for Grout for Masonry
 - 7. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
 - 8. ASTM C979 - Standard Specification for Pigments for Integrally Colored Concrete.
 - 9. ASTM C1329 - Standard Specification for Mortar Cement.
 - 10. ASTM C1384 - Standard Specification for Admixtures for Masonry Mortars.
 - 11. ASTM E514 - Standard Test Method for Water Penetration and Leakage Through Masonry.
 - 12. ASTM C 1357 - Standard Test Method for Evaluating Masonry Bond Strength.
 - 13. ASTM C 1314 - Standard Test Method for Constructing and Testing Masonry Prisms Used to Determine Compliance with Specified Compressive Strength of Masonry.
 - 14. ASTM C 1142 - Standard Specification for Extended Life Mortar for Unit Masonry.
 - 15. ASTM C 1148 - Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar.
 - 16. ASTM C 1019-20 - Standard Test Method for Sampling and Testing Grout for Masonry.

- B. International Masonry Industry All-Weather Council (IMIAC):
 - 1. Recommended Practices and Guide Specification for Cold Weather Masonry Construction.
 - 2. Recommended Practices and Guide Specification for Hot Weather Masonry Construction.
- C. National Concrete Masonry Association (NCMA):
 - 1. NCMA TEK Bulletin #8-2A Removal of Stains from Concrete Masonry.
 - 2. NCMA TEK Bulletin #8-3A Control and Removal of Efflorescence.

1.04 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.
- C. Samples: Submit selection and verification samples of mortar.

1.05 CLASSIFICATION OF MORTAR

- A. Classification by Volume Measurements: Unless otherwise approved by Architect, conform to ASTM C 270 (or latest version), Table 1, for Cement-lime Mortar.
- B. Classification by Test:
 - 1. Strength test, if required, determined with mortar prepared in laboratory selected by Architect or Owner, using representative materials and in proportions proposed for use. Preparation of and curing of mortar and test cubes shall conform to ASTM Specification C 270 of latest issue. Laboratory tests, if required, paid for by Contractor.
 - 2. Minimum Compressive Strength at End of 28 Days: Not less than that prescribed in ASTM C 270 (or latest version), Table 2, for Cement-lime Mortar.

PART 2 - PRODUCTS

2.01 MORTAR MATERIALS

- A. Mortar Cement & Sand Masonry Mortar: SPEC MIX® Mortar Cement & Sand Masonry Mortar is a dry pre-blended mortar mix containing mortar cement and dried masonry sand formulated for superior bond, workability and board life.
 - 1. Mortar Type: M (2,500 psi).
 - 2. Mortar Type: S (1,800 psi).
 - 3. Applicable Standards: ASTM C 144, ASTM C 270, ASTM C 595, ASTM C 780, ASTM C 1072, ASTM C 1093, ASTM C 1157, ASTM C 1314, ASTM C 1329, ASTM C 1384, ASTM C 1586, ASTM C 1714, ACI 530.1, IMIAC.

- B. Approved Manufacturers:
 - 1. Pro Mix® Masonry Mortar (Types S), as manufactured by Ash Grove Packaging, 315 Phillips Road, North Little Rock, AR 72117, 1-800-548-4219. For colored mortar provide ASH GROVE® Cement Color.
 - 2. Solomon Colors, Inc. SGS Concentrated Mortar Colors, 800-624-0261. Color to be selected from manufacturer's complete offering.
- C. Basic Requirements: Conform to ASTM C 270 for materials, aggregate, and water and for storage, measurement, and mixing. Weights per cubic foot of materials in mortar are considered as follows:
- D. Portland Cement: Type I or Type II conforming to ASTM C 150.
- E. Sand: Clean sharp granules, free from loam, acids, alkalies, soluble salts, clay, or organic matter, conforming to ASTM C 144.
- F. Quicklime for Lime Putty: Conform to ASTM C 5 with lime slaked and putty prepared in accordance with ASTM C 270. If hydrated lime is used conform to ASTM C 207, Type S.
- G. Mortar for Laying Exterior Masonry: Waterproofed with Dry Block Mortar Admixture by Grace Construction Products.

2.02 ANTI-FREEZE ADMIXTURE

- A. Mortar admixture for use when temperature drops below 50 deg.F.
- B. Provide Conspec Q-Set, or approved equal.

2.03 GROUT FOR MASONRY SIGNIFICANCE AND USE (ASTM C1019-20)

- A. Grout used in masonry is a fluid mixture of cementitious materials and aggregate with a high water content for ease of placement.
- B. During construction, grout is placed within or between absorptive masonry units. Excess water must be removed from grout specimens in order to provide compressive strength test results more nearly indicative of the grout strength in the wall. In this test method, molds are made from masonry units having the same absorption and moisture content characteristics as those being used in the construction.
- C. This test method is used to either help select grout proportions by comparing test values or as a quality control test for uniformity of grout preparation during construction.
- D. The physical exposure condition and curing of the grout are not exactly reproduced, but this test method does subject the grout specimens to absorption conditions similar to those experienced by grout in the wall.

1. Test results of grout specimens taken from a wall should not be compared to test results obtained with this test method.

PART 3 - EXECUTION

3.01 MORTAR MIXING

- A. Mix complying with manufacturer's instructions. Mix in batches for work immediately on hand. Measure by known capacity volume using barrow, buggy, manufacturer's packages, or related containers or by using approved batching device so specified proportions are consistently maintained. Do not use material that has partially set, been re-tempered, or used, frozen, caked, or become lumpy. Mix mortar with proper water amount for minimum of 3 minutes to desired consistency in batch mixer. Use mortar of as wet a consistency as can conveniently be handled. Do not use mortar which has greatly stiffened and in which cementing material has started to set. Do not re-temper mortar.

3.02 MORTAR USES

- A. **Type N Mortar:** Type N mortar is suitable for general use in exposed masonry above grade. It is recommended for use in parapet walls, chimneys and exterior walls when subject to severe exposure.
- B. **Type S Mortar:** Type S mortar is recommended for use in reinforced and unreinforced masonry where higher flexural strengths than Type N are required.
- C. **Type M Mortar:** Type M mortar is recommended for use in masonry in contact with earth such as foundations, retaining walls, paving, sewers and manholes, and in reinforced masonry.
- D. **Type O Mortar:** Type O mortar is suitable for interior use in non-loadbearing applications.

END OF SECTION 04 05 13

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Furnish and install specified joint reinforcement, anchors, ties, control joints, and related masonry accessories.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 PRODUCT HANDLING

- A. Protection: Protect masonry accessory materials before, during, and after installation. Protect installed work and materials of other trades.
- B. Replacements: In event of damage, immediately make replacements necessary to approval of Architect and at Contractor's expense.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers for Masonry Joint Reinforcement, Veneer Anchors, Seismic Anchors and Seismic Joint Reinforcement, Column Weld-on Anchors Joint Reinforcement and Brick Veneer Ties:
 - 1. 3GEN Masonry Products, Inc., (800) 556-5785, www.3genmp.com
 - 2. Heckmann Building Products, 800-621-4140.
 - 3. Hohman & Barnard, Inc., (800) 296-0771.
 - 4. Wire-Bond, Memphis, TN, 901-775-9444.

2.02 METAL ACCESSORIES

- A. Brick Ties: Provide Heckmann No. 75 Pos-I-Tie® one-piece barrel screw consisting of a 92% Zamac 2 Zinc Barrel, steel/EPDM washer, flanged head, and eye to receive Pos-I-Tie® wire tie. Designed to seat barrel directly on structural portion of backup, with flanged head and washer sealing the fastener hole. Anchors to Concrete/CMU/Wood backup, Steel Stud (18 gage - 12 gage) backup, or Structural Steel backup. **METAL CORRUGATED TIES WILL NOT BE ALLOWED.**
1. Masonry Veneer Wire Ties
 - a. Pos-I-Tie® Triangle Wire Ties for single barrel loop without ThermalClip®.
 - 1) 3/16" diameter x length required per wall assembly
 - 2) Hotdip Galvanized After Fabrication
- B. Reinforcing Bars: Where shown, Grade 60 conforming to ASTM A 615.
- C. Weep Holes: Provide 2-5/8" x 3-1/2" x 1/2" WeepVent™ as manufactured by Mortar Net® Solutions, 800-664-6638 or approved equal. Install at every third (3rd) head joint horizontally at bottom and three (3) courses down from top of wall, unless otherwise shown on the drawings. WeepVent™ to be installed by experienced masons familiar with properly specified weep hole systems. Color to be selected by architect. Provide special sizes where required.
1. Place WeepVent™ in open head joints at the flashing level.
 2. Insert a WeepVent™ at a maximum of 24 inches on center in open head joints.
 3. Clean flashing and weep holes free of mortar droppings and debris.
 4. Align exterior face of WeepVent™ with exterior plane of mortar.
- D. Cavity Wall Drainage System: Provide 2" thick trapezoidal shaped Mortar Net® with Insect Barrier fabricated in a 90% open mesh. The insect barrier fabric is made of nylon and polyester woven material and is attached to the face of the trapezoidal Mortar Net® material. Mortar Net® Solutions or approved equal; Telephone: 800-664-6638.
1. Verify installation of flashing and completion of first two courses of masonry.
 2. Extend flashing from the bottom of the MortarNet to at least 6 inches above the top of the MortarNet to prevent mortar bridging between the outer wythe and inner wall.
 3. Remove mortar droppings and debris from flashing and weep vents.
 4. Install one continuous row of MortarNet at base of wall in cavity and over all wall openings directly on flashing, with dovetail profile facing upward. For wall cavities that exceed 11 feet in height, place an additional continuous trapezoidal strip on wall reinforcing anchors/ties at every 9 feet to 11 feet of wall height.
 5. Butt ends together. Compress slightly if necessary.
 6. Face Insect Barrier toward the outside of the building.
 7. **Approved Equal Manufacturer:** CavClear® for Masonry Mat or CavClear Insulation System as provided by Archovations, Inc., 715-381-5773.

2.03 FINISHES FOR METAL ACCESSORIES

- A. Finish metal accessories according to the following requirements as set forth in ASCE6/ACI 530.1:
 - 1. Joint Reinforcement, Interior Wall: ASTM A641 Class 1
 - 2. Joint Reinforcement, wire ties or anchors, in exterior walls or interior walls exposed to moist environment: ASTM A153 Class B2
 - 3. Sheet metal ties or anchors completely embedded in mortar or grout: ASTM A525 Class G60
 - 4. Wire ties or anchors in interior walls: ASTM A641 Class 3
 - 5. Sheet metal ties and anchors in exterior walls or interior walls exposed to moist environment: ASTM A153

2.04 EXPANSION JOINTS IN BRICK VENEER

- A. In addition to locations shown on drawings, locate joints so that spacing does not exceed 1.5 times height of wall or 30'-0" o.c.. Verify with Architect prior to placement. Contractor will bear full responsibility for unauthorized placement of joints.
- B. At Shelf Angles provide 1/4" thick Dur-O-Wal "Soft-Joint" D/A 2010, or approved equal. Closed cell neoprene material shall conform to ASTM D2056 class RE41 or 2A1.
- C. At vertical expansion joints provide 3/8" thick Dur-O-Wal "Expansion-Joint" D/A 2015, or approved equal. Closed cell neoprene material shall conform to ASTM D2056 class RE41 or 2A1.
- D. At exposed face of brick, provide backer rod and sealant in addition to joint.

PART 3 - EXECUTION

3.01 INSTALLATION OF MASONRY ACCESSORIES

- A. Install masonry accessories at proper stages of masonry construction specified in Section 04 20 00 - Unit Masonry, and as required for performance of proper masonry workmanship.
- B. Apply flashing to weather barrier system prior to and/or after installing cladding anchors per weather barrier manufacturer recommendations.

END OF SECTION 04 05 23

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PART 1 - GENERAL**1.01 DESCRIPTION**

- A. Work Included: Furnish labor, tools, scaffolding, and required equipment, and materials for masonry construction specified and required to provide high quality masonry workmanship.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

- A. Qualifications of Workmen:
 - 1. For actual cutting and placing of masonry units, use skilled journeyman masons thoroughly experienced with materials and methods specified and thoroughly familiar with design requirements.
 - 2. Have one skilled journeyman mason present at all times during execution of work of this Section who shall personally direct and execute this portion of the Work.

1.05 SAMPLE FIELD PANELS

- A. Erect a sample field panel for each of the following masonry materials required for this project:
 - 1. Face Brick: include accent colors and special shapes
- B. Each sample panel is to be 6' long by 4' high. Use full size units to show color, color range, texture, bond, profile of joints, and workmanship. After approval, panel will be the standard for minimum workmanship and appearance requirements. Do not remove panel until authorized by Architect.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. **Materials:** Meet referenced ASTM Standards, with modifications specified herein.
- B. **Face Brick:** Conform to ASTM C 216, Grade SW, Type FBX, Void Area <25%, Face Shell shall be minimum 3/4" or Face Shell shall be a minimum of 3/4" and dimensional tolerances shall be in accordance with ASTM C 216 - 10, Table 6A, Column B).
1. PROVIDE CERTIFICATION OF COMPLIANCE FROM INDEPENDENT TESTING AGENCY CONDUCTED IN ACCORDANCE WITH ASTM C67-16 TO INCLUDE ALL CRITERIA FROM TABLE 2 (PERMISSIBLE CHIPPAGE), TABLE 3 - COLUMN 'B' (TOLERANCES ON DIMENSIONS) AND TABLE 4 (TOLERANCES ON WARPAGE) OF ASTM C 216 - 10 ARE MET WHEN PRODUCT IS PROVIDED TO JOB SITE FOR MOCK-UP REVIEW ONLY. **DO NOT DELIVER FACE BRICK UNTIL ARCHITECT HAS REVIEWED CERTIFICATION AND APPROVED FIELD MOCK-UP.**
 2. Size: Modular Size Face Brick 3-5/8" x 2-1/4" x 7-5/8"; include special shapes, if applicable.
 3. Color range and texture. Provide products from one of the following:
 - a. Yankee Hill Brick and Tile as distributed by Acme Brick:
 - 1) Light Red, Smooth Texture, Item No. 16100
 - 2) Medium Red, Velour Texture, Item No. 20415
 - b. Antique Brick & Block
 4. Match color and texture of face brick in existing building. Submit brick samples proposed for use under this Contract for approval by Architect prior to ordering brick.
- C. **Packaged Materials:** Provide mortar materials specified in Section 04 05 13. Provide masonry accessories specified in Section 04 05 23. Deliver and store packaged materials, including cement, in original packages plainly marked with brand and maker's name. Materials in broken containers and in packages showing water marks and evidence of damage will be wholly rejected. **Mortar color shall be selected by the architect.** MATCH EXISTING COLORED MORTAR.
- D. **Concrete Fill:** Fill voids in concrete block where required with structural masonry grout complying with ASTM C476 and ASTM C404. Refer to NCMA TEK 09-04A and TEK 3-2A. Grout may be Fine or Course depending on use. Do not use mortar for this purpose.

2.02 MASONRY CLEANERS

- A. Products approved for use are Sure Klean® 600 Detergent.
1. 101 Lime Solvent for dark-colored brick and tile surfaces.
 2. Sure Klean® Vana Trol® acidic cleaner for new masonry surfaces.
 3. EaCo Chem NMD 80 buffered acid-based new masonry cleaner.

- B. Provide products by ProSoCo®, Enviro Klean® Safety Klean, alternative to traditional acidic compounds.
- C. Consult masonry manufacturer and ProSoCo Technical Service prior to applying any cleaner. Some cleaners are not suited for use on certain masonry units and may cause damage that will be repaired or replaced at Contractor's expense.

2.03 FLEXIBLE FLASHING

- A. Provide **Rhino-Bond** Aqua Flash 500, #4120 composite sheet type, 40 mil peel and stick no-drool flashing by Wire-Bond® or approved equal. Use termination bar for securing flashing to structure where required at surface-mount substrates incompatible with membrane adhesive.
 - 1. Stainless Steel Drip Edge Flashing - DO NOT USE!
- B. Flashing at the base of brick veneer wall: Brick veneer – install metal or flexible through-the-wall flashing that starts behind the bottom edge of the weather-resistant barrier and extends down and out across the support ledge then hangs down. Ensure that weep holes are included in the bottom course of brick to allow water to drip out and down the flashing.

PART 3 - EXECUTION

3.01 LAYING BRICK

- A. Lay each brick with full bed of mortar, **including head joints**. Thoroughly fill where brick comes in contact with anchors, each one being fully grouted in place to attain full, secure anchorage. **Insulation and anchorage for face brick in brick and block walls shall proceed simultaneously with the setting of facing.** Bonds to be accurately preserved.
 - 1. Lay brick so that manufacturer's logo's are not visible.
 - 2. **LAY BRICK WITH HEAD JOINTS 100% FULL. FAILURE TO FILL HEAD JOINTS FULLY WILL BE GROUNDS FOR REJECTION OF THE WORK.**
- B. Lay brickwork to a line and keep each tier plumb, true and level. Build in required anchors and miscellaneous built-in items furnished by other Contractors or by Owner. Cutting of masonry for same afterward will not be allowed. Frames and related work furnished by others to be bedded and pointed up, as required. Cover top of brick with tight boards or tarpaulins when discontinuing work. Lay face brick in 1/2 bond, with mortar finished using a round tool giving concave joints. Nominal thickness of all joints is 3/8" and uniform. Provide solid face brick where required in masonry construction to avoid exposure of lighting holes in regular units. Match solid brick to specified face brick in size, color and texture.

- C. At all openings, including those for doors, windows and all corners, there shall be no less than 4 inch wide units, especially at major building entries at eye level. No slivers will be acceptable.
- D. Keep cavity clean of mortar droppings and other materials during construction. Strike joints facing cavity flush.

3.02 CONSTRUCTION TOLERANCES

- A. Lay masonry units plumb, level and true to line within the tolerances specified.
- B. Maximum variation from plumb:
 - 1. In 10 feet: 1/4 inch
 - 2. In 20 feet: 3/8 inch
 - 3. In 40 feet or more: 1/2 inch
- C. Maximum variation from level:
 - 1. In any bay or up to 20 feet: 1/4 inch
 - 2. In 40 feet or more: 1/2 inch
- D. Maximum variation from linear building lines:
 - 1. In any bay or up to 20 feet: 1/2 inch
 - 2. In 40 feet or more: 3/4 inch
- E. Maximum variation in cross-sectional dimensions of columns and thickness of walls from dimensions shown:
 - 1. Minus 1/4 inch
 - 2. Plus 1/2 inch
- F. Maximum variation in prepared opening dimensions:
 - 1. Accurate to minus 0 inch
 - 2. Plus 1/4 inch

3.03 PROTECTION OF OPEN CAVITY WALLS DURING CONSTRUCTION

- A. Protection:
 - 1. All exposed openings in CMU construction shall be protected during the erection process to prevent water from entering, especially at the tops of walls, and settling within interior cavities causing leaching and other damaging occurrences resulting from capillary action. Secure temporary waterproof membranes at the end of each day's work to prevent rain and snow from entering the cores and cavities. Planks laid on the wall are not considered adequate cover.
 - 2. Refer to the Portland Cement Association publication "Recommended Practices for Laying Concrete Block".

3.04 INSTALLING FLEXIBLE FLASHING

- A. Install continuous flexible flashing. Lap material at joints minimum 6" and tightly seal with mastic. Spot bonding of mastic equal to 25% of the flashing area applied at 12 inch intervals is acceptable. Apply mastic by trowel at rate of 50 square feet per gallon unless otherwise shown on the container.
 - 1. Where exposed portions are used as a counter-flashing, lap base flashing at least four inches.
 - 2. Terminate exterior edge beyond face of wall approximately 1/4-inch.
 - 3. Turn back edge up 8 inches unless noted otherwise where flashing terminates in mortar joint or hollow masonry unit joint.
 - 4. Terminate interior raised edge in masonry backup unit approximately 2 inches into unit unless shown otherwise.
 - 5. Where dowels, reinforcing bars and fastening devices penetrate flashing, seal penetration with sealing compound.
 - 6. Coordinate with other work to set in a bed of mortar above and below flashing so that total thickness of the two layers of mortar and flashing are same as regular mortar joint.
 - 7. Where ends of flashing terminate turn ends up 2 inch and fold corners to form dam extending to wall face in vertical mortar or veneer joint.
 - 8. Turn flashing up not less than 8 inches between masonry wythes or behind exterior veneer.

3.05 BUILT-IN ITEMS

- A. Build in wood blocks, strips, wedges, frames, loose lintels, miscellaneous iron and other items furnished by other subcontractors and which may be required for properly securing their work.

3.06 FREEZING WEATHER

- A. Do not lay masonry when outside air temperature is below 40 degrees F., unless suitable means are provided to heat masonry materials and to protect completed work from freezing for at least 48 hours.

3.07 CLEANING PREMISES

- A. Mason Contractor: Remove rubbish and building materials left over from operations under his charge, whenever directed by General Constructor. Premises must be left clear and clean. When buildings are completed, completely remove mortar droppings.

3.08 POINTING AND CLEANING

- A. Cut out defective mortar joints. Refill solidly with mortar and tool to match adjacent work.

- B. On completion clean exposed masonry, removing foreign material, excess mortar and stains. Apply cleaning solution to sample area of approximately 20 square feet at an inconspicuous location approved by Architect. Use cleaning solution specially manufactured for this purpose, applying in accordance with manufacturer's directions. Drench masonry with clean water before applying solution, and after cleaning, rinse with clean water to remove all traces of solution. Protect materials adjacent to masonry from contact with cleaning solution.
- C. High Pressure Water Cleaning: **This method of cleaning will not be allowed on masonry surfaces unless approved by architect and masonry manufacturer.** High pressure water is to be used to saturate the masonry before cleaning takes place and may be used to rinse away cleaning solution and foreign particles after cleaning is complete. Allow mortar to cure for a minimum of seven (7) days before subjecting it to high pressure cleaning. After consulting with Architect and manufacturer for cleaning recommendations, test clean a sample panel of all the materials selected for the work. Apply water at a pressure ranging from 300-500 psi (not to exceed 800 psi). Provide a flow rate of water between 3 and 6 gallons per minute through a "Fan" type, stainless steel tip dispersing a 25° to 50° fan spray. Do not use less than 15° fan spray tip. Application of acidic cleaning compounds through the high pressure system will not be allowed. Do not apply sealer until masonry is completely dry and cleaning has been reviewed by Architect.

END OF SECTION 04 20 00

PREPARATION OF HOT-DIP GALVANIZED STEEL SURFACES FOR PAINTING

PART 1 - GENERAL**1.01 WORK INCLUDED**

- A. Degreasing surfaces
- B. Surface profiling
- C. Washing and rinsing
- D. Steel, including shop-fabricated bollards, in or near direct contact with grade or not protected by substantial roof or canopy overhang.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 REFERENCES

- A. Publications
 - 1. American Galvanizers Association (AGA):
Inspection of Products Hot-Dip Galvanized After Fabrication
Duplex Systems: Painting Over Hot-Dip Galvanized Steel
 - 2. Elsevier, van Eijnsbergen, J.F.H., New York, 1994: *Duplex Systems - Hot-Dip Galvanizing Plus Painting Wet Storage Stain*
- B. Reference Standards
 - 1. American Society for Testing and Materials (ASTM):
A 123/123M Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A 153/153M Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A 780 Repair of Damaged Hot-Dip Galvanized Coatings

D 6386 Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting

D 7803 Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Powder Coating

1.05 QUALITY ASSURANCE

- A. Coating Applicator: Company specializing in painting or Hot-Dip Galvanizing after fabrication.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Load and store galvanized articles in accordance with accepted industry standards.

PART 2 - PRODUCTS

2.01 ACCEPTABLE SURFACE PREPARERS

- A. Members of the American Galvanizers Association or equal, such as painting contractors, approved by the design professional.

2.02 HOT-DIP GALVANIZED MATERIALS

- A. Material for surface preparation suitable for painting is required to be Hot-Dip galvanized as described in ASTM A123/A 123M and A 153/A 153M. Hot-Dip galvanized articles and fabrications may be newly galvanized, partially galvanized or completely weathered.

2.03 HOT-DIP GALVANIZING REQUIREMENTS

- A. Hot-Dip galvanizing practices shall be in accordance with the applicable portions of ASTM A123/A 123M or A 153/A 153M.
- B. Water quenching or chromate quenching conversion coating should be avoided as these processes interfere with paint adhesion and surface preparation.

PART 3 - EXECUTION

3.01 SURFACE SMOOTHING

The following process should only be used if high spots of zinc are visible on the parts to be painted.

- A. Zinc high spots, such as a metal drip line, should be removed by cleaning with hand or power tools as described in SSPC Surface Preparation Specification 2 or 3. The zinc should be removed until it is level with the surrounding area, taking care that the base coating is not removed by the cleaning methods.

- B. After cleaning, the surface shall be inspected for conformance to the required zinc thickness in accordance with ASTM A123/A 123M or A 153/A 153M utilizing a magnetic-field-type thickness instrument in accordance with ASTM E 376. Any item falling below the required zinc thickness, before or after removal of any high spots, shall be repaired in accordance with ASTM A 780.

3.02 AQUEOUS ALKALINE CLEANING

This surface cleaning is required for all galvanized steel parts, except for those that have been galvanized less than 24 hours.

- A. An alkaline solution, pH in the range of 11 to 12 but not greater than 13, can be used to remove traces of oil, grease or dirt.
- B. This solution can be applied through immersion in a tank filled with the solution, sprayed on, or brushed on with a soft bristle brush, usually nylon and not steel or copper.
- C. When dipping or spraying, the solution works best in the temperature range from 60 to 85 C (140 to 185F).
- D. After cleaning, rinse thoroughly in hot water under pressure. Allow to dry completely before proceeding.

3.03 SOLVENT CLEANING

This is an alternative to Section 3.02.

- A. Typical cleaning solvents, such as mineral spirits or high-flash naphtha, can be used to remove oil and grease. The procedure to be used is as specified in SSPC Surface Preparation Specification 1.
- B. Proper rags or brushes should be used to wipe galvanized parts. Small parts may be dipped or cleaned in ultrasonic baths of solvents.
- C. After cleaning, rinse thoroughly in hot water or water under pressure. Allow to dry completely before proceeding.

3.04 HAND OR POWER-TOOL CLEANING

The following process should be used only if there is visible evidence of wet storage stain on the galvanized surface.

- A. Hand or power-tool cleaning may be used to clean light deposits of zinc reaction by-products, such as wet storage stain, as specified in SSPC Surface Preparation Specification 2 or 3.

3.05 SWEEP BLASTING

This process is required for all galvanized parts, except those that have been exposed to the environment for more than one year.

- A. Abrasive sweep or brush blasting which uses a rapid nozzle movement will roughen the galvanized surface profile. The abrasive material must be chosen with care to provide a stripping action without remove excess zinc layers. Follow the procedures detailed in ASTM D 6386 for abrasive sweep blasting.
- B. Following abrasive blast cleaning, surfaces should be blown down with clean compressed air.

3.06 ZINC PHOSPHATE TREATMENT

This is an alternate process for Section 3.05.

- A. This conversion-coating process consists of treating the newly galvanized zinc surface with an acidic zinc phosphate solution containing oxidizing agents and other salts for accelerating the conversion action. Follow the procedures detailed in ASTM D 6386 for zinc phosphate treatment.
- B. After 3 to 6 minutes, the surface should be washed with clean water and allowed to completely dry before application of the paint system.

3.07 WASH PRIMER TREATMENT

This is an alternate process for Section 3.05.

- A. This process involves the use of metal conditioner to neutralize surface oxides and hydroxides and to etch the surface. Follow the procedures detailed in ASTM D 6386 for wash primer treatment.
- B. For drying time prior to top coating, follow the manufacturer's instructions. This wash-primer treatment may be better suited to certain types of paint systems.

3.08 ACRYLIC PASSIVATION/PRETREATMENT

This is an alternate process for Section 3.05.

- A. The passivation/pretreatment process consists of applying an acidic acrylic solution to the newly galvanized surface and then allowing it to dry, forming a thin film coating. Follow procedures detailed in ASTM D 6386 for acrylic passivation/pretreatment.
- B. Painting is possible any time during a period of four months after application as long as the surface is free of visible zinc oxides or zinc hydroxides.

3.09 REPAIR OF DAMAGED COATING

The following process should be used only if there is visible damage to the zinc coating.

- A. The maximum area to be repaired is defined in accordance with ASTM A 123/A 123 M Section 6.2, current edition.
 - 1. The maximum area to be repaired in the field shall be determined in advance by mutual agreement between parties.

- B. Repair areas damaged by welding, flame cutting or during handling, transport or erection, by one of the approved methods in accordance with ASTM A 780 whenever damage exceeds 3/16" in width. Minimum thickness requirements for the repair are those described in ASTM A 123/A 123M Section 6.2 current edition.

END OF SECTION 05 05 16

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PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Furnish and erect specified steel framing, column bases, lintels and related structural steel shapes and accessories.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.
- B. Miscellaneous metal fabrications, architecturally exposed structural steel, metal stairs and ladders, steel joists and joist girders, cold-formed metal framing, and metal deck are specified elsewhere in these Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
1. Furnish Shop Drawings, for review by Architect, on structural steel showing necessary fabrication details, fittings, fastenings, anchorage and erection details. In addition to provisions of the General Conditions, prepare structural steel Shop Drawings by or under the supervision of a registered professional engineer. Do not use reproductions, in any form, of the Contract Drawings for Shop Drawings. Furnish two prints of Shop Drawings submitted to Architect for review. Submit related shop drawings together; partial submittals will not be accepted. Furnish mill certificates on foreign steel proposed for use and not produced within the continental USA. Include with mill certificates certified copies of mill test reports giving names and locations of mills and shops, and chemical analysis and physical properties of steel required for this project.
 - a. **Contract Document electronic files (including all drawings, specifications, addenda and supplemental information) will not be made available to Bidders or Sub-bidders before the award of a Contract nor will they be made available to the Contractor or Sub-contractors after the award of a Contract. Only conventional, paper reproductions of such information will be made available to parties listed above.**
 2. All drawings shall bear the stamp of a structural engineer licensed in the state in which the project is located.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

- A. Codes and Standards: In addition to complying with pertinent codes and regulations, comply with:
1. AISC "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings", Latest Edition.
 2. AISC "Code of Standard Practice", Latest Edition.
 3. AISC "Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design", Latest Edition.
 4. AISC "Load and Resistance Factor Design Specification for Structural Steel Buildings", Latest Edition.
 5. "Code for Welding in Building Construction" of the American Welding Society.
 6. "Specifications for Architecturally Exposed Structural Steel" of the American Institute of Steel Construction.
 7. Steel Structures Painting Council (SSPC): Painting Manual, Vol. 1, Good Painting Practice. Painting Manual, Vol. 2, Systems and Specifications.
 8. Conform to ASTM A 6, "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use".
 9. AISC "Architecturally Exposed Structural Steel (AESS)", Latest Edition. Refer to AISC Code of Standard Practice (ANSI/AISC 303-22). AESS can fall within the following five categories:
 - a. AESS 1: Basic Elements
 - b. AESS 2: Feature Elements Not in Close View
 - c. AESS 3: Feature Elements in Close View
 - d. AESS 4: Showcase Elements
 - e. AESS C: Custom Elements
- B. Conflicting Requirements: In event of conflict between pertinent codes and regulations and requirements of referenced standards or these specifications, provisions of more stringent govern.

PART 2 - PRODUCTS

2.01 STRUCTURAL STEEL

- A. Steel Shapes: Provide structural steel shapes, not otherwise indicated on Structural Drawings using high-strength steel, 50 ksi minimum yield strength, conforming to ASTM A992.
- B. Pipe Columns: ASTM A501, $F_y = 36$ ksi. or A53, Type E, $F_y = 35$ ksi
- C. Rectangular HSS: ASTM A500, Grade B ($F_y=46$ ksi) or have equal yield, ultimate, and weldability properties.
- D. Round HSS: ASTM A500, Grade B ($F_y=42$ ksi) or have equal yield, ultimate, and weldability properties.

- E. Steel Plates, Channels and Angles: ASTM A36, 36 ksi minimum yield strength.
- F. Headed Stud Shear Connectors: ASTM A108, Grade 1015 or 1020, cold finished carbon steel with dimensions complying with AISC Specifications.
- G. Furnish structural steel for this Project manufactured within continental limits of the United States of America unless mill certificates are submitted to and approved by Structural Engineer.

2.02 BOLTS AND NUTS

- A. High Strength Bolts:
 - 1. Meet ASTM A 325 for high strength bolts.
 - 2. Make bolt holes 1/16 inch larger than nominal bolt diameter.
 - 3. Threads may be included in shear plane of bolts.
- B. Machine Bolts and Anchor Bolts: Meet ASTM A307 and A449.
- C. Bolted Truss Connections: ASTM A325, slip critical in oversize round holes.

2.03 SHOP PRIMER

- A. Lead free, alkyd primer: Manufacturer's standard.

2.04 OTHER MATERIALS

- A. For materials, not specifically described but required for complete and proper installation of structural steel, use new material, free from rust, first quality of their respective kinds, and subject to approval of Architect.

PART 3 - EXECUTION

3.01 MEASUREMENT AND DIMENSIONS

- A. Contractor to verify measurements and dimensions at job site. Bring any conflict between actual measurements and dimensions shown on the Drawings and any existing condition which will prevent fabrication and erection of steel work as detailed to attention of Architect as soon as they are discovered. Contractor responsible for errors of Shop Drawings, fabrication, correct fitting, and alignment of the structural members. Shop or field splices in standard structural rolled shapes not acceptable unless shown on Contract Drawings.

3.02 WORKMANSHIP

- A. Fabricate and erect to comply with the "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" and the "Code of Standard Practice" as adopted by the American Institute of Steel Construction.

3.03 SHOP PRIMER

- A. For surface preparation, shop painting and touch-up painting of structural steel shapes, conform to the "Steel Structures Painting Manual", Volumes 1 and 2, of the Steel Structures Painting Council. **DO NOT PRIME OR PAINT STRUCTURAL STEEL THAT IS TO RECEIVE SPRAY FIREPROOFING.**

3.04 WELDING

- A. Shop and field welders continuously employed as welders are acceptable on basis of satisfactory reports dated not more than 2 years prior to award of this Contract. All others must have been re-qualified in past 6 months complying with AWS D 1.0, Appendix.

3.05 LINTELS

- A. Furnish and place all structural steel lintels required for all openings unless concrete lintels or reinforced concrete block lintels are shown on Drawings. Build structural members size marked on Drawings or if not shown as determined by the Structural Engineer. Weld members together with exterior weld being a continuous bead to prevent water from running between the members. Bear on walls 8 inches at each end for openings up to 6'-0" wide and 10 inches for wider openings where not otherwise shown.

3.06 HIGH-STRENGTH BOLTING

- A. Comply with the "Specification of Structural Joints" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation using calibrated-wrench tightening or turn-of-nut tightening methods. By either method, use a calibrating device to check tools and equipment and to provide means of reliable inspection. When turn-of-nut method tightening is used to provide bolt tension complying with ASTM A325, match-mark outer face of nut with the protruding bolt point before final tightening for visual means of noting actual nut rotation. Above marks may be made by wrench operator with crayon or daub of paint, after bolts have been brought to "snug tight" condition.

3.07 INSPECTION

- A. Engage an independent testing and inspection agency to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports.
- B. Testing agency shall conduct and interpret tests, state in each report whether test specimens comply with requirements and specifically state any deviations.
- C. Provide access for testing agency to places where structural steel work is being fabricated or produced so that inspection and testing can be accomplished.
- D. Testing agency may inspect structural steel at plant before shipment.

- E. Correct deficiencies in structural steel work that inspections and laboratory test reports have indicated to be not in compliance with requirements. Perform additional tests, at Contractor's expense, as necessary to reconfirm any noncompliance of original work and to show compliance of corrected work.
- F. Shop Bolted Connections: Inspect or test in accordance with AISC specifications.
- G. Shop Welding: Inspect and test during the fabrication or structural steel assemblies, as follows:
 - 1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
 - 2. Perform visual inspections of all welds.
 - 3. Perform tests of welds as follows. Inspection procedures listed are to be used at Contractor's option.
 - a. Liquid Penetrant Inspection: ASTM E165 or Magnetic Particle Inspection, ASTM E709, performed on root pass and on finished weld on ten percent of fillet welds. Cracks or zones of incomplete fusion or penetration are not acceptable.
 - b. Radiographic Inspection: ASTM E94 and ASTM E142, minimum quality level "202T" or Ultrasonic Inspection: ASTM E164 on 50 percent of full penetration welds.
- H. Field Welding: Inspect and test during erection of structural steel as follows:
 - 1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
 - 2. Perform visual inspections of all welds.
 - 3. Perform tests of welds as follows.
 - a. Liquid Penetrant Inspection: ASTM E165 or Magnetic Particle Inspection, ASTM E709, performed on root pass and on finished weld on ten percent of fillet welds. Cracks or zones of incomplete fusion or penetration are not acceptable.
 - b. Radiographic Inspection: ASTM E94 and ASTM E142, minimum quality level "202T" or Ultrasonic Inspection: ASTM E164 on 50 percent of full penetration welds

3.08 ERECTION

- A. Use Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings of AISC except as otherwise specified.
- B. Sequence: Contractor responsible for erection method and sequence.

- C. Progress: As erection progresses, secure the work to take care of dead loads, wind, and erection stresses. Where structural steel is being erected, completely connect the in-place work in the tier below. **Not more than four stories of steel may be erected above the story in which all final structural connections have been made.**
- D. Alignment: After erection, accurately align and adjust the various members forming parts of a completed frame and structure before being made secure.
- E. Tolerances: AISC Code of Standard Practice apply except as otherwise specified.
- F. Erection Shims: Sufficient shims may be installed to maintain structure within tolerances. Maximum shim thickness at any one joint no greater than 1/2-inch.
- G. Field Assembly: Provide even bearing at field erected column splices and related compression joints which depend upon contact bearing upon completion with respect to the centroid of the contact area. Provide at least 65 percent of the entire contact area in full bearing and the separation of any remaining portion not to exceed 0.02 inches, except locally at toes of flanges where a 50 percent greater separation is permissible; otherwise perform corrective measures.
- H. Anchors: Locate and install anchor bolts and anchors, preset by templates, into connecting work. Provide bearing plates under ends of primary structural members resting on masonry and set in full beds of non-shrink grout.
- I. Base Plates: Support and align column base plates on steel leveling devices. After support members have been plumbed and properly positioned and anchor nuts tightened, pack solidly entire bearing area under plate with non-shrink grout specified in "Concrete" Division of these Specifications. Leave leveling devices in place and cut off flush with edge of column base plates.
- J. All welds, cut edges and areas where primer is missing or damaged is to be cleaned and re-primed.

END OF SECTION 05 10 00

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Furnish and erect steel decking specified.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
1. Shop Drawings:
 - a. Before metal decking is delivered to job site, submit Shop Drawings to Architect for review. Submit related shop drawings together; partial submittals will not be accepted. Do not use reproductions, in any form, of the Contract Drawings for Shop Drawings.
 - b. Show sizes, locations, marking of decking units, sizes of holes to be cut in the shop, end closures types and fittings, and methods of securing, anchoring, and attaching to structural members.
 - c. Show verification that members used are adequate to carry live and dead loads involved.
 - d. Show welds, both shop and field, by currently recommended symbols of the American Welding Society.
 - e. Furnish one print of Shop Drawings for Architect review, in addition to acceptable Portable Document Format (PDF) file submissions.
 - f. **Contract Document electronic files (including all drawings, specifications, addenda and supplemental information) will not be made available to Bidders or Sub-bidders before the award of a Contract nor will they be made available to the Contractor or Sub-contractors after the award of a Contract. Only conventional, paper reproductions of such information will be made available to parties listed above.**
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

- A. Following specifications and codes govern with modifications specified herein:

1. American Iron and Steel Institute: AISI S100-16, North American Specification for the Design of Cold-Formed Steel Structural Members.
 2. Steel Deck Institute: Design Manual for Composite Deck, Form Decks, and Roof Decks.
 3. American Welding Society: Code for Welding in Building Construction.
 4. ASTM A653 / A653M-20: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- B. Conflicting Requirements: In event of conflict between pertinent codes and regulations, referenced standards requirements and these specifications, provisions of the more stringent govern.

PART 2 - PRODUCTS

2.01 STEEL DECKING

- A. Type 'B', 1.5 inch rib depth, 22 gage steel by Vulcraft Division of Nucor Corporation, or approved equal manufactured by member of the Steel Deck Institute. Chemically clean steel deck of oil, grease and dirt.
- B. Provide manufacturer's standard shop primer-painted steel sheet, top and bottom sides, at areas that do not receive spray applied fireproofing meeting ASTM A1008/A1008M, Grade C or D.
1. Primer for Shop Painted Sheets: Manufacturer's standard primer. When finish painting of steel decking is specified in Section 09 91 00 - Painting, primer coating shall be compatible with specified finish painting.
 2. Provide impermanent or provisional two-coat bright white primer on bottom sides along with either primer-painted or galvanized topsides if conditions warrant.

PART 3 - EXECUTION

3.01 FABRICATION

- A. Fabricate metal decking to comply with final Shop Drawings and the referenced standards.

3.02 SHOP PRIMER

- A. Paint steel deck and accessories with protective paint shop coat using type standard with manufacturer and conforming to requirements of the Steel Deck Institute. After erection, wire brush field connections and touch up welded, corroded or abraded areas with same paint as shop coat. **DO NOT PRIME OR PAINT METAL DECK THAT IS TO RECEIVE SPRAY FIREPROOFING.**

3.03 ERECTION

- A. General: Erect metal decking to comply with the Drawings and final Shop Drawings, aligning straight, plumb, and level.
- B. Provide sump plates or pans, cant strips, vent clips, and rubber closures required for complete and proper installation.
- C. Cut decking to provide openings required by structural design Drawings and holes required for work of other trades. Form penetrations where decking is to receive concrete prior to concrete placement. Cut decking only after concrete has attained 75% of its design strength.
- D. Attach decking by puddle welding to supporting structure. **MECHANICAL FASTENING OR POWDER ACTUATED FASTENING WILL NOT BE ALLOWED.**
- E. Touch-up field welds and burned and abraded spots in shop finish using material equivalent to shop finish.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

END OF SECTION 05 30 00

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PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Furnish and erect structural steel framing and accessories.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
1. Shop Drawings:
 - a. Submit shop drawings showing complete details for the fabrication and erection of members. Manufacturer's professional engineer shall be licensed in the state where proposed project is located.
 - b. Submit details, schedules, procedures, and diagrams showing the sequence of erection.
 - c. Provide setting drawings, templates, instructions and directions for installation of anchorage devices.
 - d. Submit shop drawings for review prior to starting any work. Work performed prior to shop drawing review is at contractors risk.
 - e. **Contract Document electronic files (including all drawings, specifications, addenda and supplemental information) will not be made available to Bidders or Sub-bidders before the award of a Contract. CAD files will be available to the Contractor or Sub-contractors with a release letter or per AIA Document C106™ - 2013 Digital Data Licensing Agreement, after the award of a Contract.**
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 REFERENCES

- A. American Iron and Steel Institute (AISI)
1. "Specification for the Design of Cold-Formed Steel Structural Members" .
 2. "Cold-Formed Steel Design Manual" (Latest).
- B. American National Standards Institute (ANSI)
1. ANSI A58.1 - "Roof, Wind and Snow Loads".

- C. American Society for Testing and Materials (ASTM):
 - 1. ASTM A446 - Steel Sheet, Zinc-coated (galvanized) by Hot-Dip Process, Structural (Physical) Quality.
 - 2. ASTM A570 Hot-Rolled Carbon Steel Sheet & Strip, Structural Quality.
 - 3. ASTM A525 - Sheet Steel, Zinc-Coated (Galvanized) by the Hot-Dip Process, General Requirements.
 - 4. ASTM A611 - "Standard Specification for Steel, Cold-Rolled Sheet, Carbon, Structural."
 - 5. ASTM C955 - "Standard Specification for Load Bearing Steel Studs, Runners (Track), Bracing, and Bridging."
- D. American Welding Society (AWS):
 - 1. AWS D1.1 - "Structural Welding Code" and D1.3 - "Specifications for Welding Sheet Steel in Structures."
 - 2. AWS - "Standard Qualification Procedure".
- E. Metal Lath/Steel Framing Association (ML/SFA) - "Lightweight Steel Framing Systems Manual," Latest Edition.
- F. American Society of Civil Engineers (ASCE) - "Minimum Design Loads for Buildings and Other Structures: Chapter 6 - Wind Loads".

1.05 PERFORMANCE REQUIREMENTS

- A. Contractor is responsible for design, fabrication and erection of steel stud framing to meet the requirements of the latest adopted Local Code.
- B. Compute all structural properties in accordance with AISI "Specifications for the Design of Cold Formed Steel Structural Members."
- C. Provide weldments as required in accordance with American Welding Society (AWS) AWS D1.3 "Structural Welding Code - Sheet Steel".

1.06 SYSTEM DESCRIPTION

- A. Design Requirements: The supplier shall design and/or verify the size and strength of all light gauge cold-formed Metal Framing members and connections in accordance with the ML/SFA Lightweight Steel Framing Systems Manual.
 - 1. Design shall use the superimposed design loads specified in the "Design Criteria" section of the "Structural General Notes" in the contract drawings.
 - 2. Design shall be based upon information shown on the drawings and specified herein.
 - 3. Maximum deflection of exterior wall systems shall not exceed L/600 for Masonry Veneer and L/360 for EIFS Veneer.
 - 4. 18 gage studs are the minimum allowed for framing that supports masonry.

- B. Design shall conform to: AISI Specification for the Design of Cold-Formed Steel Structural Members. Wall bridging shall be designed to provide resistance to minor axis bending and rotation of wall studs. Designated selected exterior and/or interior walls shall be designed to provide frame stability and lateral load resistance. All connections (member to member, and member to structure) shall be designed and detailed.
- C. Qualification of Field Welding: Qualify welding process and welding operators in accordance with AWS "Standard Qualification Procedure".

1.07 DELIVERY AND STORAGE

- A. Protect steel studs from rusting and damage.
- B. Deliver to project site in manufacturer's unopened containers or bundles, fully identified with name, brand, type and grade.
- C. Store off the ground in a dry, ventilated space.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Provide products manufactured by one of the following manufacturers or by a current member of the Steel Stud Manufacturers Association.
 - 1. Consolidated Systems Incorporated, 4900 Hungerford Road, Memphis, Tennessee 38118, Phone (901) 365-0226
 - 2. Dietrich Industries Inc., 500 Grant Street, Suite 226, Pittsburgh, Pennsylvania 15219, Phone (412) 281-2805
 - 3. Marino\WARE, 400 Metuchen Road, South Plainfield, NJ, 800-627-4661.
 - 4. Telling Industries, 1400 Southwire Road, Osceola, AR 72370, 888-711-3124.
 - 5. The Steel Network, Inc., Telephone: 888-474-4876.
 - 6. Approved equal.

2.02 GENERAL REQUIREMENTS

- A. Provide type, size, gauge and physical properties as described by the manufacturer's load and height tables and in accordance with the current local building code. All section properties shall be calculated in accordance with the AISI Specification for the Design of Cold-Formed Steel Structural Members (latest edition).
- B. Structural calculations specifically related to this project and performed by the manufacturer's professional engineer will indicate depths, gages and spacings of studs required to meet deflection and load bearing requirements. Professional engineer shall be licensed in the state where proposed project is located.

- C. At all instances where radius steel stud and drywall construction is shown on drawings it is intended that the radius be smooth not faceted. Contractor is required to provide smooth face radius by whatever means necessary.
- D. Runners: Match studs; type recommended by stud manufacturer for floor and ceiling support of studs, and for vertical abutment of drywall work at other work.

2.03 MATERIALS

- A. All structural members shall be formed from steel conforming to ASTM A653-94.
- B. All structural members shall be zinc coated in accordance with ASTM A924, G-60 coating.
- C. System Components: With each type of steel stud required, utilize runners (tracks), shoes, clips, angles, ties, fasteners, door jamb reinforcers, bridging and accessories for the applications indicated, as needed to product a complete metal stud system in both vertical and horizontal planes for interior and exterior conditions.

2.04 FABRICATION

- A. General: Framing components may be prefabricated prior to erection. Fabricate components plumb, square, true to line and braced against racking with joints welded. Perform lifting of prefabricated components in a manner to prevent damage or distortion.
- B. Fastenings: Attach similar components by welding. Attach dissimilar components by bolting, or screw fasteners, as standard with manufacturer.
- C. Cutting of steel framing members may be accomplished with a saw or shear. Torch cutting of load carrying members is not permitted. Cut framing components squarely for attachment to perpendicular members, or as required for an angular fit against abutting members. Hold members positively in place until fastened.
- D. Wire tying of framing components is not permitted.

PART 3 - EXECUTION

3.01 ERECTION

- A. Anchor tracks securely to supporting structure to transfer imposed loads.
- B. Provide complete, uniform and level bearing support for bottom track at each bearing stud location.
- C. At intersection and abutting track joints, anchor abutting track pieces securely to a common structural element, or splice them together.

- D. Splices in axial loaded studs not permitted.
- E. Framed Wall Openings: Include properly designed header and multiple (or heavier) studs at each edge of opening, to compensate for those removed.
- F. Diagonal Bracing: Install at wall locations used as "shear walls" for frame stability and to resist wind and lateral loads. Anchor bracing securely for uplift and horizontal shear. Position additional stud(s) as required to resist the vertical component.
- G. General:
 - 1. Install continuous tracks sized to match studs. Align tracks accurately to the layout at base and top of studs. Secure tracks as recommended by the stud manufacturer for the type of construction involved, except do not exceed 24" o.c. spacing for nail or power-driven fasteners, nor 16" o.c. for other types of attachment. Provide fasteners at corners and end of tracks.
 - 2. Set studs plumb, except as needed for diagonal bracing or required for no-plumb walls or warped surfaces and similar requirements.
 - 3. Where stud system abuts structural columns or walls anchor ends of stiffeners to support structure.
 - 4. Install supplementary framing, blocking and bracing in the metal framing system wherever walls or partitions are indicated to support handrails, bumper guards, wall mounted door stops, fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with the stud manufacturer's recommendations and industry standards in each case, considering the weight or loading resulting from the item supported.
 - 5. Secure studs to top and bottom runner tracks by either welding or screw fastening at both inside and outside flanges.
 - 6. Frame wall openings larger than 2'-0" square with double stud at each jamb of frame except where more than 2 are either shown or indicated in manufacturer's instructions. Install runner tracks and jamb studs with stud shoes or by welding, and space jack studs same as full-height studs of the wall. Secure stud system all around to wall opening frame in the manner indicated.
 - 7. Frame both sides of expansion and control joints, as shown for the wall system, with a separate stud and do not bridge and joint with components of the stud system.
 - 8. **Provide framing, including cross-bracing, for attachment of exterior soffit components able to resist upward wind forces, where applicable. Refer to Section 07 42 93 - Soffit Panels [Section .**

END OF SECTION 05 41 00

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PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Furnish and install miscellaneous metal items required and specified. Provide miscellaneous bolts, anchors, supports, braces, and connections necessary for completion of Work.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
 - 1. Submit Shop Drawings on miscellaneous metal items for review by Architect, prior to fabrication. Include type, grade, class of metal and sizes, details of fabrication, methods of assembling, connections to supporting construction, reinforcement, and location of hardware.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 REFERENCES

- A. American Institute of Steel Construction (AISC):
 - 1. Specifications for the Design, Fabrication and Erection of Structural Steel for Building
- B. American National Standards Institute (ANSI):
 - 1. ANSI A14.3, "Ladders, Fixed, Safety Requirements."
- C. American Society for Testing and Materials (ASTM):
 - 1. ASTM A36, "Structural Steel."
 - 2. ASTM A53, "Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe."
 - 3. ASTM A123, "Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products."
 - 4. ASTM A153, "Zinc Coating (Hot-Dip) on Iron and Steel Hardware."
 - 5. ASTM A307, "Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength."
 - 6. ASTM A446, "Specification for Sheet Steel, Zinc-Coated by the Hot-Dip Process."
 - 7. ASTM A500, "Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes."

8. ASTM A568, "Specification for General Requirements for Steel, Carbon and High-Strength Low Alloy Hot-Rolled Sheet and Cold Rolled Sheet."
 9. ASTM A627, "Specification for Homogeneous Tool-Resisting Steel Bars for Security Applications."
 10. ASTM A780, "Practice for Repair of Damaged Hot-Dipped Galvanized Coatings."
 11. ASTM B221, "Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube."
- D. American Welding Society (AWS):
1. AWS D1.1 - Structural Welding Code.
- E. Steel Structures Painting Council Specification (SSPC):
1. Steel Structures Painting Manual.

1.05 QUALITY ASSURANCE

- A. Qualifications of Welders: Use certified welders and the shielded arc process for welding performed in connection with work of this Section.
- B. Codes and Standards: In addition to complying with pertinent codes and regulations, comply with:
1. "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction.
 2. "Code for Welding in Building Construction" of the American Welding Society.
- C. Conflicting Requirements: In event of conflict between pertinent codes and regulations, requirements of the referenced standards, and these specifications, provisions of more stringent govern.
- D. Design, engineer, fabricate and install handrails and railing systems to comply with requirements of ASTM E985 for structural performance based on testing performed in accordance with ASTM E 894 and E 935. Conform to the current version of the IBC.
- E. Handrails, guardrails, and their supports to be designed for 50 lbs per linear foot, applied in any direction at the top of the top rail, and a concentrated load of 200 lb applied in any direction at any location along the top of the rail. The uniform load and concentrated loads are not to be applied simultaneously. Other components, including guardrail infill and bottom rails, are to be designed for 100 lbs acting on a projected area of 1 square foot, including the open space between components. The effects of this load are not to be combined with the load on the top rail.
- F. ASTM E 985 - For railing - related definitions and structural performance criteria.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Steel plates, angles, and other structural shapes shall conform to ASTM A36.
- B. Steel pipe shall conform to ASTM A53, Grade B, Schedule 40.
- C. Galvanized steel pipe and tube shall conform to ASTM A53.
- D. Steel Tubing shall conform to ASTM A500.
- E. Sheet Steel, Galvanized: ASTM A446.
- F. Sheet and Strip Steel, Hot Rolled: ASTM A568.
- G. Extruded Aluminum: ASTM B221.
- H. Anchors and Fasteners for Aluminum: Stainless steel.
- I. Welding Materials: AWS D1.1; type required for materials being welded.
- J. Anchors
 - 1. Threaded Type Concrete Inserts: Galvanized malleable iron or cast steel capable of receiving 3/4 inch diameter machine bolts.
 - 2. Slotted Type Concrete Inserts: Welded box type fabricated with minimum 1/8 inch thick galvanized pressed steel plate with slot to receive 3/4 inch diameter square head bolt and knockout cover.
 - 3. Expansion Shield for Masonry Anchorage: FS FF-2-325.
 - 4. Toggle Bolts: FS FF-B-588.
- K. Fasteners
 - 1. Bolts, Nuts and Washers for Exterior Locations: ASTM A307, galvanized in accordance with ASTM A153.
 - 2. Bolts, Nuts and Washers for Interior Locations: ASTM A307, Grade A, regular hexagon head.
 - 3. Bolts, Round Head: ANSI B-18.5
 - 4. Wood Screws, Flat Head Carbon Steel: ANSI B-18.6.1.
 - 5. Plain Washers, Helical Spring Type Carbon Steel: FS FF-W-84.
- L. Stock Hat Channel for Cladding Support:
 - 1. Galvanized G90 Solid / Vented, 18ga / 16ga for exterior cladding applications.
 - a. Vented hat channels shall be use in horizontal orientation where vertically oriented exterior cladding is detailed to allow for moisture mitigation, maintaining a drained and ventilated cavity.

- b. Hat channels can be installed in a number of ways depending on the cladding needs. Where hat channels are used as furring, behind a concealed fastener system, they can be oriented in either direction. In an installation where there are exposed fasteners, they can also be installed either direction, and sometimes in both directions to allow for panels to share hat channels. Channels project out 1".
- c. 16ga hat channels to be used where a heavier duty panel, or more durable support system is required. Use 18ga for lighter weight options.

2.02 FABRICATION

- A. Fabricate steel items according to approved shop drawings and to applicable portions of AISC Specifications. Conceal welds where possible; grind exposed welds smooth and flush with adjacent finished surface. Ease exposed edges to small uniform radius.
- B. Pre-assemble products in shop to greatest extent possible. Disassemble units to extent necessary for shipping and handling. Clearly mark units for re-assemble and installation.
- C. For exposed to view fabrications, use materials which are smooth and free of surface blemishes including pitting, seams marks, roller marks, roller trade names and roughness. Remove blemishes by grinding or by welding and grinding, prior to cleaning, treating and application of surface finishes including zinc coating.
- D. Fabricate items with joints tightly fitted and secured.
- E. Fit and shop assemble in largest practical sections for delivery to Project site.
- F. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of structure, except where specifically noted otherwise.
- G. Make exposed joints butt tight, flush and hairline.
- H. Fabricate anchorage and related components of same material and finish as metal fabrication, unless indicated otherwise.

2.03 ROUGH HARDWARE

- A. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Division 6 sections.
- B. Fabricate items to sizes, shapes, and dimensions required. Furnish malleable-iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.

2.04 LOOSE STEEL LINTELS

- A. Fabricate loose structural steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.
- B. Weld adjoining members together to form a single unit where indicated.
- C. Size loose lintels for equal bearing of one inch per foot of clear span but not less than 8 inches bearing at each side of openings, unless otherwise indicated.
- D. All steel lintels shall be coated with a zinc rich primer.

2.05 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports for applications indicated or which are not a part of structural steel framework, as required to complete work.
- B. Fabricate units to sizes, shapes, and profiles indicated and required to receive adjacent other construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 - 1. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.
 - a. Except as otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inch x 8 inches long.

2.06 SHELF AND RELIEVING ANGLES

- A. Fabricate shelf and relieving angles from steel angles of sizes indicated and for attachment to concrete framing. Provide slotted holes to receive 3/4 inch bolts, spaced not more than 6 inches from ends and not more than 24 inches o.c., unless otherwise indicated.
- B. Galvanize shelf angles to be installed on exterior concrete framing.

2.07 FINISHES, GENERAL

- A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.
- B. Finish metal fabrications after assembly.
- C. Galvanizing: For those items indicated for galvanizing, apply zinc-coating by the hot-dip process compliance with the following requirements:
 - 1. ASTM A153 for galvanizing iron and steel hardware.

2. ASTM A123 for galvanizing both fabricated and unfabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 0.0299 inch thick and heavier.
- D. Preparation for Shop Priming: Prepare un-coated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
1. Interiors (SSPC Zone 1A): SSPC-SP3 "Power Tool Cleaning":
 2. Apply shop primer to un-coated surfaces of metal fabrications, except those with galvanized finish or to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with requirements of SSPC-PA1 "Paint Application Specification No. 1" for shop painting.
 3. Lead Free, Zinc Rich Alkyd Primer - Air Dry: Manufacturer's standard.

2.08 PIPE GUARDS

- A. Furnish and install 6" diameter galvanized-for-painting steel upright pipe guards filled with concrete. Refer to drawings for reinforced concrete footing detail.
1. Provide Schedule 40 Pipe Bollard Cap for 6" diameter.

2.09 CASTINGS

- A. Cast Iron Trench Grates: Heavy duty Series R-4999 with type "X" frames by Neenah Foundry Co. or approved equal.

2.10 ACCESS DOORS

- A. Manufacturer: Milcor Limited Partnership, 1150 North Cable Road, Lima, OH 45805, 1-800-528-1411 or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete masonry or similar construction.

- D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.
- E. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.

3.02 CLEANING

- A. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touch-up of field painted surfaces.
 - 1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A780.

END OF SECTION 05 50 00

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PART 1 - GENERAL

1.01 DESCRIPTION

- A. Worked covered by this Section includes furnishing of and paying for all materials, labor, services, equipment, licenses, taxes, other items, and appliances for execution, installation and completion of all work specified herein and/or shown on the drawings.
 - 1. All steel expose to exterior shall be galvanized. Refer to Section 05 05 16 - Preparation of Hot-Dipped Galvanized Steel Surfaces.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

- A. Design, engineer, fabricate and install handrails and railing systems to comply with requirements of ASTM E985 for structural performance based on testing performed in accordance with ASTM E 894 and E 935. Conform to the current version of the IBC.
- B. Structural design, fabrication and assembly shall be in accordance with requirements of NAAMM Metal Stairs Manual, except as otherwise specified or shown.
- C. Design stairs to support a live load of 100 pounds per square foot.
- D. Handrails, guardrails, and their supports to be designed for 50 lbs per linear foot, applied in any direction at the top of the top rail, and a concentrated load of 200 lb applied in any direction at any location along the top of the rail. The uniform load and concentrated loads are not to be applied simultaneously. Other components, including guardrail infill and bottom rails, are to be designed for 100 lbs acting on a projected area of 1 square foot, including the open space between components. The effects of this load are not to be combined with the load on the top rail.
- E. ASTM E985-00(2006) - Standard Specification For Permanent Metal Railing Systems And Rails For Buildings.

- F. Calculations: Provide professionally prepared calculations and certification of performance of this work, signed and sealed by a Professional Engineer registered in the state where the work is located. Perform structural design of the stair including supports and railing for the metal stair frame. Indicate how Design Criteria as specified have been incorporated into the design.
- G. Conform to the following current Accessibility Standards:
 - 1. ICC/ANSI-A117.1 - Standard for Accessible and Usable Buildings and Facilities.
 - 2. Americans with Disability Act Standards for Accessible Design (ADASAD).
 - 3. Architectural Barriers Act (ABA).

1.05 MOCKUP

- A. General: Mockup components for railing, to include handrail, shall be full size, using the same materials as those to be used in the actual Work, including details and methods of construction.
- B. Fabricate exterior railing mockup in accordance with approved Shop Drawings.
- C. Railing Mockup may be part of final assembly but contractor has the option of removing and proper disposal.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Steel Pipe: ASTM A53, Standard Weight.
 - 1. Shop primed for interior applications
 - 2. ASTM A123 and ASTM A153 After-Fabrication Galvanizing for exterior applications.
 - 3. G90 Continuous Galvanizing (Coil to Coil) for exterior painted applications.
- B. Rectangular Tubing: ASTM A500, Grade B or have equal yield, ultimate, and weldability properties.
- C. Steel Grating: Fed. Spec. RR-G-661, Type I or II, with serrated surfaces. Shop primed for interior applications, zinc coated for exterior applications.
- D. Sheet Steel: ASTM A366.
- E. Structural Steel: ASTM A36.
- F. Steel Floor Plate: ASTM 786.
- G. Steel Decking: Form from steel conforming to ASTM A446, with properties conforming to AISI Specification for the Design of Cold-Formed Steel Structural Members. Shop primed for interior applications, zinc coated for exterior applications.

- H. Steel Plate: ASTM A570.
- I. Iron Castings: ASTM A48, Class 30.
- J. Malleable Iron Castings: ASTM A47.
- K. Stainless Steel Pipe & Fittings: Type 304 (18-8), Ornamental Grade, No.4 Satin Finish.
- L. Aluminum Pipe Railing: 1-1/2" IPS (1.900 inch OD), 6063 Alloy, Schedule 40 aluminum pipe.

2.02 STAIR NOSING

- A. Manufacturer: Balco-Metalines, Inc., P.O. Box 17249, Wichita, Kansas 67217, 1-800-767-0082, or approved equal.
- B. At Concrete Stairs: Furnish and install Single Component Stair Nosing Type R-315PC, 3" wide x 1/4" thick mill finish aluminum with abrasive treads in standard Black color BLA-1. Provide Type 1-Cast-In Continuous Anchor. This profile may be used at Cast-In-Place concrete or at steel pan stair system.

2.03 FABRICATION GENERAL

- A. Verify dimensions on site prior to shop fabrication.
- B. Fit and shop assemble components in largest practical sizes, for delivery to site and installation.
- C. Supply components required for secure anchorage of stairs, handrails and railings.
- D. Fully weld joints. Grind exposed welds smooth and flush with adjacent surfaces.
- E. Make exposed butt joints tight, flush, and hairline.
- F. Accurately form components required for anchorage of members to each other and to building structure.
- G. Welding:
 - 1. Structural steel, AWS D1.1 and sheet steel, AWS D1.3.
 - 2. Where possible, locate welds on unexposed side.
 - 3. Grind exposed welds smooth and true to contour of welded member. Remove welding splatter.

2.04 SHOP PRIMER

- A. Lead free, alkyd primer: Manufacturer's standard.

2.05 CLOSED RISER STAIRS

- A. Provide treads, risers, platforms, stringers, headers and other supporting members.
- B. Fabricate pans for treads from sheet steel, and fabricate pans for platforms from steel decking. Form risers to have sanitary cove.
- C. Fabricate stringers, headers, and other supporting members from structural steel.

2.07 OPEN RISER STAIRS AND INDUSTRIAL STAIRS

- A. Provide treads, platforms, stringers and other supporting members.
- B. Make treads and platforms of steel grating. Fabricate steel grating treads and platforms in accordance with the requirements of NAAMM Metal Bar Grating Manuals.
- C. Fabricate pans for treads from sheet steel, and fabricate pans for platforms from steel decking.
- D. Make treads and platforms of checkered steel floor plate. Turn floor plate down to form nosing on treads and edge of platform at head of stairs.
- E. Support treads by use of carrier plates or carrier angle. Provide abrasive nosing on treads and edge of platforms at head of stairs. Furnish toe plates where shown.

2.08 STEEL RAILING SYSTEM

- A. Rails and Posts: Sizes and shapes as indicated.
- B. Mounting on Concrete Floor: Steel sleeves, sized to receive railing post with 1/4 inch clearance.
- C. Mounting on Masonry or Concrete Walls: Provide brackets with anchors.
- D. Mounting on Stud Walls: Provide brackets and anchor plates, pre-drilled to receive bolts.
- E. Splice Connectors: Steel threaded collars.
- F. Handrail Returns: Handrail extensions must return to a wall, itself or to the walking surface. Note: Leave a gap between a wall return and the wall, and verify approval by the local Authority Having Jurisdiction (AHJ) before fabrication and installation.
- G. Rail Extensions: Extensions shall return to a wall, guard, or the landing surface or continue to another stair run.
 - 1. Extensions of the handrail is required by the ADA and building codes.
 - 2. Ramps: Handrails extend horizontally above the landing for 12 inches minimum beyond the top and bottom of the ramp runs.

3. Stairs, top extension: Handrails extend horizontally above the landing for 12 inches minimum beginning directly above first riser nosing.
4. Stairs, bottom extension: Handrails extend at the slope of the stair flight for a horizontal distance equal to one tread depth beyond the last riser nosing.

2.09 STANDARD ALLOY STEEL PIPE RAILINGS

- A. Provide ADA and code compliant cast ductile iron wall mount handrail brackets in standard finish, No. 1766 round saddle with one mounting hole as manufactured by Wagner Collaborative Metal Works, 888-243-6914, or approved equal.
- B. Provide Standard Alloy steel snap-on cover flange No. 2065 and base No. 2065B for 1.66 inch OD railing for concealed mounting of posts and handrail brackets where indicated on drawings. Manufacturer to be Wagner Collaborative Metal Works, 888-243-6914, or approved equal.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Supply items to be embedded in masonry or concrete or placed in partitions with setting templates and erection drawings to approximate sections.

3.02 STAIR INSTALLATION

- A. Provide hangers and struts required to support the loads imposed.
- B. Perform job site welding and bolting as specified for shop fabrication.
- C. Set stairs and other members in position and secure to structure as shown. Install stairs plumb, level and true to line.

3.03 RAILING INSTALLATION

- A. Provide standard terminal fittings at ends of posts and rails.
- B. Secure brackets, posts and rails to steel by welds, and to masonry or concrete with expansion sleeves and bolts, except secure posts at concrete by setting in sleeves filled with commercial non-shrink grout.
- C. Install adhesive anchors per current Code strength design methodology for structural concrete and ACI standard ACI 355.4-11, requiring test requirements and assessment criteria to include, but not be limited by the following:
 1. Concrete depth

2. Edge distance
 3. Anchor embedment
 4. Mounting plate sizes
 5. Reinforcement
- D. Set rails horizontal or parallel to rake of stairs to within 1/8-inch in 12 feet.
- E. Set posts plumb and aligned to within 1/8-inch in 12 feet.

3.04 STAIR NOSING INSTALLATION

- A. Installation instructions for poured concrete.
1. Pour concrete to form stairs. Schedule pours to allow safety stair treads to be installed quickly before initial set occurs. Make sure to have required number of safety treads before pouring concrete.
WARNING: THE USE OF VERY LARGE AGGREGATE OR CONCRETE WITH A VERY LOW SLUMP WILL MAKE INSTALLATION OF THE STAIR NOSING DIFFICULT.
 2. Select one of the stair nosing components and place nosing, with attached anchors, into fresh concrete. Ensure that front edge of nosing is flush with riser form or at the dimension indicated on the architectural drawings.
 3. Gently work nosing into the concrete until back edge of nosing is level with finished edge of tread. Work nosing into concrete until it is level, plumb, flush with tread, and at the proper elevation. To provide a stable installation ensure that stair nosing anchors are securely set in concrete and that concrete completely surrounds nosing components.
 4. Any voids left between the underside of the metal stair nosing and the substrate will allow flexing of the stair nosing itself. **It is vital that the installer tamp down the stair nosing to totally seat it into the substrate and fully rest upon any riser return such as in pan-filled steps.** This action will prevent the occurrence of hollows and voids which can lead to flexing and cantilevering of the nosing.
 5. Repeat the procedures given in Step 2 and Step 3 above until all stair nosing are installed and properly positioned.
 6. After concrete has taken its initial set, remove riser forms and finish concrete riser flush to stair nosing front or as otherwise specified. This is important to ensure that the riser has a clean finish.
 7. Stairway must be closed for a minimum of twenty-four (24) hours or until concrete has cured.

3.05 FIELD PRIME PAINTING

- A. When installation is complete, clean field welds and surrounding areas to bright metal, and coat with same primer paint used for shop priming.

END OF SECTION 05 55 00

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Includes: Provide rough carpentry, and installation of items specified in other Sections, normally installed by carpenters. Section specifies wood blocking, framing, sheathing, furring, nailers, sub-flooring, rough hardware, and light wood construction.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.
- C. Shop Drawings: Show fabrication and installation details for trusses.
 - 1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
 - 2. Indicate sizes, stress grades, and species of lumber.
 - 3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
 - 4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
 - 5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
 - 6. Show splice details and bearing details.

1.04 QUALITY ASSURANCE

- A. Material Grading: Identify hardboard, particleboard, lumber, and plywood by affixing grademark, stamp, or related identifying marks indicating material grades, rules or standards under which they are produced, and complying with rule or standard under which the material is produced. Use certified inspection agency certified by the Board of Review, American Lumber Standards Committee, to grade lumber species. In lieu of piece grade-marking, a certificate of inspection from an agency certified by the Board of Review, American Lumber Standards Committee may be furnished for precut lumber. Applicable grading rules are as follows:

1. Douglas Fir, White Fir, and Cedar: "Standard Grading and Dressing Rules for West Coast Lumber" as published by the West Coast Lumber Inspection Bureau.
 2. Ponderosa and Western White Pine: "Grading Rules for Western Lumber", published by the Western Wood Products Association.
 3. Southern Yellow Pine: "Standard Grading Rules for Southern Pine Lumber" as published by the Southern Pine Inspection Bureau.
 4. Redwood: "Standard Specifications for Grades of California Redwood Lumber" as published by Redwood Inspection Service.
- B. Plywood: Conform to U. S. Product Standard PS 1 issued by the National Bureau of Standards. Stamp or brand each standard size panel to show type and grade of panel. When used structurally, plywood to meet performance standards for its type as described in Product Standard PS 1 for Douglas Fir plywood. Furnish material identified as to species, grade, and glue type by an approved agency or independent testing laboratory with appropriate affixed grade-marks on each panel. Provide in addition to above requirements, exterior type plywood for permanently exposed plywood in outdoor applications.
- C. Qualifications of Workmen: Provide sufficient skilled workmen and carpenter foreman present at all times during execution of this portion of the Work, thoroughly familiar with type construction involved, materials and techniques specified.

1.05 PRODUCT HANDLING

- A. Protection:
1. Store materials to ensure proper ventilation and drainage. Protect against damage and weather.
 2. Deliver materials to job site and store, in safe area, out of the way of traffic, and shored off ground surface.
 3. Identify framing lumber as to grades and store grades separately.
 4. Protect metal products with adequate weatherproof outer wrappings.
 5. Use extreme care in off-loading lumber to prevent damage, splitting, and breaking materials.
- B. Replacements: In event of damage, immediately make repairs and replacements necessary to approval of Architect at Contractor's expense.

PART 2 - PRODUCTS

2.01 LUMBER

- A. Provide lumber for structural carpentry using following species provided grade for each is not lower than minimum shown:
- | | |
|--|--------------|
| 1. Pine, Southern Yellow - SPIB Rules (KD) | No. 2 Common |
| 2. Fir, Douglas - WCLIB Rules | Standard |
| 3. Fir, White - WCLIB Rules | Standard |
| 4. Pine, Western White - WWP A Rules | Standard |

5. Redwood - RIS Rules
6. Cedar, Western Red, & Incense - WCLIB Rules
- Construction Heart
Standard
- B. Lumber (except where otherwise noted): Surfaced 4 sides unless, in addition to being dressed, it has been notched, ship-lapped, or patterned.
- C. Lumber Dimensions: Are nominal.
- D. Structural Performance: Metal-plate-connected wood trusses shall be capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.
1. Design Loads: As indicated.
 2. Maximum Deflection under Design Loads:
 - a. Roof Trusses: Vertical deflection of 1/360 of span.
- E. Comply with applicable requirements and recommendations of TPI 1, TPI DSB, and SBCA BCSI.
- F. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

2.02 FIRE-RETARDANT AND PRESERVATIVE TREATED LUMBER

- A. Manufacturers: Provide wood treatment by or under license from Chemical Specialties, Inc., One Woodlawn Green, Suite 250, 200 E. Woodlawn Road, Charlotte, NC 28217. ASD. Tel: (800) 421-8661, or approved equal by one of the following companies:
1. Osmose, Inc., 1016 Everee Ln., Griffin, GA 30224
 2. Arch Wood Protection, Inc., 1955 Lake Park Dr., Ste. 250, Smyrna, GA 30080
 3. Hoover Treated Wood Products, Inc., 154 Wire Rd., Thomson, GA 3082
- B. Fasteners and Connectors: For treated wood and where wood is in ground contact, subject to high relative humidity, or exposed to weather, provide steel fasteners with hot-dip galvanized coating per ASTM A153/A153M; provide steel connectors with hot-dip galvanized coating per ASTM A653, Class G185 sheet with 1.85 ounces of zinc coating per square foot.
- C. Wood Preservative Treatment:
1. ACQ Preserve.
 - a. Use 0.25 lb/cu ft (4.0 kg/cu m) retention.
 - b. Kiln dry after treatment to 19 percent maximum moisture content for lumber and 18 percent for plywood.
 - c. Treat wood in the following locations:
 - 1) In contact with roofing, flashing, or waterproofing.
 - 2) In contact with masonry or concrete.
 - 3) Within 18 inches (450 mm) of grade.
 - 4) Exposed to weather.
 - 5) Other locations indicated.

- D. Fire-Retardant Treatment:
1. Lumber: Comply with AWWPA C20 .
 2. Plywood: Comply with AWWPA C2 7, Type A.
 3. Surface Burning Characteristics: UL FRS rating; flame spread and smoke developed ratings of 25 or less in a test of 30 minutes' duration.
 4. Treatment: D-Blaze®.

2.03 PLYWOOD

- A. Plywood (not otherwise specified or noted on the Drawings): Douglas Fir or Southern Yellow Pine panels, C-D grade for concealed applications and **A-C grade for exposed applications to receive paint or stain**, meeting U.S. Product Standard PS 1. Contractor shall replace any painted exposed-to-view C-D grade plywood at no cost to the owner.
- B. Wall Sheathing (Refer to Section 07 27 23 - Board Product Air barriers):
1. Minimum 11/32 inch thick with supports 16 inches on center and 15/32 inch thick with supports 24 inches on center unless specified otherwise.
 2. Minimum 48 inches wide at corners without corner bracing of framing.
- C. The backs of parapet walls are required to be sheathed with Exterior Grade plywood.

2.04 HARDWARE

- A. Provide rough hardware required for proper installation of carpentry work. Furnish hot-dipped galvanized, nails, spikes, screws, bolts, ply clips and similar items using proper types and ample sizes to fasten and hold the various members securely in place.
- B. Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
- C. ASTM F1667 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.

2.05 METAL CONNECTOR PLATES

- A. Fabricate connector plates to comply with TPI 1.
- B. Hot-Dip Galvanized-Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 coating designation; and not less than 0.036 inch thick.
1. Use for interior locations unless otherwise indicated.
- C. Hot-Dip Heavy-Galvanized-Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.

1. Use for wood-preservative-treated lumber and where indicated.

2.06 BLOCKING

- A. Provide solid wood blocking system capable of sustaining loads as listed within these documents, including drawings. Do not cut or bend metal studs, or cut wood studs, to achieve flush fit to face of studs. Blocking is to span between vertical studs and be fire resistant where applicable. Verify with architect any condition or loading requirement not listed. 2x solid blocking or two layers of 5/8" or 3/4" plywood, depending on required loads and clearances, may be used at contractor option. Coordinate any electrical and audio visual components, including back-boxes and conduit, with respective contractors.
 1. Attach blocking between studs for support of surface mounted items.
 - a. Plumbing fixtures.
 - b. Toilet partitions.
 - c. Wall cabinets.
 - d. Toilet accessories
 - e. Hardware.
 - f. Architectural woodwork.
 - g. Grab bars.
 - h. Handrails and railings.
 - i. Signage.
 - j. Other items requiring backing for attachment.

2.07 OTHER MATERIALS

- A. Provide materials, not specifically described but required for a complete and proper installation using new material, suitable for the intended use, and subject to approval of Architect.

PART 3 - EXECUTION

3.01 WORKMANSHIP

- A. Carpentry: Produce joints true, tight, and well nailed. Lay out, install and fit wood framing, furring, stripping, and blocking as required by conditions encountered.
- B. All Work: Plumb, level, and brace with sufficient nails, spikes, and bolts required to ensure secure attachment and rigidity.
- C. Any piece of work or carpentry material with defects that prevent it from serving its intended purpose satisfactorily, including crooked, warped, bowed, or otherwise defective material, even if within the limits of grade specified, will be rejected. Replace with an acceptable piece.

3.02 TEMPORARY ENCLOSURES AND PROTECTION

- A. Provide temporary enclosures at door, window, and related openings in exterior walls, as necessitated by weather and adverse conditions. Maintain enclosures in good repair and remove when no longer needed. Protect door and window frames.

3.03 STUD WALLS AND PARTITIONS

- A. Sole Plates: Single 2" thick members for walls and partitions.
- B. Studs (unless otherwise called for): 2 x 6's spaced 16" maximum o.c., doubled at sides and heads of openings, tripled at corners and placed to provide end nailing for sheathing. Toenail studs to sole plates with two 8d nails on each face side of each stud. Lay out studs so one occurs at each joint in plywood paneling and gypsum board.
- C. Top Plates: Double 2" thick members for walls and partitions.
- D. Provide plates of same width as studs to form continuous horizontal ties. Provide suitable splice plates at ends of sole plates, securely nailed in place. Nail lower members of top plates to studs and corner posts with two 16d nails at each stud and post. Nail upper and lower members of top plates together with 10d nails spaced 16" o.c.. Use two 10d nails at ends of upper members, and arranged so no joint in an upper member occurs over joint in lower member. Provide trusses and lintels over openings in walls and bearing partitions. Splices in plates not permitted over openings where a plate forms part of lintel.
- E. Provide one row of horizontal blocking between studs, near mid-height of wall. Furnish blocking of same width as studs.
- F. Provide additional blocking for anchorage of wall or ceiling mounted items as follows:
 - 1. Attach blocking between studs for support of surface mounted items.
 - a. Plumbing fixtures.
 - b. Toilet partitions.
 - c. Wall cabinets.
 - d. Toilet accessories
 - e. Hardware.
 - f. Architectural woodwork.
 - g. Grab bars.
 - h. Handrails and railings.
 - i. Signage.
 - j. Other items requiring backing for attachment.
 - k. DO NOT impede attic ventilation over the entire roof area.
- G. Anchor plates and sills of interior partitions to concrete slab with "Ramset", or approved equal, power-driven drive pins. Use No. 3330 drive pins. Set drive pins not less than 2" from edge of concrete. Spacing of drive pins not to exceed 4 feet on centers with drive pins at ends of all sections of plate.

3.04 ROOF FRAMING

- A. Use roof anchors to anchor roof trusses to top plates. Provide anchors using approved design and made of 18 gauge zinc coated metal. Fasten each anchor in place with nails made especially for that purpose by anchor manufacturer, using one nail at each nail-hold provided. Use one anchor at each end of truss involved.

3.05 PLYWOOD INSTALLATION

- A. Wall Sheathing: Apply with surface grain parallel to supports. Support end joints of sheets on bearings and stagger with alternate courses in line. Provide edge blocking or suitable edge support. Fasten shear panels in place with 10d common nail at 6" o.c. at edge and end supports and 12" o.c. at intermediate supports. Fasten shear panels to cold-formed steel with #8 TEK screws at 6" o.c. at edges and end supports, and at 12" o.c. at intermediate supports.
- B. Sub-flooring: Apply with face grain at right angles to supports with edges 1/8 inch apart at side joints and 1/16 inch apart at end joints, and nail at supported edges 6 inches on center and at intermediate supports 10" o.c.. Provide 1/4" clearance at walls. Install each panel with end joints occurring over supports and end joints staggered.

END OF SECTION 06 10 00

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PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Furnish and install millwork, shelving, ornamental wood items, hardware and accessories specified.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
1. Shop Drawings: Submit **newly prepared** architectural woodwork Shop Drawings for review by Architect prior to start of fabrication. **Do not duplicate Architect's construction drawings.** Indicate on shop drawings, dimensions, species, matching of panels, profiles of moldings, assembly details, applied finish, surfacing, built-in hardware, and necessary connections to other trades.
 - a. **Contract Document electronic files (including all drawings, specifications, addenda and supplemental information) will not be made available to Bidders or Sub-bidders before the award of a Contract nor will they be made available to the Contractor or Sub-contractors after the award of a Contract. Only conventional, paper reproductions of such information will be made available to parties listed above.**
 2. Brochures: Submit manufacturer's descriptive literature on specialty items not manufactured by the architectural woodworker, as requested by Architect.
 3. Samples: Submit finished samples of each wood species to receive transparent finish.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

- A. Standards:
1. "Quality Standards" of the Architectural Woodwork Institute (AWI) are referenced in this specification, however, where more stringent requirements are specified, the more stringent shall govern. Any reference to Premium, Custom or Economy in this specification is as defined in latest edition of the AWI "Quality Standards" and as modified in this specification.

2. Provide Custom grade for any item not given a specific quality grade as defined in latest edition of the AWI "Quality Standards."
- B. Competence: Approved woodwork manufacturer, regularly engaged and well experienced in manufacture of fixtures and wood trim and finish of monumental building type, having reputation for doing satisfactory work on time and successfully completing comparable work. Architect reserves the right to approve woodwork manufacturer selected to furnish woodwork.

1.05 FIELD DIMENSIONS

- A. Woodwork manufacturer is responsible for details and dimensions not controlled by job conditions. Show on Shop Drawings all required field measurements beyond his control. General Contractor and the woodwork manufacturer shall cooperate to establish and maintain these field dimensions.

1.06 PRODUCT HANDLING

- A. Protection: Protect architectural woodwork before, during, and after installation. Protect installed work and materials of other trades.
- B. Replacements: In event of damage, immediately make repairs and replacements necessary to approval of Architect and at Contractor's expense.

PART 2 - PRODUCTS

2.01 MATERIALS FOR ARCHITECTURAL WOODWORK

- A. Paint Finish:
 1. Exposed Solid Wood: Close grained hardwood.
 2. Semi-exposed or Concealed Solid Wood: Mill option.
 3. Exposed Plywood: Hardwood veneer medium density overlay.

2.02 STANDING AND RUNNING TRIM

- A. Fabricate according to AWI Quality Standards for "Custom" Grade with painted finish.

2.03 MILLWORK

- A. Fabricate according to AWI Quality Standards for "Custom" Grade, Flush Overlay type, for painted finish.
- B. Hardware: Install cabinet hardware furnished under this Section of these Specifications.
- C. Edge Banding: Provide solid wood as shown on drawings. **IRONED ON TAPE EDGE BANDING WILL NOT BE ACCEPTED.**

- D. Drawer Construction: Drawers are to be four sided, solid wood, drawer box type. **NO PANEL PRODUCTS WILL BE ALLOWED.** Head screw from the inside of the drawer box and install pulls through the drawer box.
1. Approved Alternate: Blum METABOX steel drawer system, 800-438-6788, as an acceptable product.
 2. Boxes with melamine finish shall be plywood core. No MDF or particle board allowed, particularly where adjacent to sinks or lavatories.

2.04 HIGH PRESSURE LAMINATED PLASTIC SURFACES

- A. Provide finish surfaces using products from one of the following High Pressure Laminate (HPL) manufacturers, or an equal approved by Architect, in colors and patterns selected by Architect from manufacturer's standard line, in satin finish General Purpose grade:
1. Wilsonart LLC, "Wilsonart" designer colors
 2. Nevamar Corporation, "Nevamar" designer colors
 3. Formica Corporation, "Formica" designer colors
- B. Fabricate to AWI Quality Standards for "Custom" Grade.
- C. Adhesive: Type I, complying with CS 35.

2.05 HIGH PRESSURE LAMINATED PLASTIC MILLWORK

- A. Fabricate according to AWI Quality Standards for "Custom" Grade, Flush Overlay type, for High Pressure Laminate (HPL) and/or Thermally Fused Laminate (TFL) with MDF or particle board (PB) finish on all surfaces.
- B. Provide finish for all surfaces, inside and out, using product from one of the following high pressure plastic laminate manufacturers, or an equal approved by Architect, in colors and patterns selected by Architect from standard range of colors and patterns of approved manufacturer, in satin finish General Purpose grade:
1. Ralph Wilson Plastics, "Wilsonart" designer colors
 2. Formica Corporation, "Formica" designer colors
 3. Nevamar Corporation, "Nevamar" designer colors
- C. Adhesive: Type I, complying with CS 35.
- D. Install thermally fused **through-color coordinated** PVC edge banding on all drawer and door edges as provided by Charter Industries, 800-538-9088, or approved equal.
- a. 3mm edging at counter tops, drawers, doors, and splashes.
 - b. 1mm edging at cabinet boxes, exposed shelving, and concealed shelving.

2.06 LOW PRESSURE LAMINATED PLASTIC MILLWORK MELAMINE

- A. Fabricate according to AWI Quality Standards for "Custom" Grade, Flush Overlay type, for Thermally Fused Melamine (TFM) Laminated finish on **interior** of doors, drawers, sides, and interior shelves **only**.

- B. Install thermally fused **through-color coordinated** PVC edge banding on all drawer and door edges as provided by Charter Industries, 800-538-9088, or approved equal.
 - a. 3mm edging at counter tops, drawers, doors, and splashes.
 - b. 1mm edging at cabinet boxes, exposed shelving, and concealed shelving.

2.07 WOOD DOOR FRAMES

- A. Provide Custom Quality, rotary cut, paint grade Birch, Maple, or Gum lumber and trim material for wood door frames requiring painted finish.
- B. Provide Premium Quality, Rift-sawn, OR Plain-sliced, Red Oak OR Premium Quality, Rotary-cut, "Natural" Yellow Birch lumber and trim material for wood door frames requiring stained finish.

2.08 HARDWARE

- A. Cabinet Doors: **(All pulls shall be ADA compliant)**
 - 1. 1 Pair Hinges: Bright Nickel Plated Steel, Medium-Duty, concealed style with a minimum 110 degree opening capability with three-dimensional adjustment and automatic closing as manufactured by SALICE or approved equal. Provide Clip Mounting Plate where required.
 - 2. 1 Pull: Amerock 3-3/4 Inch (96mm) CTC Bar Pull #19011SS Stainless Steel.
 - 3. 1 Cam Lock, where required, masterkeyed and keyed alike in groups as directed by Architect. Provide Cam Locks for 20% of cabinet doors equal to Medeco Cabinet Locks or as indicated on the drawings.
 - 4. Provide self-adhesive rubber silencers at each corner of the leading edge of cabinet doors.
- B. Cabinet Drawers:
 - 1. 1 Pair Drawer Slides: KV® Tru-Trac TT100 ball-bearing type (Length as required) at face-frame or frame-less construction. Provide heavy duty, full extension drawer slides at file drawers and all drawers over 7" deep.
 - 2. 1 Pull: Amerock 3-3/4 Inch (96mm) CTC Bar Pull #19011SS Stainless Steel.
 - 3. 1 Cam Lock, where required, masterkeyed and keyed alike in groups as directed by Architect. Provide Cam Locks for 20% of cabinet drawers UON.
- C. Adjustable Cabinet Shelf Supports: Millwork subcontractor to install in-line 5mm bore holes with Knappe & Vogt 332 ANO Shelf Support clips where indicated or required.
 - 1. Approved equal: Handy Button Shelf Spoon for 5mm holes, 5/16" Pin Length, Nickel finish, Item Number: THB6144.
- D. Grommets: Provide grommets where shown on millwork drawings by Doug Mockett & Co., P.O. Box 3333, Manhattan Beach, California 90266, 213-318-2491, or approved equal. Color to be selected by Architect from manufacturers standard line. Exact locations to be verified with Architect before installation.
 - 1. Provide TG Flip-Top® Series: 2 inch hole plastic grommets in plastic laminated countertops only.

2.09 COUNTER SUPPORT BRACKETS

- A. **EH-Inside Wall Mount Counter Support Bracket:** Provide Model No. EH-1818FM flush-mounted ADA-compliant Counter Support Bracket as manufactured by Rakks, 800-826-6006, where indicated on drawings. Install according to manufacturer's published recommendations. Flush mounts should be screwed into wood studs with #14 screws in 3 places. Verify that required wood stud blocking is installed correctly.
 - 1. For installation into metal studs, additional wood blocking should be placed inside the stud for maximum strength. Drill with 3/16" drill bit through the stud and wood blocking and secure with 1/4-20 x 2" bolts and nuts.
- B. **EHV Vanity Support Bracket:** Provide Model No. EH-1818 surface-mounted ADA-compliant Vanity Support Bracket as manufactured by Rakks, 800-826-6006, where indicated on drawings. Install according to manufacturer's published recommendations. Verify that required blocking is installed correctly.
- C. **Installation on CMU or concrete walls (if applicable):** Use masonry drill bits for Heavy Duty Brackets. Drill into the location of the first screw hole marks. This process will cause some concrete dust to collect around the holes; brush or blow this away before continuing. If using concrete anchors, drive these into the hole first, then place and align each shelving bracket. Finish by drilling the appropriate screws into the anchors and then through the shelving material itself for optimum support. Do not overdrive with power driven drills. Hand tightening is recommended as well as coated (Tapcon) screws.

2.10 OTHER MATERIALS

- A. Provide materials, not specifically described but required for complete and proper installation of architectural woodwork, selected by Contractor subject to approval by Architect.

PART 3 - EXECUTION

3.01 FABRICATION

- A. Fabricate millwork, ornamental wood, and countertops to comply with reviewed Shop Drawings and referenced standards.

3.02 FACTORY FINISH

- A. Factory finish architectural woodwork in accordance with requirements of AWI Section 1500 for Custom finish.
 - 1. Finish System: AWI Section 1500, Conversion Varnish with custom stain color to be selected by architect.
 - a. Close Grain Woods:
 - Washcoat
 - Custom Stain
 - Sealer

- Sand
 - Top Coat
 - Top Coat
 - b. Open Grain Woods:
 - Custom Stain
 - Sealer
 - Sand
 - Top Coat
 - Top Coat
- 2. Apply factory finish to all faces and edges that receive stain finish.
- B. For items to receive painted finish, refer to Section 09 91 00.

3.03 UNDER-COUNTER AND BUILT-IN ITEMS COORDINATION

- A. Prior to fabrication, verify exact location of specified and Owner Furnished under-counter and built-in items. Verify dimensions of appliances and equipment to be installed within the millwork. Notify Architect immediately of any dimensional discrepancies that would interfere with installation of under-counter or built-in items.

3.04 INSTALLATION

- A. Install architectural woodwork true, square, plumb, level, and firmly anchored for long life under heavy use.
- B. Install standing and running trim with minimum number of joints. Use full-length pieces, from maximum length of lumber available, to the greatest extent possible. Stagger joints in adjacent and related members. Cope at returns, miter at corners and comply with Quality Standards for joinery. Butt joints, except as detailed, are not acceptable.
- C. Paneling: Anchor paneling to supporting substrate with concealed panel hanger clips and by blind nailing on backup strips, splined connection strips, and similar associated trim and framing. Do not face nail unless otherwise indicated.
- D. Complete the finishing work specified in this section to whatever extent not completed at shop or before installation of woodwork.

3.05 WOOD DOOR FRAMES

- A. Set wood door frames plumb and in true alignment, securely wedged and fastened in place. In walls and partitions of wood construction, provide double wedge blocking driven solidly between jambs and frames and adjacent studding at three locations on each side of each door opening, at approximate levels of top and bottom door butts and lock or latch strikes. Fasten frames in place by nailing them to studding through the blocking, using at least three 12d finishing nails at each location.

3.06 FINAL INSPECTION

- A. General: Prior to final inspection and acceptance by Architect, completely check each installed item and adjust for proper operation.
- B. Compliance:
 - 1. Owner reserves right to request and pay for inspection by representative of the Architectural Woodwork Institute to determine that work of this Section has been performed to comply with referenced standards.
 - 2. In event above inspection determines architectural woodwork, or any part of it does not comply with referenced standards, contractor pays all costs for initial inspection and all subsequently required re-inspections. Immediately remove non-complying items, and immediately replace them with items complying to referenced standards of these specifications, at Contractor's expense.

END OF SECTION 06 40 00

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PART 1 - GENERAL

1.01 DESCRIPTION

- A. Composite Decking - Trex Enhance Basics and Naturals

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are located in Division 1 of the Specifications.
- B. Section 06 10 00 - Rough Carpentry

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.
- C. Product Data Indicate sizes, profiles, surface style, and performance characteristics.
- D. Samples: For each product specified, one sample representing actual product color, size, and finish.

1.04 REFERENCES

- A. ASTM D-7032: Standard Specification for Establishing Performance Ratings for Wood-Plastic Composite Deck Boards and Guardrail Systems (Guards or Handrails), ASTM International.
- B. ASTM D-7031: Standard Guide for Evaluating Mechanical and Physical Properties of Wood-Plastic Composite Products, ASTM International
- C. ASTM E-84: Test Method for Surface Burning Characteristics of Building Materials, ASTM International.
- D. ASTM D 570: Water Absorption of Plastics
- E. ASTM D 1761: Mechanical Fasteners in Wood
- F. ASTM D1413: Test method for Wood Preservatives by Laboratory Soil-block Cultures

- G. ASTM C177: Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus

1.05 DESIGN / PERFORMANCE REQUIREMENTS

- A. Structural Performance:
1. Deck board: Uniform Load – An allowable span of 16 in. on-center and 100 lbf/sq. ft.
 2. Tread of Stairs: Concentrated Load: An allowable span of 9 in. on-center, and 750 lbf-, and 1/8" max. deflection, with a concentrated load of 300 lbf on area of 4 sq. in.
- B. Fire-Test Response Characteristics per ASTM E-84.
- a. Flame Spread Index– Class C.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store Trex products on a flat and level surface. Support bundles on supplied dunnage.
- B. Keep material covered using the provided bundle cover until time of installation.
- C. For detailed storage recommendations:

PART 2 - PRODUCTS

2.01 MANUFACTURES

- A. Documents are based on products supplied by Trex Company, Inc., 2500 Trex Way, Winchester, VA 22601. Website:

<https://www.trex.com/customer-support/trex-owners/downloads/>

2.02 APPLICATIONS / SCOPE

- A. Wood-Plastic Composite Lumber
1. Material Description: Composite Decking consisting of recycled Linear Low-Density Polyethylene (LLDPE) and recycled wood. The product is extruded into shapes and sizes as follows:
 - a. Trex Enhance Decking Boards (nominal dimensions); 1" x 5.5".
 - b. Lengths: 12, 16, and 20 feet
 - c. Color: To be specified by owner from Trex standard list of colors.

2. Physical and Mechanical Properties as follows:

Test	Test Method	Value
Flame Spread Index	ASTM E 84	Class C
Thermal Expansion	ASTM D1037	1.9 x 10 ⁻⁵ inch/inch/degree F
Moisture Absorption	ASTM D1037	< 1%
Screw Head Pull-Through	ASTM D1761	161 lbf per screw**
Fungus Resistance	ASTM D1413	Rating - no decay
Termite Resistance	AWPA E1-72	Rating = 9.6

3. ** Fastener used in testing: #8 x 2.5 in. approved Stainless Steel Screw

2.03 ACCESSORIES

- A. Fasteners:
1. Trex Universal Hideaway Hidden Fasteners
 2. Other recommended fasteners: Refer to Trex Literature

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install according to Trex installation guidelines: Trex Literature
- B. Cut, drill, and rout using carbide tipped blades.
- C. Do not use composite wood material for structural applications.

3.02 CLEANING

- A. Following cleaning recommendations as found in Trex installation guide at: Trex Literature.

END OF SECTION 06 53 00

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PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The extent and location of polymer fabrications is indicated on the drawings.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.
- C. Product Data:
1. Submit product data for each specified product. Include manufacturer's technical data sheets and published instruction instructions.
 2. Submit Material Safety Data Sheets (MSDS) for adhesives and sealants.
- D. Shop Drawings:
1. Submit fully dimensioned shop drawings showing countertop layouts, joinery, terminating conditions, substrate construction, cutouts and holes. Show plumbing installation provisions. Include elevations, section details, and large scale details.
- E. Samples:
1. Submit selection and verification samples for each color, pattern, and finish required.
- F. Quality Assurance Submittals:
1. Test Reports: Submit certified test reports showing compliance with specified performance characteristics and physical properties, if required.
 2. Warranty: Specimen copy of specified warranty.
- G. Maintenance Data: Submit manufacturer's published maintenance manual with closeout submittals.

1.04 REGULATORY REQUIREMENTS

- A. Accessibility Requirements: Comply with the U.S. Architectural & Transportation Barriers Compliance Board ADA-ABA Accessibility Guidelines for Buildings and Facilities.
- B. Adhesives, Sealants, and Sealant Primers:
 - 1. SCAQMD (South Coast Air Quality Management District) Rule 1168.

1.05 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Fabricator Qualifications: Documented experience in fabricating solid surfacing countertops similar in scope and complexity to this Project. Currently certified by the manufacturer as an acceptable fabricator.
 - 2. Installer Qualifications: Documented installation experience for projects similar in scope and complexity to this Project, and currently certified by the manufacturer as an acceptable installer.
- B. Allowable tolerances:
 - 1. Variation in component size: 1/8".
 - 2. Location of openings: 1/8" from indicated location.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Protect units during transit, delivery, storage and handling to prevent damage, soiling and deterioration.

1.07 WARRANTY

- A. Provide manufacturer's 10 year warranty against defects in materials. Warranty shall provide material and labor to repair or replace defective materials.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Provide products of one of the following manufacturers:
 - 1. Corian® surfaces from the DuPont company
 - 2. Wilsonart® Solid Surface (basis-of-design)
 - 3. LG Hausys HI-MACS® America, Inc.
 - 4. LOTTE Staron®
 - 5. Avonite Surfaces®
 - 6. Approved equal.

2.02 SOLID POLYMER FABRICATIONS

- A. Material: Homogeneous filled acrylic; not coated, laminated or of composite construction; meeting ANSI Z124.3 & .6, Type Six, and Fed. Spec. WW-P-541E/GEN.
- B. Reception Areas: Horizontal surfaces of 1/2" thick solid polymer material adhesively joined with inconspicuous seams; edge details as indicated on Drawings. Vertical surfaces of 1/2" material; eased edge detail to be 1-1/2" profile with 1/8" Round Over unless otherwise indicated on Drawings.
- C. Table tops: 1/2" thick solid polymer material, adhesively joined with inconspicuous seams; edge details as indicated on Drawings. Vertical surfaces of 1/2" material; eased edge detail to be 1-1/2" profile with 1/8" Round Over unless otherwise indicated on Drawings.
- D. Countertops with sinks: 1/2" thick countertop of solid polymer material; edge details as indicated on Drawings, complete with Drop-In Single Bowl Sink and Double Bowl sink. Provide counter complete with backsplash of size shown. Refer to plumbing drawings for sink model selection.
- E. Window Sills (where detailed): 1/2" thick solid polymer material, adhesively joined with inconspicuous seams; edge details as indicated on Drawings.
- F. Color(s) to be selected by Architect from manufacturer's standard line.
- G. References:
 - 1. DuPont™ Corian® Solid Surface Product Fabrication - Directional Aesthetics (K-26833).
 - 2. DuPont™ Corian® Solid Surface Fabrication/Installation Fundamentals - Edge Details and Build-ups (K-25293).
 - 3. DuPont™ Corian® Solid Surface Fabrication/Installation Fundamentals - Backsplashes (K-25294).
 - 4. DuPont™ Corian® Solid Surface Fabrication/Installation Fundamentals - Thermoforming (K-25297).

2.03 ACCESSORY PRODUCTS

- A. Joint adhesive: Manufacturer's standard two-part adhesive kit to create inconspicuous, non-porous joints, with a chemical bond.
- B. Sealant: Manufacturer's standard mildew-resistant, FDA recognized silicone sealant in color to be selected by Architect from manufacturer's standard line.
- C. Bowl mounting hardware: Manufacturer's approved bowl clips, brass inserts and fasteners for attachment of undermount bowls.

2.04 FABRICATION

- A. For warranty coverage, fabricator/installer shall be approved by solid polymer manufacturer.
- B. Fabricate components in shop to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and solid polymer manufacturer requirements.
- C. Form joints between components using manufacturer's standard joint adhesive. Joints shall be inconspicuous in appearance and without voids. Attach 2" wide reinforcing strip of solid polymer material under each joint.
- D. Provide holes and cutouts for plumbing and accessories as indicated on the drawings.
- E. Rout and finish component edges to a smooth, uniform finish. Rout all cutouts, then sand all edges smooth. Repair or reject defective or inaccurate work.
- F. Finish: All surfaces shall have uniform finish.
 - 1. Matte, with a gloss rating of 5 - 20.
- G. Provide permanently attached thermo-formed 1/2" radius coved back splashes specified and install per industry standards. End splashes shall be provided loose for installation at the job site after horizontal surfaces, to which they are to be attached, have been installed. Comply with forming data from manufacturer.
 - 1. Construct matching molds of plywood to form component shape.
 - 2. Form pieces to shape prior to seaming and joining.
 - 3. Cut pieces larger than finished dimensions. Sand edges. Remove all nicks and scratches.
 - 4. Heat entire component uniformly prior to forming.
 - 5. Prevent blistering, whitening and cracking of solid polymer material during forming.
- H. Thermoforming: Comply with forming data from manufacturer.
 - 1. Construct matching molds of plywood to form component shape.
 - 2. Form pieces to shape prior to seaming and joining.
 - 3. Cut pieces larger than finished dimensions. Sand edges. Remove all nicks and scratches.
 - 4. Heat entire component uniformly prior to forming.
 - 5. Prevent blistering, whitening and cracking of solid polymer material during forming.
- I. Cove Back Splashes: Fabricate 1/2" radius cove at intersection of counters and back splashes. Form back splashes using 1/2" solid polymer material.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Installer must examine the substrates and conditions under which polymer fabrications are to be installed and notify the Contractor in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.02 JOB MOCK-UP

- A. Prior to final approval of shop drawings, erect one full size mock-up of each component at project site for architect review.
- B. Should mock-up not be approved, rework or remake until approval is secured. Remove rejected units from project site.
- C. Approved mock-ups shall remain as part of finished work.

3.03 INSTALLATION

- A. Install components plumb and level, in accordance with approved shop drawings and product installation details.
- B. Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work. Keep components and hands clean when making joints.
- C. Adhere bowls to countertops using manufacturer recommended adhesives and color-matched silicone sealant.
- D. Keep components and hands clean during installation. Remove adhesives, sealants and other stains. Components shall be clean on Date of Substantial Completion.
- E. Make plumbing connections to sinks in accordance with Division 15, Mechanical.
- F. Protect surfaces from damage until Date of Substantial Completion. Replace damaged work that cannot be repaired to architect's satisfaction.
- G. Fabricator/Installer is to provide a commercial care and maintenance video, review maintenance procedures and warranty details with the Owner upon completion of project.

END OF SECTION 06 61 16

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PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Fiberglass reinforced plastic (FRP) wall panels.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are located in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 REFERENCE STANDARDS

- A. ASTM International (ASTM) (www.astm.org):
 - 1. ASTM D 2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
 - 2. ASTM D 5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels.
 - 3. ASTM D 5420 - Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact).
 - 4. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Delivery Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage and Handling Requirements:
 - 1. Store and handle materials in accordance with manufacturer's instructions.
 - 2. Keep materials in manufacturer's original, unopened containers and packaging until installation.
 - 3. Store materials in clean, dry area indoors at temperature and humidity conditions in accordance with manufacturer's instructions.

4. Store materials on flat, level surface, raised above floor, with adequate support to prevent sagging.
5. Store materials out of direct sunlight.
6. Protect materials and finish during storage, handling, and installation to prevent damage.

1.06 WARRANTY

- A. Warranty Period: 1 year from date of purchase.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer: VALTO, Inc. (formerly Crane) 23525 West Eames Street, Channahon, Illinois 60410, 815-467-8600. Web: www.VALTOfrp.com
Approved equal manufacturers:
1. Marlite®, 800-377-1221, info@marlite.com
 2. Interstate Plastics, 300 Commerce Circle, Sacramento, CA 95815, 916-679-5146, www.interstateplastics.com
 3. Panolam® Surface Systems, 877-726-6526, www.panolam.com
- B. Single Source: Provide FRP panels and accessories from single manufacturer.

2.02 MATERIAL

- A. Self Adhered FRP Panels and Trims: GLASBOND with SURFASEAL.
1. Panel Composition: GLASBOND PWIP Skin with Pressure Sensitive Foam Backing.
 2. Color: White (85).
 3. Finish: Smooth.
 4. Thickness: 0.15" (overall thickness) | 0.09" (panel thickness).
 5. Available Sizes: 4' x 8' | 4' x 10'.
 6. Fire Rating: Class C per ASTM E-84.
 7. Panels shall be installed in accordance with manufacturer's guidelines as set forth in the Crane Composites Installation Guide (Form #6876).
- B. Panel Compliance: ASTM D 5319.
- C. Panel Low-Emitting Materials: Comply with testing and product requirements of California Department of Health Services standards for Volatile Organic Emissions.
- D. Panel Surface Protection: "Surfaseal" molecularly-bonded surface protection film for impact, abrasion, and scratch resistance.

2.03 ACCESSORIES

- A. Moldings, Trim, and Caps: 1-piece extruded polypropylene or PVC, configured to cover panel edges and corners.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas to receive FRP panels.
- B. Examine Substrate Surfaces to Determine:
 - 1. Corners: Plumb and straight.
 - 2. Surfaces: Smooth, sound, and uniform.
 - 3. Nails or Screw Fasteners: Countersunk.
 - 4. Joints and Cracks: Filled flush and smooth with adjoining surfaces.
- C. Notify Architect of conditions that would adversely affect installation or subsequent use.
- D. Do not begin preparation or installation until unacceptable conditions are corrected.

3.02 PREPARATION

- A. Clean substrates to remove substances that could impair bond of adhesive, including oil, grease, dirt, dust, or other contaminants.
- B. Acclimate FRP panels by unpacking and placing in installation space a minimum of 24 hours before installation.
- C. Lay out FRP panels before beginning installation.
 - 1. Locate panel joints to provide equal panel widths at ends of walls.
 - 2. Locate panel joints to provide trimmed panels at corners a minimum of 12 inches wide.

3.03 INSTALLATION

- A. Install FRP panels in accordance with manufacturer's instructions at locations indicated on the Drawings.
- B. Install FRP panels plumb, level, square, flat, and in proper alignment.
- C. Install FRP panels to be water resistant and washable.
- D. Install FRP panels with manufacturer's recommended gap for panel field and corner joints.

- E. Fasteners:
 - 1. Use fasteners in accordance with manufacturer's instructions to install FRP panels securely to supports.
 - 2. Pre-drill fastener holes in FRP panels, 1/8 inch greater in diameter than fasteners.
- F. Adhesive:
 - 1. Install FRP panels in full spread of adhesive.
 - 2. Follow adhesive manufacturer's instructions for application of adhesive.
- G. Install trim accessories with adhesive and nails or staples.
 - 1. Do not fasten through FRP panels.
- H. Sealant:
 - 1. Fill grooves in trim accessories with sealant before installing FRP panels.
 - 2. Bed inside corner trim in bead of sealant.
 - 3. Remove excess sealant and smears as FRP panels are installed.
 - 4. Clean in accordance with sealant manufacturer's instructions.
- I. Tolerances: Install FRP panels within manufacturer's installation tolerances.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: If requested by Owner, provide manufacturer's field service consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.05 ADJUSTING

- A. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.
- B. Remove and replace with new material, damaged components that cannot be successfully repaired, as determined by Architect.

3.06 CLEANING

- A. Clean FRP panels promptly after installation in accordance with manufacturer's instructions.
- B. Do not use harsh cleaning materials or methods that could damage finish.

3.07 PROTECTION

- A. Protect installed FRP panels and finish surfaces from damage during construction.

END OF SECTION 06 83 16

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Furnish labor, materials, tools, and equipment required and perform waterproofing work specified.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

- A. Qualifications of Installers: Perform work under this Section by specialty subcontractor regularly engaged in performance of type work required. Use workmen experienced in installation of specified products. Applicator to provide qualified, competent foreman present and in charge at all times work under this Section is performed.
- B. Installer Guarantee: Furnish written guarantee for waterproofed under this Section against leakage for period of 2 years after acceptance, making good at his own expense leakage which may develop within guarantee period.

1.05 PRODUCT HANDLING

- A. Protection: Protect waterproofing materials before, during, and after installation. Protect installed work and materials of other trades.
- B. Replacements: In event of damage, immediately make repairs and replacements necessary to Architect approval and at Contractor's expense.

1.06 WATER AND VAPOR TRANSMISSION PREVENTION

- A. Refer to Section 07 26 16 - Under Slab Vapor Barrier.

PART 2 - PRODUCTS

2.01 EMULSION-TYPE DAMPPROOFING

- A. For above-grade cavity wall applications provide Sealmastic Emulsion Dampproofing breather-type coating as manufactured by WR Meadows, Inc. or approved equal system. Apply according to manufacturer's recommended standards. Approved equals:
 - 1. BASF MasterSeal 610 Waterborne Emulsified-Asphalt Dampproofing, fiber-free for application by brush or spray.
 - 2. TREMproof 250GC single component, Rapid Curing, Fluid-Applied Elastomeric Waterproofing membrane as manufactured by TREMCO, (800) 321-7906.

2.02 COLD-APPLIED MEMBRANE WATERPROOFING

- A. MANUFACTURERS: Provide Polyguard 650 Sheet Membrane Waterproofing System as manufactured by Polyguard Products, Inc., Ennis, Texas 75120-0755, phone: 800-541-4994 or approved equal.
- B. PRODUCTS: Self-adhesive Membrane Waterproofing: Polyguard 650 Membrane, a 60 mil rubberized asphalt membrane consisting of a high density polyethylene film bonded to a layer of rubberized asphalt meeting or exceeding the following requirements:
- C. Accessory Products
 - 1. Substrate Conditioner: Polyguard 650 LT Liquid Adhesive or Polyguard ShurTac Water Based Liquid Adhesive, or approved equal.
 - 2. Mastic: Polyguard 650 Mastic, or approved equal.
 - 3. Liquid Membrane: Polyguard LM-95, or approved equal.
 - 4. Termination Bar: Polyguard Termination Bar, or approved equal.
- D. Protection Course:
 - 1. For horizontal applications: Polyguard Asphaltic Protection Board, or approved equal.
 - 2. For vertical applications: Polyguard Asphaltic Protection Board or polystyrene protection board (by others).
- E. Prefabricated Drainage Composite: Polyguard Drainage Composites Flow 15-P for vertical applications or Flow 18-H for horizontal applications. Polyguard Drainage Composites shall be designed to promote positive drainage while serving as a protection course.
- F. Prefabricated Perimeter Drainage Composite: Polyguard Total Flow System including Universal "T" Connectors and/or Outlet Connectors as needed for facilitate perimeter drainage, or approved equal.

2.03 PRE-MOULDED MEMBRANE

- A. Under elevator pit, provide W.R. Meadows "Seal-Tight" PREMOULDED MEMBRANE VAPOR SEAL with PLASMATIC CORE. PMPC is a seven-ply, weather-coated, permanently bonded, semi-flexible bituminous core board. It is composed of a homogeneous, high-melt point bituminous material, in combination with an exclusive plasmatic core suspended mid-point in the bituminous core. This core is sealed under heat and pressure between liners of asphalt-impregnated felt and a glass-mat liner. An asphalt weather coat is applied to the glass-mat liner and covered with a polyethylene anti-stick sheet.
- B. PMPC offers a perm rating of less than 0.002 perms and conforms to ASTM E 1993-98.

2.04 LIQUID COLD-APPLIED WATERPROOFING

- A. BASF MasterSeal® HLM 5000 one-component, moisture-curing, bitumen-modified polyurethane elastomeric waterproofing membrane for exterior below-grade or between slab applications. Provide 60 mil minimum thickness.
- B. W.R. Meadows, Inc. HYDRALASTIC™ 836 Cold-Applied, Single Component Waterproofing for use on interior or exterior concrete surfaces, vertical or horizontal, above-grade and below-grade. Use for positive-side waterproofing for foundations and in between-slab applications.
- C. TREMproof 250GC single component, Rapid Curing, Fluid-Applied Elastomeric Waterproofing membrane as manufactured by TREMCO, (800) 321-7906.

2.05 LIQUID APPLIED BREATHABLE WATERPROOF COATING

- A. BASF MasterProtect EL 750 (formerly Thorolastic®) water-based, 100% acrylic, elastomeric, waterproof coating with 300% elongation, in standard color [**custom color**] , and three textures. Apply per manufacturer's recommended standards for above-grade concrete, masonry, stucco and EIFS applications.

2.06 EXPANDING CONCRETE JOINT WATERSTOP

- A. Provide WATERSTOP-RX® as manufactured by CETCO, a Minerals Technologies Company or approved equal. Install per manufacturer's published recommendations.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

- A. Inspection: Carefully inspect installed work of other trades and verify work is complete to point where this installation may properly commence.

- B. Discrepancies: Do not proceed with installation in areas of discrepancy until discrepancies are fully resolved.

3.02 INSTALLATION OF DAMP-PROOFING AND WATERPROOFING IN GENERAL

- A. Preparation: Prepare surfaces to receive damp-proofing and waterproofing, strictly complying with manufacturer's recommendations. Deliver waterproofing materials to project site in original sealed containers with manufacturer's brand and name clearly identified.
- B. Installation: Install damp-proofing and waterproofing complying with manufacturer's recommendations, covering surfaces to prevent penetration of moisture.

3.03 INSTALLING COLD-APPLIED MEMBRANE WATERPROOFING

- A. Priming: Apply primer to a cleaned, dust free surface. Apply by roller or spray. Apply Polyguard 650 LT Liquid Adhesive at the rate of 250-300 sq. ft. per gallon. Apply Polyguard ShurTac Water Based Liquid Adhesive at the rate of 350-400 per gallon. Allow to dry per manufacturer's directions.
- B. Membrane Installation - Vertical Surfaces
 1. All inside and outside corners shall be treated either with 12 inch wide membrane strip or by applying a 90 mil thick application of Polyguard LM-95. The 12 inch wide membrane should be centered over outside corners.
 2. Install a 3/4 inch, 45 degree angle cant of Polyguard LM 95 Liquid Membrane at all changes in plane including inside corners.
 3. Waterproofing membrane should be applied vertically in sections of 8 feet in length or less. On walls higher than 8 feet, apply two or more sections with the upper section overlapping the lower.
 4. Side laps should be a minimum of 2 ½ inches and end laps should be a minimum of 6 inches.
 5. Use a hard roller to firmly press in the material as it is placed on the vertical surface.
 6. All terminations of the membrane should receive a bead of Polyguard 650 Mastic. The bead should be troweled to a flat surface approximately 1/8 inch thick by 3/4 inches wide. The mastic should be worked into cut edge terminations.
 7. Inadequately lapped seams and damaged areas should be patched with small sections of membrane. The patch should extend a least 6 inches in each direction beyond the defect.
 8. Fishmouths and severe wrinkles should be slit, flaps overlapped and repaired as above.
 9. Termination bar at top termination of field sheet. (optional)

C. Membrane Installation - Horizontal Surfaces:

1. All inside and outside corners shall be treated either with 12 inch strips of membrane or a 12 inch wide by 90 mil thick application of Polyguard LM-95. The field membrane should be centered over the corner. All inside corners shall have a minimum 3/4 inch fillet of Polyguard LM-95 or latex modified cement mortar.
2. Waterproofing membrane should be applied to the primed surface starting at the low point and working to the high point in a shingling technique.
3. Side laps should be a minimum of 2 ½ inches and end laps a minimum of 6 inches.
4. The entire membrane should be firmly rolled with a linoleum roller weighing approximately 75 pounds. This will insure excellent adhesion and minimize air pockets between the substrate and membrane.
5. At penetrations, posts or projections, seal to the penetration with Polyguard LM-95 then apply a second flashing sheet over the penetration extending a minimum of 6 inches from the detail. The cut edges of all terminations must be sealed with Polyguard 650 Mastic.
6. At drains, apply Polyguard LM-95 around the inside edge of the drain out at least 6 inches then overlap with sheet membrane a minimum of 6 inches. All permanently exposed cut edge terminations must be sealed with Polyguard 650 Mastic.
7. Membrane turned up on walls shall be terminated into a reglet or under a counter flashing. The membrane may also be rolled firmly to the wall and sealed with a troweled bead of Polyguard 650 Mastic.
8. Inadequately lapped seams and damaged areas should be patched with small section of membrane. The patch area should extend a least 6 inches beyond the defect.
9. Fishmouths and severe wrinkles should be slit, flaps overlapped and repaired as above.
10. Upon completion of horizontal membrane application, flood test the surface with 2 inches of water for 24 hours. Check with the structural engineer to make sure the deck structure will withstand the weight of the flood test.
11. Mark any leak areas found during flood test and make repairs.

- D. Install protection board immediately after installation of the membrane. Install protection board in a coating of compatible adhesive with edges butting tightly.

3.04 INSTALLING PRE-MOULDED MEMBRANE

- A. Apply under-slab installation of "PM" boards directly over the leveled drainage fill. Lay boards in "Dutch-lap" method with 6" headlap and 6" sidelap at each joint. Apply catalytic bonding asphalt on contact surfaces of each lap to seal joint, using one gallon of asphalt for each 200 square feet of contact surface. Seal perforations through membrane, either required or accidental, with bonding asphalt.

END OF SECTION 07 10 00

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PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Furnish and apply water-repellant sealer materials specified.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

- A. Qualifications of Applicators: Use only workmen thoroughly trained and experienced in skills required, completely familiar with manufacturer's recommended methods of application, and completely familiar with requirements of this Section of specifications.
- B. Manufacturer's Directions: Carefully follow manufacturer's printed directions in application of water repellant. Make available printed directions to Architect's Representative if requested.

PART 2 - PRODUCTS

2.01 EXTERIOR WALL WEATHER SEALER

- A. Select exterior masonry walls of the building, except natural stone, shall receive water based siloxane water repellant.
1. Sure Klean® Weather Seal Siloxane PD (Pre-Dilute) by ProSoCo®.
 2. Chemprobe/Tnemec Series 633 Prime-A-Pell® Plus H2O
 3. BASF MasterProtect® H 177
 4. Sure Klean® Custom Masonry Sealer for Historic Renovated surfaces.

- B. The weather sealer shall be applied in strict accordance with the manufacturer's instructions. Do not alter or dilute the material. The weather sealer shall be applied as packaged. Preferred method of application is with low pressure (20 psi) airless spray equipment or with a heavily saturated brush or roller in two wet-on-wet applications. The wall surface shall be completely dry, clean and free from surface dirt, dust, oil or other surface contaminants.
- C. Provide Installer's two (2) year guarantee and Manufacturer's five (5) year non-prorated, material warranty for moisture penetration.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

- A. Inspection: Carefully inspect installed work of other trades and verify that work is complete to point where this installation may properly commence.
- B. Discrepancies: Do not proceed with application in areas of discrepancy until discrepancy are fully resolved.

3.02 APPLICATION OF DAMPPROOFING IN GENERAL

- A. Preparation: Prepare surfaces to receive dampproofing, strictly complying with manufacturer's recommendations.
- B. Application: Apply dampproofing complying with manufacturer's recommendations, covering areas to prevent penetration of moisture.

END OF SECTION 07 19 00

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Furnish and install insulation and related items specified.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 PRODUCT HANDLING

- A. Protection:
1. Deliver materials to job site and store in safe dry place with labels intact and legible at time of installation.
 2. Protect building insulation materials before, during, and after installation. Protect installed work and materials of other trades.
- B. Replacements: In event of damage, immediately make repairs and replacements necessary to approval of Architect and at Contractor's expense.

1.05 REFERENCES

- A. Concealed Installations: Flame Spread rating of not more than 75 and a smoke developed rating of not more than 450 when tested in accordance with ASTM E84.
- B. Exposed Installations: Flame Spread rating of not more than 25 and a smoke developed rating of not more than 450 when tested in accordance with ASTM E84.

PART 2 - PRODUCTS

2.01 RIGID PERIMETER AND WALL INSULATION BOARD

- A. Where indicated as "Perimeter Insulation" at turn-down slab transitions, provide 2" thick Styrofoam™ Brand Square Edge Extruded Polystyrene (XPS) Foam Insulation Shiplap, Owens Corning® FOAMULAR® 250, or approved equal. Insulation Minimum R-Value is to meet ASHRAE 90.1-2022 for heated Slab-On-Grade Floors of R-15 for 24 inches.
 - 1. Sopra-XPS by Soprema.US, 800-356-3521.
 - 2. Dupont™ Styrofoam™ Brand Cavitymate™ Ultra Extruded Polystyrene Insulation.
 - 3. Kingspan GreenGuard® Type IV XPS Insulation Board.
- B. Where indicated as continuous "Wall Insulation" ABOVE GRADE, provide STYROFOAM™ Brand Extruded Polystyrene Foam (XPS) Square Edge Insulation, meeting ASTM C578, Type IV, non-structural sheathing as manufactured by Dow Building Solutions, or approved equal. Material is detailed as 1.5" thick and 48" wide in 8' and 9' lengths with R-5 per inch.
- C. Installation is to be per manufacturer's published recommendations.

2.02 BATT INSULATION

- A. Fiberglass Building Insulation Manufacturers:
 - 1. Certainteed, 800-233-8990
 - 2. Johns Manville, 800-866-3234
 - 3. Knauf Insulation, 800-825-4434
 - 4. Owens Corning Fiberglass, 800-GET-PINK
- B. Material: Formaldehyde-free Fiberglass type bearing the UL Classification marking as to fire resistance conforming to Federal Specification HH-I-521F, and ASTM C-665:
 - 1. Un-faced, Type I in walls

2.03 ACOUSTICAL INSULATION

- A. In partitions, provide un-faced Owens-Corning Pink Next Gen™ Fiberglas™ Sound Attenuation Batts (SAB) or approved equal complying with ASTM C 665, Type I and ASTM E 136. Flame spread rating shall not exceed 25 and smoke developed shall not exceed 50 when tested complying with ASTM E 84. Approved equal manufacturers:
 - 1. Certainteed **NoiseReducer™** Sound Attenuation and Acoustical Ceiling Batts.
 - 2. Knauf Insulation EcoBatt® Insulation with ECOSE® Technology.
 - 3. Johns Manville Unfaced or ComfortTherm® Batts and Rolls.
 - 4. ROCKWOOL Safe'n'Sound® Fire & Soundproof Insulation available in 3" and 6" thicknesses. Mineral wool batt insulation conforms to ASTM C167.

2.04 EXTERIOR FURRED WALL INSULATION

- A. Insulation on Exterior Concrete Walls: Provide furred-wall system by Certainteed Corp., or approved equal, using galvanized Z-channels of 1" depth fastened to wall with power actuated fasteners, 1" thick, pre-cut "Certainteed WP-EES" insulation boards nested in Z-channels and with foil or polyethylene film vapor barrier on warm (inside) face of insulation. Do not use wood or hat-channel furring.

2.05 FIRE RESISTIVE JOINT SYSTEMS IN RATED ASSEMBLIES

- A. Thermafiber Safing Insulation - Type SAF

2.06 FIRE STOPPING OF THROUGH PENETRATIONS IN RATED ASSEMBLIES

- A. Thermafiber Safing Insulation - Type SAF

2.07 OTHER MATERIALS

- A. Provide materials including fasteners and retainers, not specifically described but required for complete and proper installation of building insulation, selected by Contractor subject to approval of Architect.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

- A. Inspection: Carefully inspect installed work of other trades and verify that work is complete to point where this installation may properly commence.
- B. Discrepancies: Do not proceed with installation in areas of discrepancy until discrepancies are fully resolved.

3.02 INSTALLING BATT AND BLANKET INSULATION

- A. Install vapor barriers flat against framing members, without buckles or wrinkles and secure in place to avoid leakage in air borne water vapor.
- B. After piping and wiring is in place, install and support blanket and batt insulation in position required, and coordinate with framing.
- C. Remove insulation and vapor barriers torn, displaced, water soaked, and damaged. Replace with new material.

3.03 INSTALLING ACOUSTICAL BATT INSULATION

- A. Install the batts: Push the insulation into place between the studs. Hold the batts in place by applying pressure instead of using staples like with wood studs. Ensure proper placement: Pull the insulation to the front of the stud to eliminate any space between the insulation and the stud flange.

3.04 INSTALLING OTHER INSULATION

- A. Install materials not specifically set forth above in strict accordance with manufacturer's instructions.

END OF SECTION 07 21 00

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide vapor barrier and installation accessories for installation under concrete slabs.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.
- C. Quality control/assurance:
1. Summary of test results per paragraph 9.3 of ASTM E1745.
 2. Manufacturer's samples and literature.
 3. Manufacturer's installation instructions for placement, seaming, penetration prevention and repair, and perimeter seal per ASTM E1643.
 4. All mandatory ASTM E1745 testing must be performed on a single production roll per ASTM E1745 Section 8.1.
 5. Contact vapor barrier manufacturer to schedule a pre-construction meeting and to coordinate a review, in-person or digital, of the vapor barrier installation.
 6. Vapor barrier manufacturer must warrant in writing (a) compliance with the designated ASTM E1745 classification, and (b) no manufacturing defects in the product for, at least, the Life of the Building.
 7. Manufacturer's verify in writing 20 years in the industry with no reported product failures.

1.04 REFERENCES

- A. American Society for Testing and Materials (ASTM):
1. ASTM E1745- 17 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
 2. ASTM E1643-18a: Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
- B. Technical Reference - American Concrete Institute (ACI):

1. ACI 302.2R-06: Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
2. ACI 302.1R-15: Guide to Concrete Floor and Slab Construction.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Liner shall have all of the following qualities:
 1. Maintain permeance of less than 0.01 Perms as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1 (7.1.1-7.1.5).
 2. Other performance criteria:
 - a. Strength and Longevity: ASTM E1745.
 - b. Thickness: 15 mils minimum
 3. Provide third party documentation that all testing was performed on a single production roll per ASTM E1745 Section 8.1.
 4. Warranty: (a) compliance with the designated ASTM E1745 classification, and (b) no manufacturing defects in the product for, at least, the Life of the Building.
- B. Vapor barrier product:
 1. Basis of Design: Stego® Wrap Vapor Barrier (15-mil) by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.
- C. Approved Alternate Manufacturers:
 1. Griffolyn® Vaporguard® 15-mil manufactured by Reef Industries, 800-231-6074.
 2. Moistop Ultra 15 by Fortifiber, (800) 773-4777.
<https://www.fortifiber.com/product/moistop-ultra-15/>
 3. **No Other Substitutions allowed.**

2.03 ACCESSORIES

- A. Seams:
 1. Stego Tape by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com
- B. Sealing Penetrations of Vapor barrier:
 1. Stego Mastic by Stego Industries LLC, (877) 464-7834
www.stegoindustries.com
 2. Stego Tape by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com
- C. Perimeter/terminated edge seal:
 1. Stego Crete Claw (textured tape) by Stego Industries LLC, (877) 464-7834
www.stegoindustries.com
 2. Stego Term Bar by Stego Industries LLC, (877) 464-7834
www.stegoindustries.com
 3. StegoTack Tape (double-sided sealant tape) by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com

4. One-sided seaming tape is not a recommended method of sealing at the terminated edge.
- D. Penetration Prevention:
 1. Beast Foot by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com
- E. Vapor Barrier-Safe Hand Screed System
 1. Beast Screed by Stego Industries, LLC, (877) 464-7834
www.stegoindustries.com

PART 3 - EXECUTION

3.01 PREPARATION

- A. Ensure that subsoil is approved by Architect or Geotechnical Engineer.
 1. Level and compact base material.
- B. Contact vapor barrier manufacturer to schedule a pre-construction meeting and to coordinate a review, in-person or digital, of the vapor barrier installation.

3.02 INSTALLATION

- A. Install vapor barrier in accordance ASTM E1643.
 1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible.
 2. Extend vapor barrier to the perimeter of the slab. If practicable, terminate it at the top of the slab, otherwise (a) at a point acceptable to the structural engineer or (b) where obstructed by impediments, such as dowels, water stops, or any other site condition requiring early termination of the vapor barrier. At the point of termination, seal vapor barrier to the foundation wall, grade beam or slab itself.
 - a. Seal vapor barrier to the entire slab perimeter using manufacturer's textured tape with a surface that creates a mechanical seal to freshly-placed concrete, per manufacturer's instructions.
 3. Overlap joints 6 inches and seal with manufacturer's seam tape.
 4. Apply seam tape/textured tape/double-sided tape to a clean and dry vapor barrier.
 5. Seal all penetrations (including pipes) per manufacturer's instructions.
 6. Avoid the use of stakes driven through vapor barrier by utilizing screed and forming systems that will not leave punctures in the vapor barrier.
 7. Repair damaged areas with vapor barrier material of similar (or better) permeance, puncture and tensile.

END OF SECTION 07 26 16

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PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide combination wall sheathing, water-resistive barrier, and air barrier panel system, including accessories required for proper completion of work.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Capable of demonstrating that all wood procurement operations are conducted in accordance with procedures and policies of the Sustainable Forestry Initiative (SFI) Program.
- B. Code Compliance: Comply with requirements of the following:
 - 1. International Code Council (ICC), ICC-ESR1474 (ZIP System Wall Sheathing).
 - 2. International Code Council (ICC), ICC-ESR2227 (ZIP System Tape).
 - 3. Florida Building Code Compliance: Provide sheathing complying with Florida Building Code product and installation requirements for locations outside of high velocity wind zone.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Outdoor Storage: Comply with manufacturer's recommendations.
 - 1. Set panel bundles on supports to keep off ground.
 - 2. Cover panels loosely with waterproof protective material.
 - 3. Anchor covers on top of stack, but keep away from sides and bottom to assure adequate air circulation.
 - 4. When high moisture conditions exist, cut banding on panel stack to prevent edge damage.

1.08 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sheathing system that fail due to manufacturing defects within specified warranty period.
 - 1. Construction Period Warranty: Manufacturer shall warrant the panels and tape for weather exposure for a period of 180 days from installation.
 - 2. System Limited Warranty Period: 30 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

2.02 WOOD PANEL PRODUCTS

- A. Oriented Strand Board: DOC PS 2-10.
- B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated. Thickness shall satisfy minimum and maximum requirements for referenced performance category.
- C. Factory mark panels to indicate compliance with applicable standard.

2.03 COMBINATION WALL SHEATHING, WATER-RESISTIVE BARRIER, AND AIR BARRIER

- A. Oriented-Strand-Board Wall Sheathing: With integral water-resistive barrier, Exposure 1 sheathing.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Huber Engineered Woods LLC; ZIP System Wall Sheathing or a comparable product by one of the following:
 - 2. Span Rating, [Panel Grade](#) and Performance Category: Not less than 24/16; [Rated Sheathing](#); 7/16 Performance Category.
 - 3. Edge Profile: Square edge.
 - 4. Provide fastening guide on top panel surface with pre-spaced fastening symbols for 16-inches and 24-inches on centers spacings.
 - 5. Performance Standard: DOC PS2-10 and ICC-ES ESR-1474.
 - 6. Factory laminated integral water-resistive barrier facer.
 - 7. Perm Rating of Integral Water-Resistive Barrier: 12-16 perms.

8. Assembly maximum air leakage of 0.0072 cfm/sq. ft. infiltration and 0.0023 cfm/ sq. ft. exfiltration at a pressure differential of 1.57 psf.
9. Exposure Time: Designed to resist weather exposure for 180 days.

2.04 FASTENERS

- A. General: Provide fasteners of size and type that comply with requirements specified in this article by the authority having jurisdiction, International Building Code, International Residential Code, Wood Frame Construction manual, and National Design Specification.
 1. For wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.

2.05 MISCELLANEOUS MATERIALS

- A. Self-Adhering Seam and Flashing Tape: Pressure-sensitive, self-adhering, cold-applied, proprietary seam tape consisting of polyolefin film with acrylic adhesive.
 1. Basis-of-Design Product: Subject to compliance with requirements provide Huber Engineered Woods; ZIP System Tape or a comparable product by one of the following:
 2. Thickness: 0.012 inch (0.3 mm).
 3. Width: [3.75 inch (95.3 mm)] [6 inch (152.4 mm)].
 4. Code Compliance: Comply with requirements of authorities having jurisdiction and ICC Evaluation Service, Inc. "AC148 - Acceptance Criteria for Flexible Flashing Materials."
 5. International Code Council (ICC), ICC-ES2227 (ZIP System Tape).
 6. American Architectural Manufacturer's Association; AAMA 711.
- B. Liquid-Applied Flashing Membrane: Gun-grade, cold-applied, silyl-terminated polyether (STPE) liquid flashing membrane compatible with sheathing/weather barrier and self-adhering seam and flashing tape, and tested as part of an assembly meeting performance requirements. Follow manufacturer's recommendation for integration with ZIP System Tape.
 1. Basis-of-Design Product: Subject to compliance with requirements provide Huber Engineered Woods; ZIP System Liquid Flash or a comparable product by one of the following:
 2. Hardness, Shore A, ASTM C 661: 40 to 45
 3. Total Solids: 99 percent
 4. Tensile Strength, ASTM D412: 75 psi

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. ICC-ES ESR-1539 or NES NER-272 for power-driven fasteners.
 - 2. Chapter 23 in ICC's "International Building Code."
 - 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."
- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Only mechanically attached and drainable EIFS and exterior insulation should be used with ZIP System wall sheathing.

3.02 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in American Wood Council, "ASD/LRFD Manual for Engineered Wood Construction," 2012 edition for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Wall Sheathing:
 - a. Nail or staple to wood framing.
 - b. Screw to cold-formed metal framing.
 - c. Space panels 1/8 inch apart at edges and ends.
 - d. Install fasteners 3/8 inch to 1/2 inch from panel edges.
 - e. Space fasteners in compliance with requirements of authority having jurisdiction.

3.03 SHEATHING JOINT TREATMENT

- A. Seal sheathing joints according to sheathing manufacturer's written instructions.
 - 1. Apply ZIP System proprietary seam tape to joints between sheathing panels.
 - 2. Utilize ZIP System tape gun or hard rubber roller provided by manufacturer to ensure tape is completely adhered to substrates.
 - a. When using ZIP System Liquid Flash to seal sheathing joints, follow manufacturer's recommendations for sealing panel seams.

3.04 FLEXIBLE FLASHING INSTALLATION

- A. Apply ZIP System Tape flexible flashing or ZIP System Liquid Flash liquid applied flashing membrane where indicated to comply with manufacturer's written instructions.
 - 1. After flexible flashing tape has been applied, roll surfaces with a hard rubber to ensure that flashing is completely adhered to substrates.
 - 2. Width of Flexible Flashing: 6 inch.
 - a. Apply liquid-applied flashing membrane at penetrations, gaps, and cracks to form continuous weathertight surface. Apply liquid membrane according to manufacturer's written instructions. Follow manufacturer's recommendation for integration with ZIP System Tape.

END OF SECTION 07 27 23

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PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This Section covers the pre-finished, pre-fabricated Factory Manufactured Architectural Concealed attachment Metal Wall system. All metal trim, accessories, fasteners, insulation, and sealants indicated on the drawings as part of this section.
 - 1. Factory formed metal wall panels
- B. Related work specified elsewhere
 - 1. Metal Roof Deck: Division 5: Metal Decking
 - 2. Wood Framing and Decking: Division 6 Roof Carpentry Section
 - 3. Flashing and Trim: Division 7- Flashing and Sheet Metal
 - 4. Coping and Gravel Stops: Division 7 Roof Specialties and Accessories
 - 5. Sealants: Division 7 Joint Sealers Sections

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.
- C. Shop Drawings: Show layouts of metal panels. Include details of each condition of installation, panel profiles, and attachment to building. Provide details at a minimum scale 1-1/2-inch per foot of edge conditions, joints, fastener and sealant placement, flashings, openings, penetrations, and special details. Make distinctions between factory and field assembled work.
 - 1. Indicate points of supporting structure that must coordinate with metal panel system installation.
 - 2. Include structural data indicating compliance with performance requirements and requirements of local authorities having jurisdiction.
- D. Samples for Initial Selection: For each exposed product specified including sealants. Provide representative color charts of manufacturer's full range of colors.
- E. Samples for Verification: Provide 12-inch- long section of each metal panel profile. Provide color chip verifying color selection.

1.04 QUALITY ASSURANCE

- A. Manufacturer/Source: Provide metal panel assemblies and accessories from a single manufacturer accredited under IAS AC472, Part B.
- B. Manufacturer Qualifications: Approved manufacturer listed in this Section with minimum five years' experience in manufacture of similar products in successful use in similar applications.
 - 1. Approval of Comparable Products: Submit the following in accordance with project substitution requirements, within time allowed for substitution review:
 - a. Product data, including certified independent test data indicating compliance with requirements.
 - b. Samples of each component.
 - c. Sample shop drawings from similar project.
 - d. Project References: Minimum of five installations not less than three years old, with Owner and Architect contact information.
 - e. Sample warranty.
 - f. Certificate of accreditation under IAS AC472 Part B.
 - 2. Substitutions following award of contract are not allowed except as stipulated in Division 01 General Requirements.
 - 3. Approved manufacturers must meet separate requirements of Submittals Article.
- C. Installer Qualifications: Experienced Installer certified by metal panel manufacturer with minimum of five years' experience with successfully completed projects of a similar nature and scope.
 - 1. Installer's Field Supervisor: Experienced mechanic certified by metal panel manufacturer supervising work on site whenever work is underway.

1.05 WARRANTY

- A. Special Manufacturer's Warranty: On manufacturer's standard form, in which manufacturer agrees to repair or replace metal panel assemblies that fail in materials and workmanship within one year from date of Substantial Completion.
- B. Special Panel Finish Warranty: On Manufacturer's standard form, in which Manufacturer agrees to repair or replace metal panels that evidence deterioration of factory-applied finish within the warranty period, as follows:
 - 1. Fluoropolymer Two-Coat System:
 - a. Basis of Design System: MBCI, Signature 300.
 - b. Color fading in excess of 5 Hunter units per ASTM D 2244.
 - c. Chalking in excess of No. 8 rating per ASTM D 4214.
 - d. Failure of adhesion, peeling, checking, or cracking.
 - e. Warranty Period: 40 years from date of Substantial Completion.

1.06 PRODUCT HANDLING

- A. Ordering: Comply with manufacturer's ordering instruction and lead time requirements to avoid construction delays.
- B. Deliver components, sheets, metal soffit panels and other manufactured items so as not to be damaged or deformed. Package metal soffit panels for protection during transportation and handling.
- C. Unload, store and erect metal soffit panels in a manner to prevent bending, warping, twisting and surface damage.
- D. Stack metal wall panels on platforms or pallets, covered with suitable weathertight and ventilated covering.
- E. Store metal wall panels to ensure dryness. Do not store metal wall panels in contact with other materials that might cause staining, denting or other surface damage.
- F. Protect strippable protective coating on any metal coated product from exposure to sunlight and high humidity, except to the extent necessary for material installation.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Basis of Design Manufacturer: MBCI Metal Roof and Wall Systems, Division of NCI Group, Inc.; Houston TX. Tel: (877) 713-6224; Email: info@mbci.com
Web: www.mbc.com
 - 1. Provide basis of design product, or comparable product approved by Architect prior to bid.

2.02 PERFORMANCE REQUIREMENTS

- A. General: Provide metal panel system meeting performance requirements as determined by application of specified tests by a qualified testing facility on manufacturer's standard assemblies.

2.03 FORMED METAL WALL PANELS

- A. **Fluted-Rib-Profile, Concealed Fastener Metal Wall Panels:** Structural metal panels consisting of formed metal sheet with vertical panel edges and two 4-inch inverse batten flutes, with flush joints between panels, field assembled with nested lapped edges and attached to supports using concealed fasteners.
 - 1. Basis of Design: MBCI, Designer Series 16.0 Fluted Panel.
 - a. Nominal Thickness: 24 gage coated thickness, with smooth surface.
 - 1) Exterior Finish: Fluoropolymer two-coat color system.

- 2) Color: As selected by Architect from manufacturer's standard colors.
2. Panel Width: 16 inches.
3. Panel Thickness: 1-3/4 inch.

2.04 MISCELLANEOUS MATERIALS

- A. General: Provide complete metal panel assemblies incorporating trim, copings, fasciae, gutters and downspouts, and all related miscellaneous flashing. Provide required fasteners, closure strips, and sealants as indicated in manufacturer's written instructions.
- B. Flashing and Trim: Match material, thickness, and finish of metal panels.
- C. Panel Fasteners: Self-tapping screws and other acceptable fasteners recommended by metal panel manufacturers. Where exposed fasteners cannot be avoided, supply corrosion-resistant fasteners with heads matching color of metal panels by means of factory-applied coating, with weathertight resilient washers.

2.05 FABRICATION

- A. General: Provide factory fabricated and finished metal panels, trim, and accessories meeting performance requirements, indicated profiles, and structural requirements.
- B. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's written instructions, approved shop drawings, and project drawings.

2.06 FINISHES

- A. Finishes, General: Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- B. Fluoropolymer Two-Coat System: 0.2 - 0.3 mil primer with 0.7 - 0.8 mil 70 percent PVDF fluoropolymer color coat, AAMA 621, meeting solar reflectance index requirements.
 1. Basis of Design: MBCI, Signature 300.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine metal panel system substrate with Installer present. Inspect for erection tolerances and other conditions that would adversely affect installation of metal panels.
 1. Inspect framing that will support insulated metal panels to determine if support components are installed as indicated on approved shop drawings and are within tolerances acceptable to metal panel manufacturer and installer. Confirm presence of acceptable framing members at recommended spacing to match installation requirements of metal panels.

- B. Correct out-of-tolerance work and other deficient conditions prior to proceeding with insulated metal panel installation.

3.02 METAL PANEL INSTALLATION

- A. Concealed-Fastener Formed Metal Panels: Install metal panel system in accordance with manufacturer's written instructions, approved shop drawings, project drawings, and referenced publications. Install metal panels in orientation, sizes, and locations indicated. Anchor panels and other components are securely in place. Provide for thermal and structural movement.
- B. Fasten metal panels to supports with fasteners at each location indicated on approved shop drawings, at spacing and with fasteners recommended by manufacturer. Fasten panel to support structure through leading panel flange. Snap-fit back flange of subsequent panel into secured flange of previous panel. Where indicated, fasten panels together through flush-fitted panel sides.
 - 1. Cut panels in field where required using manufacturer's recommended methods.
 - 2. Dissimilar Materials: Where elements of metal panel system will come into contact with dissimilar materials, treat faces and edges in contact with dissimilar materials as recommended by metal panel manufacturer.
- C. Attach panel flashing trim pieces to supports using recommended fasteners.

3.03 ACCESSORY INSTALLATION

- A. General: Install metal panel accessories with positive anchorage to building and weather tight mounting; provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal panel assembly, including trim, copings, flashings, sealants, closure strips, and similar items.
 - 2. Comply with details of assemblies utilized to establish compliance with performance requirements and manufacturer's written installation instructions.
 - 3. Set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently weather resistant.

3.04 CLEANING AND PROTECTION

- A. Clean finished surfaces as recommended by metal panel manufacturer.
- B. Replace damaged panels and accessories that cannot be repaired to the satisfaction of the Architect.

END OF SECTION 07 42 13.13

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PART 1 GENERAL

1.01 SECTION INCLUDES

- A. TPO roofing membrane for new construction applications.
 - 1. Cover boards.
 - 2. Insulation.
 - 3. Vapor retarder.
 - 4. Deck sheathing.
 - 5. Roof pavers.
- B. Disposal of demolition debris and construction waste is the responsibility of the contractor. Perform disposal in manner complying with all applicable federal, state, and local regulations.
- C. Commencement of work by the Contractor shall constitute acknowledgment by the Contractor that this specification can be satisfactorily executed, under the project conditions and with all necessary prerequisites for warranty acceptance by roofing membrane manufacturer. No modification of the Contract Sum will be made for failure to adequately examine the Contract Documents or the project conditions.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood nailers, curbs, and blocking.
- B. Section 07 60 00 - Flashing and Sheet metal: Manufactured copings, fascias, gravel stops, and other flashing-related items.
- C. Section 07 71 13 - Manufactured Coping: Manufactured copings, fascias, gravel stops, and other flashing-related items.
- E. Section 07 76 16 - Roof Deck Pedestal System: Roof mounted pavers and pedestals.

1.03 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- B. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
- C. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.

- D. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board.
- E. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- F. ASTM C1278/C1278M - Standard Specification for Fiber-Reinforced Gypsum Panel.
- G. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
- H. ASTM D41/D41M - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
- I. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
- J. ASTM D2178/D2178M - Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.
- K. ASTM D4897/D4897M - Standard Specification for Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing.
- L. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin-Based Sheet Roofing.
- M. ASTM D7877 - Standard Guide for Electronic Methods for Detecting and Locating Leaks in Waterproof Membranes.
- N. ASTM D8231 - Standard Practice for the Use of a Low Voltage Electronic Scanning System for Detecting and Locating Breaches in Roofing and Waterproofing Membranes.
- O. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.
- P. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.
- Q. ASTM G155 - Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials.
- R. FM (AG) - FM Approval Guide.
- S. FM 4470 - Examination Standard for Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction.

- T. FM 4474 - American National Standard for Evaluating the Simulated Wind Uplift Resistance of Roof Assemblies Using Static Positive and/or Negative Differential Pressures.
- U. FM DS 1-28 - Wind Design.
- V. NRCA (RM) - The NRCA Roofing Manual.
- W. NRCA (WM) - The NRCA Waterproofing Manual.
- X. SPRI RP-4 - Wind Design Standard for Ballasted Single-Ply Roofing Systems.
- Y. UL (DIR) - Online Certifications Directory.
- Z. UL (FRD) - Fire Resistance Directory.
- AA. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies.
- BB. UL 1897 - Uplift Tests for Roof-Covering Systems; Underwriters Laboratories Inc.

1.04 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.
- C. Shop Drawings: Include roof plans and details showing terminations, all relative flashing, penetrations, attachment methods, tie-ins, and interface with adjacent work.
 - 1. Indicate insulation thicknesses and slopes.
 - 2. Include project-specific tapered insulation layout prepared by roofing manufacturer.
 - 3. Roof plan indicating orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system, if applicable.
- D. Samples for Verification: Submit two samples 6 by 6 inches in size of roof membrane and insulation.
- E. Manufacturer's Letter: Certify products meet or exceed specified requirements.
- F. Wind Uplift Resistance Submittal: Indicate compliance with wind uplift performance requirements.
- G. Field Quality Control Submittals: Field testing and inspection reports.
- H. Manufacturer's qualification statement.
- I. Installer's qualification statement.

- J. Testing firm's qualification statement.
- K. - Not used -
- L. Sustainable Design Information:
 - 1. Environmental product declaration (EPD) documentation.
 - 2. Health product declaration (HPD) documentation.
 - 3. Test report showing solar reflectance index (SRI) of membrane.
 - 4. Recycled content certificates.
 - 5. VOC content of adhesives, sealants, and coatings.
 - 6. Materials transparency documentation.
- M. Specimen Warranty or Guarantee: For approval.
- N. Executed Warranty or Guarantee.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of this section with at least three years of documented experience and approved by manufacturer for specified warranty.
- C. Testing Firm Qualifications: Company specializing in performing work of the type specified and approved by manufacturer.

1.06 DELIVERY, STORAGE AND HANDLING

- A. See Section 01 74 23 - Final Cleaning.
- B. Deliver materials in manufacturer's original containers, dry and undamaged, with seals unbroken and labels intact, unless otherwise indicated.
- C. Store materials in weather protected environment, clear of ground and moisture, and within temperature range required by manufacturer.
- D. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.
- E. Protect liquids and foam insulation from direct exposure to sunlight.

1.07 FIELD CONDITIONS

- A. Contact roofing manufacturer to confirm acceptable assemblies for special applications. Conform with manufacturer's instructions.

- B. Do not apply roofing membrane during unsuitable weather.
- C. Do not apply roofing materials when ambient temperature is below 40 degrees F (5 degrees C) unless otherwise permitted by manufacturer in writing.
- D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be covered the same day.
- F. Schedule applications so no partially completed sections of roof are left exposed at end of workday.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Material Warranty: Provide membrane manufacturer's limited warranty agreeing to replace material that leaks due to manufacturing defects within 20 years.
 - 1. Warranty: GAF Limited Warranty on GAF Single-Ply Roofing Materials.
- C. Enhanced Material Warranty: Provide membrane manufacturer's limited warranty agreeing to replace material that leaks due to manufacturing defects and cost of labor to correct leaks within 30 years.
 - 1. Warranty: GAF Integrated System Limited Warranty.
- D. System Guarantee: Provide manufacturer's system guarantee.
 - 1. Guarantee: GAF EverGuard® Diamond Pledge NDL Roof Guarantee.
 - 2. Term: 30 years.
 - 3. Liability Limit: No dollar limit on covered repairs.
 - 4. Scope of Coverage:
 - a. Repair of covered leaks resulting from manufacturing defects, ordinary wear and tear, or workmanship in applying the covering materials, subject to certain exclusions.
 - b. Leaks due to winds up to 72 mph, excluding hurricanes and tornados.
 - c. Hail up to 2 inches in diameter.
 - d. Provide GAF Well Roof Extension for a term up to 25 percent of the original guarantee duration (up to maximum duration of 35 years) when roofing system is inspected and maintained in accordance with manufacturer's terms and conditions.
- E. Extended Correction Period: Correct defective work within 2-year period commencing on date of Substantial Completion.
- F. Existing Roofing Alterations: Submit statement from existing roof membrane manufacturer that existing roof warranty has not been affected by work performed under this section.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design:
1. GAF; 1 Campus Drive; Parsippany, NJ 07054; Toll Free Tel: 877-423-7663; Email: designservices@gaf.com: www.gaf.com .
Alternate roofing systems allowed:
 - a. Versico VersiWeld® TPO www.versico.com
 - b. Carlisle Sure-Weld® TPO www.carlisesyntec.com
 - c. Johns Manville TPO www.jm.com
 - d. Elevate UltraPly™ TPO www.elevatecommercialbp.com
 2. Substitutions: See Section 01 33 00 - Submittal and Substitution Procedures.
- B. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.

2.02 ROOFING SYSTEM

- A. Roofing System Description: Listed from top of roof down.
1. Single Ply Membrane: Adhered.
 2. Cover Board: Fiber-reinforced gypsum board mechanically fastened.
 3. Insulation: Minimum two layers, having maximum board thickness of 2 inches.
 - a. Total System R-value (RSI-value): Minimum R-value as indicated in drawings.
 - b. Slope: Provide minimum slope of 1/4 inch per foot by means of tapered insulation.
 - c. Top Layers: Polyisocyanurate foam board, noncomposite; adhered.
 - d. Bottom Layer: Polyisocyanurate foam board, non-composite; adhered.
 - e. Crickets: Tapered insulation of same type as specified for top layer; minimum slope of 1/4 inch per foot unless otherwise indicated in drawings.
 4. Vapor Retarder: NA.
 5. Deck Sheathing: Fiber-reinforced gypsum board.
- B. Performance Requirements:
1. General: Roofing system to withstand specified uplift pressures, thermally induced movement, and exposure to ordinary weather conditions.
 2. Material Compatibility: Provide roofing materials and accessories compatible with one another under conditions of service and application, as demonstrated by roof membrane manufacturer based on testing and field experience.
 3. Wind Uplift Resistance: Design to withstand wind uplift forces in accordance with applicable local building code requirements as demonstrated by roofing manufacturer's independent testing.
 - a. Roofing System: Tested in accordance with FM 4474, UL 580, or UL 1897.
 - b. Design Pressures: As indicated in Structural Drawings.

4. Solar Reflectance Index (SRI): Three-year-aged SRI not less than 64, when calculated in accordance with ASTM E1980.
5. Roof Covering External Fire Resistance Classification: Class A when tested per UL 790.
6. Factory Mutual Classification: Provide roofing system listed in FM Approvals RoofNav, and having membrane, base flashings, and component materials complying with FM 4450.
 - a. Fire and Windstorm Classification: Class 1A and windstorm resistance to be in accordance with FM DS 1-28.
 - b. Hail Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34 MH.

2.03 MEMBRANE MATERIALS

- A. Membrane:
 1. TPO Membrane: Thermoplastic polyolefin sheet complying with ASTM D6878/D6878M with internally reinforced scrim.
 - a. Smooth Membrane: 60 mil, 0.060 inch nominal TPO thickness.
 2. Impact Resistance: Membrane to resist impact damage when tested in accordance with the "Resistance to Foot Traffic Test" in FM 4470.
 3. Color: Gray 345 (no min. order).
 4. Products:
 - a. GAF EverGuard® TPO Membrane: www.gaf.com.
 - b. Substitutions: See Section 01 33 00 - Submittal and Substitution Procedures.
- B. Membrane Attachment: Spray bonding adhesive as recommended by roofing manufacturer.
 1. VOC Content: Maximum 90 g/L.
- C. Membrane Fasteners: Membrane manufacturer's recommended type.
- D. Flexible Flashing: Manufacturer's standard TPO sheet flashing matching primary membrane in type and color, minimum 55 mil, 0.055 inch thickness.

2.04 COVER BOARDS

- A. Cover Board: Glass-mat faced gypsum board complying with ASTM C1177/C1177M.
 1. Thickness: 1/4 inch.
 2. Surface Finish: Factory Primed.
 3. Products:
 - a. Georgia-Pacific; DensDeck® Prime with EONIC™ Technology: www.buildgp.com.
 - b. Georgia-Pacific; DensDeck® StormX™ Prime: www.buildgp.com.
 - c. Gold Bond Building Products, LLC provided by National Gypsum Company; DEXcell® FA Glass Mat Roof Board: www.goldbondbuilding.com.

- d. Gold Bond Building Products, LLC provided by National Gypsum Company; DEXcell® FA VSH Glass Mat Roof Board: www.goldbondbuilding.com.
- e. USG Corporation; Securock® Ultralight Glass-Mat Roof Board: www.usg.com. USG Corporation; Securock® Ultralight Coated Glass-Mat Roof Board: www.usg.com.
- f. Substitutions: See Section 01 33 00 - Submittal and Substitution Procedures.

E. Fasteners: As recommended and approved by roofing manufacturer.

2.05 INSULATION

- A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
 - 1. Classification: Type II, Class 2 - Faced with coated glass fiber mat facers on both major surfaces of the core foam.
 - 2. Mold Growth Resistance: Passing ASTM D3273.
 - 3. Compressive Strength: Grade 2, 20 psi minimum.
 - 4. Board Size: 48 by 96 inches or 48 by 48 inches.
 - 5. Tapered Board: Same type as primary roof insulation.
 - 6. Products:
 - a. GAF; EnergyGuard® Polyiso Insulation: www.gaf.com.
 - b. GAF; EnergyGuard® Barrier Polyiso Insulation: www.gaf.com.
 - c. GAF; EnergyGuard® Ultra Polyiso Insulation: www.gaf.com.
 - d. GAF; EnergyGuard® NH Polyiso Insulation: www.gaf.com.
 - e. GAF; EnergyGuard® NH Barrier Polyiso Insulation: www.gaf.com.
 - f. GAF; EnergyGuard® NH Ultra Polyiso Insulation: www.gaf.com.
 - g. Substitutions: See Section 01 33 00 - Submittal and Substitution Procedures.
- B. Adhesive Attachment: Low rise foam as recommended by roofing manufacturer.

2.06 ACCESSORIES

- A. **Miscellaneous Accessories:** Provide pourable sealers, primers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.
- B. Prefabricated Roofing Expansion Joint: Type approved by roofing manufacturer. See Section 07 91 00 - Preformed Joint Seals.
- C. Prefabricated Flashing Accessories: Same material as membrane in manufacturer's standard thicknesses, including:
 - 1. Inside corners, outside corners, universal corners, and fluted corners.
 - 2. Square tube wraps.
 - 3. Conical pipe boots and split pipe boots.
 - 4. Pourable sealer pockets.

- 5. T-Joint cover patches.
- D. Wood Nailers, Curbs, and Blocking: See Section 06 10 00.
- E. **Fasteners:** Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.
- F. **Termination Bars:** Aluminum bars with integral caulk ledge; 1.3 inches wide by 0.1 inch thick.
- G. **Sealants:** As recommended by membrane manufacturer.
- H. **Thinners and Cleaners:** As recommended by adhesive manufacturer, compatible with membrane.
- I. **Welded Flexible Walkways:** Heavy-duty, slip-resistant, textured TPO walkway roll, suitable for maintenance traffic and visually distinctive from roof membrane.
 - 1. Roll Width: 34 inches.
 - 2. Surface Color: Gray (verify).
 - 3. Products:
 - a. GAF EverGuard® TPO Walkway Roll: www.gaf.com.
 - b. Substitutions: See Section 01 33 00 - Submittal and Substitution Procedures.
- j. **Retrofit Roof Drains:** Provide Johns Manville Heavy-Duty TPO RetroDrain® with U-Flow® Mechanical Seal, Aluminum Roof Drain Assembly or approved equal. Product is a one-piece spun aluminum body with TPO-coated flange and depressed sump area used to replace existing drains in re-roofing applications. Refer to JM applicator guides or detail drawings for instructions.

2.07 SUSPENDED COVER

- A. Provide TuffWrap® SmartSeam® installed under roof deck to help prevent dust and debris from falling inside the building. Shall meet IBC EC 043-2020, NFPA 13, ASTM E84 Class A, FM-4652 and UL 723S compliance standards. Approved to be installed under fire sprinklers during re-roofing. Tel.: 800-995-4556. Email: www.tuffwrap.com

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secure.

- C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
- D. Verify deck surfaces are dry and free of moisture, snow or ice.
- E. Verify roof openings, curbs, and penetrations through roof are solidly set, and nailing strips are in place.
- F. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION - WOOD DECK

- A. Verify wood deck conforms with manufacturer's minimum requirements.
 - 1. Minimum Thickness: 15/32-inch for wood sheathing or nominal 1 x 4-inch for wood planks.
 - 2. Oriented Strand Board (OSB): Structural 1 rated.
 - 3. Wood Joist Spacing: Not exceeding 24 inches on center.
 - 4. Sheathing: Installed with all four sides bearing on and secured to joists and cross blocking. "H" clips are not acceptable.
- B. Verify flatness and tightness of joints in wood decking; fill knot holes with latex filler.
- C. Confirm dry deck by moisture meter with [12] <Insert number> percent moisture maximum.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 PREPARATION - CONCRETE DECK

- A. Cure concrete until specified compressive strength is achieved.
- B. Grout joints in precast concrete roof decks flush with top of concrete.
- C. Clean concrete of curing compounds that would impair adhesion of roofing components.
- D. Verify concrete is visibly dry and free of moisture.
- E. Fill surface honeycomb and variations with latex filler.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.04 PREPARATION - METAL DECK

- A. Verify metal deck conforms with manufacturer's minimum requirements.
 - 1. Minimum Uncoated Thickness: 22 gauge.
 - 2. Galvanized Coating: Minimum G90/Z275.

3. Meeting the gauge and span requirements in the current Factory Mutual FM Approval Guide and installed in accordance with Loss Prevention Data Sheet 1-28 or specific FM approval.
 4. Re-roofing Over Existing Metal Decks: Remove surface corrosion and repair severely corroded areas. Fasten loose or inadequately secured decking and replace defective decking.
- B. Verify surface plane flatness and fastening of steel roof deck complies with requirements in Section 05 30 00 - Metal Decking.
 - C. Acoustical Decking: Install sound-absorbing insulation strips in accordance with acoustical roof deck manufacturer's instructions.
 - D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.05 PREPARATION - CEMENTITIOUS WOOD-FIBER

- A. Verify damaged sections of cementitious wood-fiber decks have been repaired or replaced.
- B. Verify adjacent cementitious wood-fiber panels are vertically aligned to within 1/8 inch (3.2 mm) at top surface.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.06 INSTALLATION, GENERAL

- A. Perform work in accordance with manufacturer's instructions [and FM Approvals RoofNav] .
- B. Do not apply roofing components during cold or wet weather conditions outside of manufacturer's approved conditions.
- C. Do not apply roofing membrane when ambient temperature is outside of manufacturer's required temperature range.
- D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be covered the same day.
- F. Coordinate this work with installation of all associated counter-flashing installed by other sections as work of this section proceeds.
- G. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty or guarantee for existing roofing system.

- H. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- I. Install night seal at end of each workday or when rain is forecast. Provide temporary seals to prevent water from entering completed sections of roofing system. Ensure stagger and offset of underlying insulation to prevent thermal breaks. Remove and discard temporary seals before beginning work on adjoining roofing.

3.07 INSTALLATION - INSULATION

- A. Installation Over Metal Deck: Attach insulation in accordance with roofing manufacturer's instructions. Where insulation is installed directly over metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.
 - 1. Base Layer: Mechanically fasten base layer of insulation using fasteners specifically designed and sized for fastening specified roof insulation to metal decks.
 - 2. Base Layer: Embed base layer of insulation into ribbons of insulation adhesive.
 - 3. Base Layer: Loosely lay base layer of insulation units over substrate to be simultaneously fastened with top layer or cover board.
 - 4. Upper Layers: Adhere upper layers of insulation using insulation adhesive.
 - 5. Upper Layers: Set upper layers of insulation in solid mopping of hot roofing asphalt.
 - 6. Upper Layers: Mechanically fasten top layer of insulation using fasteners specifically designed and sized for fastening specified roof insulation to metal decks.
 - 7. Upper Layers: Loosely lay upper layers of insulation units to be simultaneously fastened with cover board
- B. Installation Over Wood and Wood Panel Decking: Attach insulation in accordance with roofing manufacturer's instructions.
 - 1. Slip Sheet: Mechanically fasten slip sheet to roof deck using mechanical fasteners specifically designed and sized for fastening slip sheet wood decks.
 - 2. Base Layer: Mechanically fasten base layer of insulation using fasteners specifically designed and sized for fastening specified roof insulation to wood decks.
 - 3. Base Layer: Embed base layer of insulation into ribbons of insulation adhesive.
 - 4. Base Layer: Set base layer of insulation in solid mopping of hot roofing asphalt applied to slip sheet.
 - 5. Base Layer: Loosely lay base layer of insulation units over substrate to be simultaneously fastened with top layer or cover board.
 - 6. Upper Layers: Adhere upper layers of insulation using insulation adhesive.
 - 7. Upper Layers: Set upper layers of insulation in solid mopping of hot roofing asphalt.
 - 8. Upper Layers: Mechanically fasten top layer of insulation using fasteners specifically designed and sized for fastening specified roof insulation to wood decks.

9. Upper Layers: Loosely lay upper layers of insulation units to be simultaneously fastened with cover board.
- C. Installation over Concrete Decks: Attach insulation in accordance with roofing manufacturer's instructions [and FM (AG) Factory Mutual requirements].
1. Base Layer: Mechanically fasten base layer of insulation using fasteners specifically designed and sized for fastening specified roof insulation to concrete decks.
 2. Base Layer: Embed base layer of insulation into ribbons of insulation adhesive.
 3. Base Layer: Set base layer of insulation in solid mopping of hot roofing asphalt.
 4. Base Layer: Loosely lay base layer of insulation units over substrate to be simultaneously fastened with top layer or cover board.
 5. Upper Layers: Adhere upper layers of insulation using insulation adhesive.
 6. Upper Layers: Set upper layers of insulation in solid mopping of hot roofing asphalt.
 7. Upper Layers: Mechanically fasten top layer of insulation using fasteners specifically designed and sized for fastening specified roof insulation to concrete decks.
- D. Lay subsequent layers of insulation with joints staggered from joints of preceding layer in accordance with manufacturer's instructions.
- E. Place tapered insulation to required slope pattern in accordance with manufacturer's instructions.
- F. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- G. At roof drains, slope insulation down to roof drains with each side equal to the diameter of the drain bowl plus 36 inches (914 mm).
- H. Do not install more insulation than can be covered with membrane in same day.

3.10 INSTALLATION - COVER BOARD

- A. Install cover board over insulation with joints staggered from joints of insulation in accordance with manufacturer's instructions.
- B. Trim cover board neatly to fit around penetrations and projections as directed by cover board manufacturer.
- C. Mechanical Attachment: Fasten cover board in accordance with manufacturer's instructions.

3.11 INSTALLATION - MEMBRANE

- A. Install membrane and all related flashing in accordance with roofing system manufacturer's instructions.
- B. Roll out membrane, free from wrinkles or tears.
- C. Accurately align roof membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Shingle joints on sloped substrates in direction of drainage where possible.
- D. Adhered Application:
 - 1. Adhesive: Apply adhesive at prescribed rate and in conformance with manufacturer's instructions. Bond membrane and apply pressure by means required by manufacturer. Adhere one roll before proceeding to adjacent rolls. Avoid trapping air between membrane and substrate.
 - 2. Hot Roofing Asphalt: Apply solid mopping of asphalt at temperature and rate required by manufacturer and install fleece-backed membrane.
 - 3. In addition to adhering, mechanically fasten roof membranes securely at terminations, penetrations, and perimeter of roofing.
- E. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and all related sheet flashing. Test lap edges with probe to verify seam weld continuity in accordance with manufacturer's technical bulletins.
- F. At intersections with vertical surfaces terminate and seal top of all related sheet flashing with termination bars secured to nailing strips or structural backing or in conformance with roofing manufacturer's approved details.
 - 1. Insert flashing into reglets and secure.
- G. Extend membrane under copings, facias, gravel stops, edge metals, and secure to outside face of wall.
- H. Around roof penetrations, seal flanges and flashings with flexible flashing.
- I. Install roofing expansion joints where indicated. Make joints watertight.
- J. Coordinate installation of roof drains and all related flashing. Terminate membranes according to manufacturer's approved details. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.
- K. Walkways: Install walkways in accordance with roofing system manufacturer's instructions at the following locations. Provide manufacturer's minimum clearance between units.
 - 1. Perimeter of each rooftop unit.
 - 2. Between each rooftop unit location, creating continuous paths connecting rooftop unit locations.

3. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
4. Top and bottom of each roof access ladder.
5. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
6. Locations indicated on Drawings.
7. Other locations required by roof membrane manufacturer's requirements.

3.14 FIELD QUALITY CONTROL

- A. See Section 01 45 23 - Testing and Inspection Services: Quality Requirements for independent field testing and inspection requirements, and requirements for monitoring quality of specified product installations.
- B. Provide regular on-site attendance of roofing manufacturer's representative during installation of this work.
 1. Perform fastener-pullout tests in accordance with roof system manufacturer's requirements. Submit test results to manufacturer and Architect within 24 hours after performing tests.
 2. Probe heat welded seams and test seams in accordance with manufacturer's recommendations.
- C. Repair or remove and replace components of roofing system where tests or inspections indicate they do not comply with specified requirements. Perform repairs using manufacturer's approved repair procedures.
- D. Perform additional testing and inspecting at Contractor's expense to determine if repaired or additional work complies with specified requirements.

3.15 CLEANING

- A. See Section 01 78 00 - Closeout Submittals: Execution and Closeout Requirements for additional requirements.
- B. Properly dispose of all product wrappers, pallets, cardboard, scrap, waste and debris. Replace damaged material with new materials.
- C. Clean adjacent construction where soiled by work of this section. Comply with manufacturer of adjacent construction's instructions and procedures.

3.16 PROTECTION

- A. Protect installed roofing system from construction operations.
- B. Correct deficiencies in work in accordance with warranty requirements. Repair or replace defaced or damaged finishes caused by work of this section.

END OF SECTION 07 54 23

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Furnish and install metal flashing and sheet metal work specified.
 - 1. Flashing and Counter-flashing
 - 2. Gutter with Leaf Screen Gutter Guard and Downspouts and Splashblocks
 - 3. Drip Edge
 - 4. Trim
 - 5. Cricket
 - 6. Chase Cover
 - 7. Louvers
 - 8. Other work indicated and required by project

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

- A. Job Supervision: Applicator of work in this Section to furnish competent, qualified foreman present and in charge at all times work is performed.
- B. Applicable Standards:
 - 1. ANSI/SPRI/FM 4435/ES-1-11 "Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems", and NRCA Guidelines for Complying With Building Codes Using ANSI/ SPRI ES-1. Provide shop drawings, to include wood blocking, to meet this standard or certified third party test data for gravel stop, fascia profiles and coping. Refer to the drawings for design wind load parameters. Include wind loads for roof area perimeters and corners on submittals.
 - 2. Refer to the current edition of the "Architectural Sheet Metal Manual" of the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA). Use as applicable standard for method and quality of work under this Section where not specifically otherwise shown in Contract Documents. Manufacturer to provide trained metal craftsmen to supervise installation.

3. ASCE 7: Minimum Design Loads for Buildings and Other Structures.
4. ANSI/SPRI GT-1 R2022 - Test Standard for External Gutter Systems per Arkansas Code or the 2021 (or current) International Building Code.

1.05 WARRANTY

- A. Provide manufacturer's guarantee for exterior color finish for a period of 20 years against blistering, peeling, cracking, flaking, checking, chipping and excessive color change and chalking. Color change not to exceed 5 NBS units (per ASTM D-2244.64T) and chalking not less than rating of 8 per ASTM D-659.
- B. Guaranty: Guaranty sheet metal work installed under this Section against leakage or defects for 2 years after substantial completion date. Make good at Contractor expense leakage or defects occurring within this period.

PART 2 - PRODUCTS

2.01 SHEET METAL

- A. G-60 Galvalume Steel: Aluminum-zinc alloy coating AZ50, meeting ASTM A792. Keep Galvalume dry during transit, in storage, and at work site.
 1. At locations where flashing is visible from outside building, finish to be Kynar 500® based polyvinylidene fluoride (PVDF) coating, 70% resin formulation in color to be selected by Architect from manufacturer's complete line.
 - a. Primer is applied to 0.20 - 0.30 mils DFT (Dry Film Thickness) and the topcoat at 1.0 - 1.2 mils DFT.
 - b. Approved equal: Hylar 5000®.
 2. Provide mill finish at locations not visible from outside building or public view.
- B. G-90 Bare Galvanized Steel: Conform to ASTM A525 General Requirements and to ASTM A526, Commercial Quality for hot-dip galvanizing (HDG) process. Zinc coating weight not less than 1-1/4 ounces per square foot nor more than 1-1/2 ounces per square foot of surfaces covered and conforming to ASTM A90, Table X1.1, measurement.
- C. Aluminum Sheet: Provide 3003-0 alloy for flashings. For all other sheet metal work furnish 3003-14 alloy.
 1. Factory finish with oven cured Kynar 500® based polyvinylidene fluoride (PVDF) coating, 70% resin formulation in color to be selected by Architect from manufacturer's complete line.
 - a. Primer is applied to 0.20 - 0.30 mils DFT (Dry Film Thickness) and the topcoat at 1.0 - 1.2 mils DFT.
 - b. Approved equal: Hylar 5000®.
- D. Soft Temper Sheet Metal: Lead sheet, F.S. QQ-L-201, Grade B, 4 lb. per sq. ft.

- E. Gauge of Metal:
 - 1. Metal components of a roof assembly: 24 gauge (USS .025") minimum
 - 2. Scuppers, guttering, down spouts and splash pans (roof locations): 22 gauge (USS .0312") minimum. Gutter straps to be 18 gage.
 - 3. Through-Wall Flashing: 26 gauge minimum

2.02 GUTTER SYSTEM

- A. Provide accessories for complete installation including end pieces, caps, elbows, outlet tubes, mitres, hangers and basket type strainers. Conform to ANSI/SPRI GT-1 2016 (R2022) - Test Standard for External Gutter Systems per Arkansas Code (2021 IBC).
 - 1. Thru-Wall Scuppers with Conductor Heads: Metal-Era Style 3, Welded, Dropped Collector Box Version or approved equal.
 - 2. Box Downspout: 4" x 6", up to 11" x 11", with mitred elbows. Verify sizing.
- B. Manufactured from Aluminum in minimum 10 foot lengths, tapered and notched to provide a 1" telescoping lap joint. Seal watertight, and secure with 1/8" rivets, or join sections with flat locked soldered seams.
- C. Make leaders (downspouts) with 1-1/2" telescoped joints or full length without joints. Set leaders plumb, clear of walls. Secure with straps not over 6 feet apart and space so one is near top and another near bottom.
- D. Finish: Kynar 500 based polyvinylidene fluoride (PVDF) coating, 70% resin formulation in color to be selected by Architect from manufacturer's standard line.

2.03 ACCESSORIES

- A. Fasteners: All metal counter flashing and parapet cap flashing shall be attached with galvanized or cadmium plated screws with neoprene washers. Nails, screws and rivets used at other locations are to be the appropriate type for the purpose as described in the latest edition of the SMACNA Design Manual.
- B. Solder for Lead: ASTM B 32, 50% tin and 50% lead used with rosin flux.
- C. Roofing Cement: F.S. SS-C-153, Type I, Class A (summer grade) or Class B (winter grade) as applicable.
- D. Bitumastic Coating: F.S. TT-C-494, MIL-C-18480, or SSPC - Paint 12, cold applied solvent type bitumastic coating for application in dry film thickness of 15 mils per coat.
- E. Splash Blocks: Provide 36" long x 11-1/2" wide x 2-3/4" high High Strength Concrete as manufactured by Nitterhouse Masonry Products, LLC, (717) 268-4137 or approved equal at each Down Spout location or as indicated on the drawings.
 - 1. Plastic or composite splash blocks will not be allowed.

2.05 FABRICATION

- A. Fabricate all metal flashing, counter-flashing, trim and related items to comply with profiles and sizes required. Fabricate to comply with the latest edition of the SMACNA "Architectural Sheet Metal Manual", metal manufacturer's recommendations, and recognized industry practices.
- B. For continuous running work, fabricate with expansion joints in flashing, spaced sufficiently close to prevent flashing damage and failure in resistance to water penetration. Form flashing to fit substrate in each application.
- C. Where sheet metal is required and no material or gauge is indicated on the Drawings, furnish and install highest quality and gauge commensurate with the referenced applicable standard, (SMACNA Manual, latest edition).

2.06 OTHER MATERIALS

- A. Provide materials, not specifically described but required for complete and proper installation of flashing and sheet metal, of new materials, first quality of their respective kinds, and subject to approval of Architect.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

- A. Inspection: Prior to work of this Section, carefully inspect installed work of other trades and verify work is complete to point where this installation may properly commence.
- B. Discrepancies: Do not proceed with sheet metal installation in areas of discrepancy until discrepancies are resolved.

3.02 WORKMANSHIP

- A. General: Form sheet metal accurately to dimensions and shapes required, watertight and weather-tight, with angles and broken surfaces true, sharp, and in straight lines. Where intercepting other members, cope to an accurate fit and solder securely. Produce flat surfaces free from waves and buckles.
- B. Expansion: Allow a 3/8"-1/2" gap in coping caps between each section. Use 3-1/2" wide pre-finished 24 gage cover plate over joints.
 - 1. Set cover plates in visible bead of polyurethane sealant between the cap and cover plate. Wipe joints of excessive sealant.
 - 2. Attach cover plate at the front and back with hex head cadmium screws with neoprene washers, installed in the gap between the metal cap sections.
 - 3. Do not exceed maximum length of 10'-0" for cap, fascia and flashing sections. Furnish with factory formed slots or enlarged holes for fasteners.

- C. Paint metal in contact with mortar, concrete, and masonry materials with an alkali-resistant coating. Use heavy-bodied bituminous paint or approved equal.

3.03 THROUGH-WALL FLASHING

A. General:

1. Install continuous through-wall flashing.
2. Where exposed portions are used as a counter-flashing, lap base flashing at least four inches and use thickness of metal as specified for exposed locations.
3. Exposed edge of flashing may be formed as a receiver for two piece counter flashing.
4. Terminate exterior edge beyond face of wall approximately 1/4-inch with drip edge where not part of counter flashing.
5. Turn back edge up 1/4-inch unless noted otherwise where flashing terminates in mortar joint or hollow masonry unit joint.
6. Terminate interior raised edge in masonry backup unit approximately 2 inches into unit unless shown otherwise.
7. Under coping terminate both edges beyond face of wall approximately 1/4-inch with drip edge.
8. Lap end joints not less than four inches. Seal laps with sealant.
9. Where dowels, reinforcing bars and fastening devices penetrate flashing, seal penetration with sealing compound.
10. Coordinate with other work to set in a bed of mortar above and below flashing so that total thickness of the two layers of mortar and flashing are same as regular mortar joint.
11. Where ends of flashing terminate turn ends up 1 inch and fold corners to form dam extending to wall face in vertical mortar or veneer joint.
12. Turn flashing up not less than 8 inches between masonry wythes or behind exterior veneer.

END OF SECTION 07 60 00

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PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Exposed Flexible trim/fascia units.
- B. Concealed Flexible flashing.
- C. Flexible roof/wall expansion joint systems.
- D. Mastic for setting and sealing joints.

1.02 RELATED SECTIONS

- A. Section 04 20 00 - Unit Masonry.
- B. Section 06 10 00 - Rough Carpentry.
- C. Section 07 60 00 - Flashing and Sheet Metal.
- D. Section 07 92 00 - Joint Sealants.

1.03 REFERENCES

- A. ASTM D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension.
- B. ASTM D 1004 - Standard Test Methods for Initial Tear Resistance of Plastic Film and Sheeting.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings: Indicate material, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details
- D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches square, representing actual product, color, and patterns.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum five year manufacturing experience and capability for design, engineering and technical assistance for the selection, application, and installation of appropriate flashing systems for the project.
- B. Installer Qualifications: Experienced in the proper use and installation of flashing systems, including coordination with flashing of wall assembly components.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Finish areas designated by Architect.
 - 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 - 3. Refinish mock-up area as required to produce acceptable work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Stack flashing materials to avoid twisting, bending and abrasion. Protect materials from weather before installation.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Coordinate work of this section with interfacing and adjoining work for proper sequencing of each installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Nervastral Inc., which is located at: P. O. Box 11132 ; Greenwich, CT 06831; Toll Free Tel: 888-622-6030; Email: request info; Web: www.nervastral.com
- B. Substitutions:
 - 1. HydroFlash® UV + Flashing Tape by Benjamin Obdyke for open-joint cladding applications. Install per manufacturer's published recommendations - Typical.
 - 2. York 304 Self Adhering Stainless Steel Flexible Flashing.

3. Flex-Flash Flashing Self Adhering Flashing by Hohmann & Barnard, Inc.
 4. Weathermate™ Flexible Flashing by Dupont™
 5. Air-Shield™ Thru-Wall Flashing by W.R. Meadows.
 6. Blueskin® TWF Self-Adhered Thru-Wall Flashing Membrane by Henry®.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01 33 00.
- D. Open Cavity Installation: All walls to receive thru-wall flashing should be capped to prevent moisture infiltration from entering the wall during construction.

2.02 MATERIALS

- A. Elastic Sheet Flashing Materials: Nervastral elastic sheet flashing membrane, non-reinforced flexible, black elastic sheet flashing complying with the following:
1. Tensile Strength: ASTM D 412, 2000 psi.
 2. Ultimate Elongation: ASTM D 412, 250 percent.
 3. Tear Resistance: ASTM D 1004, 350 lbs. per linear inch.
 4. Flexible over a 1/16 inch mandrel at minus 20 degrees F.
- B. Bituminous Membrane Flashing Materials: Nervastral Bitu-Rap sheet flashing membrane, cross linked polyethylene sheet laminated to a rubber-asphalt membrane, complying with the following:
1. Tensile Strength: ASTM D 412, 21 pounds per inch width.
 2. Ultimate Elongation: ASTM D 412, 350 percent.
 3. Tear Resistance: ASTM D 1004, 350 lbs. per linear inch.
 4. MVT: 0.2g/100 in 2nd/24 hr.
- C. Exposed Flashing:
1. Nervastral 600 Elastic Sheet Flashing: Recommended for exposed flashing in place of metal. 0.0625 inch gauge, width: 12 inches to 48 inches.
- D. Concealed Flashing:
1. Nervastral 56 Elastic Sheet Flashing: Concealed Flashing, 0.056 inch gauge (1.4 mm), width: 12 inches to 48 inches (305 mm to 1219 mm).
 2. Nervastral 300 Elastic Sheet Flashing: Concealed Flashing, 0.030 inch gauge (0.7 mm), width: 8 inches to 60 inches (203 mm to 1829 mm).
 3. Nervastral HD Elastic Sheet Flashing: Concealed Flashing, 0.020 inch gauge (0.5 mm), width: 8 inches to 60 inches (203 mm to 1829 mm).
 4. Nervastral HD-15 Elastic Sheet Flashing: Concealed Flashing. 0.015 inch gauge (0.4 mm), width: 12 inches to 60 inches (305 mm to 1829 mm).
 5. Nervastral Bitu-Rap Bituminous Membrane Flashing: 40 mils (1 mm) thick.
- E. Roof Expansion Joint Cover
1. Nerva-Flex CA-454: Roof Expansion Joint Cove. 0.036 CPE, 3/8 inch (9.5 mm) foam, width: 13 inches.

- F. Cold Setting Mastic: Nervastral Nervaplast Adhesive formulated for use with PVC flashing. Tacky, fast-grabbing semi-pressure-sensitive rubber or resin base adhesive suitable for bonding PVC sheet to itself and to a wide variety of building materials.
- G. Roofing Cement: Cut-back asphalt containing long fibered material, in trowel grade consistency.

2.03 FABRICATION

- A. Forming: Fabricate flashings true to shape and accurate in dimension. Form pieces in longest possible lengths to minimize joints. Fold flashing at corners and at ends of pans instead of cutting.
- B. Joints: Provide not less than 4 inches (100 mm) of overlap at flashing joints.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Surfaces to receive flashing shall be reasonably smooth, free from holes or other irregularities and dry to ensure proper bonding to substrate. Metal surfaces shall be free of scale, oil, grease and dust to assure a proper bond.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide flexible flashing in the locations indicated on the Drawings.
- C. Provide Flexible flashings for concealed flashings at the following locations:
 - 1. Around windows and doors.
 - 2. Water protection on sills and heads of openings.

3. Spandrel beams.
 4. Parapets.
 5. Brick masonry through wall flashings and at cavity walls.
- D. Provide Flexible flashings for exposed flashings at the following locations:
1. Roof parapets
 2. Roof equipment curbs.
 3. Skylights.
 4. Vent pipes.
 5. Perimeter curbs.
 6. Expansion joints.
- E. Masonry Flashing: Lay horizontal flashing in slurry of fresh mortar and top with fresh full bed of mortar to receive masonry units. At vertical surfaces, spot flashing with mastic to hold in place until masonry has set.
1. Carry flashing through wall and leave exposed for inspection.
 2. After inspection, cut flashing flush with surface of masonry.
 3. Remove mortar or other obstructions from weep holes at flashing locations.
- F. Flashing in Frame Construction: Install over solid backing, both vertically and horizontally. Secure in place with mastic; avoid puncturing installed flashing with nails or other fasteners.
- G. Miscellaneous Flashing: Lay flashing in full trowel coat of mastic, lapping joints not less than 6 inches (150 mm). Roll surface of flashing with rubber hand roller to remove all air.
- H. Use Nervastral Nervaplast Cold Setting Mastic with all flashing. Roofing cement may be used only at non-critical locations.

3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged Work before proceeding with construction on concealing work.

END OF SECTION 07 65 00

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PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Extent of coping system is shown on the drawings and indicated by provisions of this section.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.
- C. Shop Drawings: Submit manufacturer's shop drawings, including plans, elevations, sections, and details, indicating dimensions, materials, components, fasteners, finish, and accessories.
- D. Samples: Submit manufacturer's sample of coping system.
 - 1. Sample Size: Minimum 6 inches long.
- E. Color Samples: Submit manufacturer's color samples of coping cap, consisting of complete set of metal color chips representing manufacturer's full range of available colors.
- F. Manufacturer's Certification: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.
- G. Manufacturer's Project References: Submit manufacturer's list of 10 successfully completed coping system projects of similar size and scope to this Project, including project name and location, name of architect, and type and quantity of coping systems furnished.
- H. Warranty Documentation: Submit manufacturer's standard warranty.

1.04 REFERENCE STANDARDS

- A. Single Ply Roofing Industry (SPRI) (www.spri.org):
 - 1. ANSI/SPRI/FM 4435/ES-1 - Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.

1.05 PRE-INSTALLATION MEETINGS

- A. Convene pre-installation meeting 1 week before start of installation of coping system.
- B. Require attendance of parties directly affecting Work of this Section, including Contractor, Architect, installer, and manufacturer's representative.
- C. Review the Following:
 - 1. Materials.
 - 2. Examination of roof edge areas.
 - 3. Installation.
 - 4. Cleaning.
 - 5. Protection.
 - 6. Coordination with other Work, including membrane roofing installation.

1.06 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Manufacturer regularly engaged in the manufacturing of coping systems of similar type to that specified for a minimum of 5 years.
- B. Installer's Qualifications:
 - 1. Installer regularly engaged in installation of coping systems of similar type to that specified for a minimum of 5 years.
 - 2. Use persons trained for installation of coping systems.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Delivery Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage and Handling Requirements:
 - 1. Store and handle materials in accordance with manufacturer's instructions.
 - 2. Keep materials in manufacturer's original, unopened containers and packaging until installation.
 - 3. Store materials in clean, dry area indoors.
 - 4. Do not store materials directly on floor or ground.
 - 5. Protect materials and finish during storage, handling, and installation to prevent damage.

1.08 WARRANTY

- A. Warranty Period:
 - 1. "Formed Coping" Coping System: Coping system shall not blow off, leak, or cause membrane roofing failure for 20 years in wind speeds up to 110 mph, when installed in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer: Hickman Edge Systems, 4 Commerce Way, Arden, North Carolina 28704. Toll Free 800-892-9173. Phone 828-676-1700. www.Hickmanedgesystems.com
- B. Substitutions: Comply with Division 01.
- C. Single Source: Provide materials from single manufacturer.

2.02 COPING SYSTEM

- A. Coping System: "Formed Coping".
 - 1. Description:
 - a. Formed coping with continuous front cleat for capping parapet walls.
 - b. Watertight.
 - c. Maintenance free.
 - 2. Tested: ANSI/SPRI/FM 4435/ES-1.
 - 3. Approved: FM 1-180 rating.
 - 4. Performance Characteristics:
 - a. Formed Coping Cap Sections:
 - 1) Capable of expanding and contracting freely, while mechanically locked in place with exposed fasteners at back leg of coping cap.
 - 2) Lock to clips by mechanical pressure from concealed splices.
 - b. Formed Coping Cap Joints: Underlaid with concealed splices.
 - 5. Wall Width: Indicated on the Drawings.
 - a. Minimum: 4 inches.
 - b. Maximum: 24 inches.
- B. Coping Cap:
 - 1. Material: 24-gauge galvanized steel.
 - 2. Formed Lengths: 10'-0".
 - 3. Finish: Pre-finished Kynar.
 - 4. Color: As selected by architect from complete manufacturer offering.
 - 5. Face Dimension: Indicated on the Drawings.
 - a. Minimum: 3 inches.
 - b. Maximum: 12 inches.
 - 6. Back Dimension: Indicated on the Drawings.

- a. Minimum: 2 inches.
 - b. Maximum: 8 inches.
- C. Continuous Front Cleat:
 - 1. Material: 20-gauge galvanized steel.
 - 2. Length: 120 inches.
 - 3. Fastener Holes: Slotted.
- D. Concealed Splices:
 - 1. Material: Same as coping cap.
 - 2. Finish and Color: Same as coping cap.
 - 3. Width: 6 inches.
 - 4. Non-hardening sealant.
- E. Fasteners:
 - 1. 1-1/2-inch stainless steel ring-shank nails through front cleat.
 - 2. #9 x 1-1/2-inch stainless steel screws with washer at back leg of coping cap.
 - 3. Suitable for intended substrate.
 - 4. Provided by coping system manufacturer.
- F. Factory-Fabricated Accessories:
 - 1. Miters.
 - 2. End caps.
 - 3. End terms.
 - 4. Material, Finish, and Color: Same as coping cap.
 - 5. Fabrication: Welded.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine roof edge areas, including membrane roofing and blocking, to receive coping system.
- B. Verify surfaces to support coping system are clean, dry, flat, level from front to back, secure, and of proper dimensions.
- C. Notify Architect of conditions that would adversely affect installation.
- D. Do not begin installation until unacceptable conditions are corrected.

3.02 INSTALLATION

- A. Install coping system in accordance with manufacturer's instructions at locations indicated on the Drawings.

- B. Membrane Roofing: Specified in Section 07 54 23.
- C. Shim areas of walls not level from front to back.
- D. Fasteners: Install coping system using fasteners in accordance with manufacturer's instructions.
- E. Install concealed splices at cap joint locations.
- F. Thermal Movement: Leave 1/4-inch gap between coping cap sections to allow for thermal expansion and contraction.
- G. Apply non-hardening sealant at splices.
- H. Review lengths of straight pieces of coping cap before cutting to avoid creating relatively short sections adjacent to full-length sections.
- I. Isolate coping system from ACQ treated wood blocking or other galvanically incompatible material with appropriate membrane material.

3.03 CLEANING

- A. Clean coping system promptly after installation in accordance with manufacturer's instructions.
- B. Remove clear protective vinyl film.
- C. Do not use harsh cleaning materials or methods that could damage finish.

3.04 PROTECTION

- A. Protect installed coping system to ensure that, except for normal weathering, coping system will be without damage or deterioration at time of Substantial Completion.

END OF SECTION 07 71 13

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PART 1 - GENERAL**1.01 DESCRIPTION**

- A. This section includes firestopping and/or soundproofing for through-penetrations and joints in or between the following fire-resistance rated assemblies, including both blank openings, linear openings, and openings containing penetrating items:
- B. Provide UL or equivalent approved firestopping system for the closures of openings in walls, floors, and roof decks against penetration of flame, heat, and smoke or gases in fire resistant-rated construction.
 - 1. Floor-ceiling assemblies.
 - 2. Roof-ceiling assemblies.
 - 3. Walls and partitions.
 - 4. Smoke barriers.
 - 5. Construction enclosing compartmentalized areas.
- C. This Section describes the requirements for furnishing and installing firestopping for fire-rated construction. Contractor is responsible for identifying various conditions requiring firestopping material and submitting proposed UL Tested Assemblies for Architects review.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
 - 1. Material Safety Data Sheets: Submit MSDS for each firestop product.
 - 2. Shop Drawings: Show typical installation details for methods of installation. Indicate which firestop materials will be used where and thickness for different hourly ratings.
 - 3. Installer Documentation: Submit document from Firestop Manufacturer wherein Manufacturer recognizes, i.e. approves installer for said Manufacturer's Firestop products.

4. Prepare job mock-up of the material proposed for use in the project as directed by Architect. Approved mock-ups may be left in place as part of the finished project and will constitute the standard for remaining work, including aesthetics. It is recommended that the Authority Having Jurisdiction (AHJ) or Fire Marshal review and comment on the job mock-up and contractor is to notify architect of AHJ observations.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

- A. Firestopping materials shall conform to Flame (F) and Temperature (T) ratings as required by local building code and as tested by nationally accepted test agencies per ASTM E 814 or UL 1479 fire tests. The F rating must be a minimum of one (1) hour but not less than the fire resistance rating of the assembly being penetrated. T rating, when required by code authority, shall be based on measurement of the temperature rise on the penetrating item(s). The fire test shall be conducted with a minimum positive pressure differential of 0.01 inches of water column.
- B. Firestopping material shall be asbestos free and free of any PCBs.
- C. Do not use any product containing solvents or that requires hazardous waste disposal.
- D. Do not use Firestop Products which after curing, dissolve in water.
- E. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991 or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements." Submit qualification data.
- F. Inspector Qualifications: Contractor to engage a qualified inspector to perform inspections and final reports. The inspector to meet the criteria contained in ASTM E699 for agencies involved in quality assurance and to have a minimum of two years' experience in construction field inspections of firestopping systems, products, and assemblies. The inspector to be completely independent of, and divested from, the Contractor, the installer, the manufacturer, and the supplier of material or item being inspected. Submit inspector qualifications.

1.05 PRODUCT DELIVERY, STORAGE AND HANDING

- A. Deliver material in the manufacturers' original, unopened containers or packages with manufacturer's name, product identification, lot numbers, UL-labels, and mixing and installation instructions, as applicable.
- B. Store materials in the original, unopened containers or packages, and under conditions recommended by manufacturers.
- C. All Firestop materials shall be installed prior to expiration of shelf life.

1.06 PROJECT CONDITIONS

- A. Conform to Manufacturer's printed instructions for installation and when applicable, curing in accordance with temperature and humidity. Conform to ventilation and safety requirements.

1.07 WARRANTY

- A. Firestop Contractor shall warrant that firestopping systems used meet firestopping requirements as herein specified.

1.08 SEQUENCING

- A. Coordinate this work as required with work of other trades.
- B. Firestopping shall precede gypsum board finishing.

1.09 PROTECTION

- A. Where firestopping is installed at locations which will remain exposed in the completed work, provide protection as necessary to prevent damage to adjacent surfaces and finishes, and protect as necessary against damage from other construction activities.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Provide materials from one of the following manufacturers:
 - 1. 3M
 - 2. Cafco
 - 3. Hilti
 - 4. STI Firestop
 - 5. Approved Equal.

2.02 MATERIALS

- A. Provide mortars, sealants, caulks, putty, collars, pillows, wrap strips, composite sheets and related materials as required by the UL Design Assembly proposed for each individual application.
- B. Accessories:
 - 1. Forming/Damming Materials: Mineral fiberboard or other type recommended by manufacturer.
 - 2. Primer, Sealant and Solvent Cleaner: As recommended by manufacturer.
- C. Seal all penetration of sound isolating construction with non-hardening material.

- D. At sound isolating construction with multiple penetrations in a relatively small area, provide Nelson Class 200 multi-cable transit system as manufactured by Nelson Firestop Products, 1-800-331-7325, or approved equal.

2.03 SAFING INSULATION

- A. Provide semi-rigid product designed for use as a fire stop that is non-combustible and non-corrosive to steel as manufactured by Thermafiber Div. of USG Interiors; Cafco Industries Ltd.; Roxul, or approved equal product combining semi-refractory mineral fiber manufactured from slag with thermosetting resin binders to comply with ASTM C665, Type I; minimum density of 4.0 pcf; passing ASTM E136 for combustion characteristics and with Fire Hazard Classification when tested according to ASTM E84; flame spread of 15 or less, fuel contribution of 0 and smoke development of 0.
- B. Curtain Wall Assembly, Spandrel Panels, and Perimeter Joint Protection: Provide Intertek Design No. CEJ 322 P or propose alternate system meeting design conditions, to include the following:
1. Reinforcing angle at horizontal butt joints
 2. Perimeter Fire Barrier Reinforcement Angle
 3. Curtain Wall Insulation, 2" thick (aluminum foil scrim on interior side of room)
 4. Impaling Screws
 5. Elastomeric Firestop Spray
 6. Other components required for a complete system

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine the areas and conditions where Firestops are to be installed and notify the architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected by the contractor in a manner acceptable to the architect.
- B. Verify that environmental conditions are safe and suitable for installation of Firestop product.

3.02 CONDITIONS REQUIRING FIRESTOPPING

- A. General:
1. Provide firestopping conditions for specified whether or not firestopping is indicated, and, if indicated, whether such material is designated as insulation, safing, or otherwise.
 2. Insulation types specified in other Sections shall not be installed in lieu of firestopping material specified herein.

B. Building Exterior Perimeters:

1. Where exterior facing construction is continuous past a structural floor, and a space would otherwise remain open between the inner face of the wall construction and the outer perimeter edge of the structural floor, provide firestopping to equal the fire resistance of the floor assembly. Mineral wool by itself is not an acceptable firestop, neither is mineral wool used with beads of caulking applied along length of mineral wool/curtain wall or mineral wool/floor slab junctures. If mineral wool is part of firestop system, the mineral wool must be completely covered by appropriate thickness of UL listed Firestop Sealant.
2. Firestopping shall be provided whether or not there are any clips, angles, plates, or other members bridging or interconnecting the facing and floor systems, and whether such items are continuous or not.
3. Where an exterior wall of composite type construction passes a perimeter structural member, such as a girder, beam, or strut, and the finish on the interior wall face does not continue up too close with the underside of the structural floor above, thus interrupting the fire-resistive integrity of the wall system, and a space would otherwise remain open between the interior face of the wall and the lower edge of the structural member, provide firestopping to continuously fill such open space.

C. Interior Walls and Partitions:

1. Where a wall or partition is continuous past a structural floor, such as at stairwells and vertical shafts, and a space would otherwise remain open between the wall face and perimeter edge of the adjoining structural floor, provide firestopping.
2. Provide firestopping whether or not there are any clips, angles, plates, or other members bridging or interconnecting the wall and floor systems, and whether or not such items are continuous.
3. Where the top edge of a fire-rated wall or partition abuts and is at right angle to fluted-type metal decking, and the construction is such that it would otherwise leave the flute spaces open, provide firestopping.
4. Where the bottom track or plate of a partition meets the concrete slab, provide firestopping sealant.
5. Where the bottom track or plate of a partition meets the top of the concrete block wall below the drywall partition, provide firestopping sealant.

D. Penetrations:

1. Penetrations include conduit, cable, wire, pipe, duct, electrical boxes, fire extinguisher cabinets, toilet accessories or other elements which pass through or penetrate one or both sides of a fire rated floor, wall, or partition.
 - a. If "5 sided" gypsum board enclosures are omitted where metal electrical back boxes not exceeding 16 square inches occur at one side only of a wall within a single stud cavity; provide fire stopping material described in this Section to completely encompass the back box and its annular space.
2. Except for floors on grade, where penetration occurs through a structural floor or roof and a space would otherwise remain open between the surfaces of the penetration and the edge of the adjoining structural floor or roof, provide firestopping to fill such spaces in accordance with ASTM E 814.

3. Where penetrations occur at fire-rated walls or partitions of solid-type construction, provide firestopping to completely fill spaces around the penetration, in accordance with ASTM E 814.
 4. Where penetrations occur at fire-rated walls or partitions of hollow-type construction, provide firestopping to completely fill spaces around the penetration, on each side of the wall or partition, in accordance with ASTM E 814.
 5. These requirements for any penetration shall apply whether or not sleeves have been provided, and whether or not penetrations are to be equipped with escutcheons or other trim. If penetrations are sleeved, firestop annular space - if any - between sleeve and wall of opening.
- E. Provide firestopping to fill miscellaneous voids and openings in fire-rated construction in a manner essentially the same as specified above.

3.03 INSTALLATION

- A. General:
1. Installation of Firestops shall be performed by applicator/installers qualified and trained by the manufacturer. Installation shall be performed in strict accordance with manufacturer's detailed installation procedures.
 2. Apply Firestops in accordance with fire test reports, fire resistance requirements, acceptable sample installations, and manufacturer's recommendations.
 3. Coordinate with plumbing, mechanical, electrical and other trades to assure that all pipe, conduit, cable, and other items which penetrate fire related construction have been permanently installed prior to installation of Firestops, schedule and sequence the work to assure that partitions and other construction which would conceal penetrations are not erected prior to the installation of Firestops.
 4. At gypsum board fire walls the entire gap between the floor slab up to the bottom edge of the gypsum board is to be filled 100% and continuous.
- B. Dam Construction: Install dams when required to properly contain Firestopping materials within openings and as required to achieve required fire resistance rating. Combustible damming material must be removed after appropriate curing. Incombustible damming materials may be left as a permanent component of the Firestop system.
- C. Field Quality Control:
1. Prepare and install firestopping systems in accordance with manufacturer's printed instructions and recommendations.
 2. Follow safety procedures recommended in the Material Safety Data Sheets.
 3. Finish surfaces of firestopping which are to remain exposed to the completed work to a uniform and level condition.
 4. All areas of work must be accessible until inspection by the applicable Code with the authorities.
 5. Correct unacceptable firestops and provide additional inspection to verify compliance with this specification at no additional cost.

3.04 CLEANING

- A. Remove spilled and excess materials adjacent to firestopping without damaging adjacent surfaces.
- B. Leave finished work in neat, clean conditions with no evidence of spillovers or damage to adjacent surfaces.

END OF SECTION 07 84 00

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PART 1 - GENERAL**1.01 DESCRIPTION**

- A. Work Included: Furnish labor, materials, tools, and equipment required to completely close (with caulking compound or sealant) all joints to give a finished appearance. Items to be caulked or sealed include but are not limited to the following:
 - 1. Hollow metal frames.
 - 2. Exterior doors, louvers, windows and any other openings in exterior walls.
 - 3. Interior fixed glass.
 - 4. Penetrations by piping, conduit and similar items.
 - 5. Plumbing fixtures.
 - 6. Millwork.
 - 7. Flooring, including saw-cut concrete slab-on-grade.
 - 8. Paving and sidewalk joints.
 - 9. Dissimilar finishes.
 - 10. Joints shown on drawings or specified to be caulked or sealed.
 - 11. All joints or gaps between similar or dissimilar materials that do not receive closure trim are to be caulked/sealed with the appropriate material as listed in Part 2 of this Section.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.
- C. Installer qualifications.
- D. Contractor certification.
- E. Manufacturer's installation instructions for each product used.
- F. Cured samples of exposed sealants for each color.
- G. Manufacturer's Literature and Data:
 - 1. Primers

2. Sealing compound, each type, including compatibility when different sealants are in contact with each other.
- H. Manufacturer warranty.

1.04 REFERENCES

- A. ASTM E84 (UL 723): Surface Burning Characteristics
- B. ASTM E814 (UL 1479) and ULC-S115: Standard Test Method for Fire Tests of Through-Penetration Fire Stops
- C. ASTM E1966 (UL 2079): Standard Test Method for Fire-Resistive Joint Systems
- D. ASTM E90: Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

1.05 QUALITY ASSURANCE

- A. Qualifications of Applicators: Use workmen thoroughly skilled and specially trained in techniques of caulking, and completely familiar with manufacturer's published recommendations for caulking material used.
- B. Rejection of Installed Caulking: Lack of skill by caulking installers is sufficient ground for Architect to reject installed caulking and to require its removal and complete recaulking at Contractor's expense.
- C. Guarantee: Guarantee caulking materials and workmanship, in writing for 2 years after substantial completion date. Repair at Contractors expense any defects developing within guarantee period.
- D. Submit manufacturer's product data sheets and color selection information for every brand and type of sealant, caulk and accessory item proposed for use on this project.
- E. Refer to Underwriters Laboratories, Inc. (UL) Volume 2 with Hourly Ratings for Joint Systems, Through-Penetration Firestop Systems and Electrical Circuit Protective Systems and Duct Assemblies.

1.06 PRODUCT HANDLING

- A. Protection: Protect caulking materials before, during, and after installation. Protect installed work and materials of other trades. In event of damage, immediately make repairs and replacements necessary at Contractor's expense.
- B. Storage: Store caulking materials and equipment under conditions recommended by manufacturer. Do not use materials stored for period of time exceeding maximum recommended material shelf-life.

1.07 JOB CONDITIONS

- A. Inspection: Carefully inspect installed work of trades and verify work is complete to point where this installation may properly commence.
- B. Discrepancies: Do not proceed with installation in areas of discrepancy until discrepancies are fully resolved.
- C. Do not install sealants under adverse weather conditions, or when temperatures are not within manufacturer's recommended limitations for installation. Install sealants only when forecasted weather conditions are favorable for proper care and development of high early bond strength.

1.08 MOCK-UP

- 1. Provide a mock-up of each type of sealant using materials, colors, and techniques approved for use on the project. Approved mock-ups may be incorporated into the Work.

PART 2 - PRODUCTS

2.01 MATERIALS FOR CAULKING AND SEALING

- A. Select caulking materials for specific locations complying with manufacturer's recommendations. Provide caulking, sealant and accessory items in color(s) selected to match adjacent materials or as selected by Architect from manufacturer's complete line.
- B. Silicone Sealant: Single component, non-sag, gun grade product meeting ASTM C920, Type S, Grade NS, Class 25.
 - 1. Silicone Sealant 790/791/795 by Dow-Corning Corp.
 - 2. Spectrum 1 by Tremco
 - 3. 890 FTS/864 NST by Pecora Corporation
 - 4. Approved Equal
- C. Mildew-Resistant Silicone Sealant: Single component, non-sag, gun grade product meeting ASTM C920, Type S, Grade NS, Class 25.
 - 1. Silicone Sealant 786 by Dow-Corning Corp.
 - 2. Sanitary 1700 by GE.
 - 3. Approved equal.
- D. Acrylic Latex Caulk (interior only): General purpose, gun grade, non-sag, paintable, non-staining latex sealant complying with ASTM C834.
 - 1. AC-20 + Silicone by Pecora.
 - 2. Acrylic Latex by Tremco.
 - 3. Approved equal.
- E. Acoustical Sealant: General purpose, gun grade, non-sag, paintable, non-staining latex

sealant complying with ASTM C834.

1. SHEETROCK® Brand Acoustical Sealant by U.S. Gypsum
 2. AC-20® FTR Acoustical and Insulation Sealant by Pecora Corporation
 3. STOPGAP by Auralex Acoustics
 4. Sashco Big Stretch Caulk
 5. Green Glue Noiseproofing Sealant
 3. Approved equal.
- F. Polyurethane Sealant (for vertical surfaces): Single component, non-sag, gun grade product meeting ASTM C920, Type S, Grade NS, Class 35.
1. MasterSeal® NP 1™ (formerly Sonolastic® NP 1™).
 2. Vulkem 921 by Mameco.
 3. Dynatrol I by Pecora.
 4. Dymonic by Tremco.
 5. QSC-102 by Carlisle.
 6. Approved equal.
- G. Polyurethane Sealant (for horizontal surfaces): Single component, non-priming, self-leveling, pourable grade product meeting ASTM C920, Type S, Grade P, Class 25.
1. MasterSeal® SL 1™ (formerly Sonolastic® SL 1™).
 2. Vulkem 45 by Mameco.
 3. NR-201 by Pecora.
 4. THC-901 by Tremco.
 5. QSC-131 by Carlisle.
 6. Approved equal.

2.02 SEALANT BACKER RODS

- A. Sealant Backer Rod for general use except at floor and deck joints: Tremco Open Cell Polyurethane, or approved equal, open cell type as recommended by sealant manufacturer for compatibility with sealant.
- B. Sealant Backer Rod for use at horizontal floor and deck joints: MasterSeal® 920 by BASF, or approved equal closed cell type as recommended by sealant manufacturer for compatibility with sealant. MasterSeal® 921 by BASF may be used where appropriate.
- C. Provide rod sized and shaped to control joint depth for sealant placement, break bond of sealant at bottom of joint, form optimum shape of sealant bead on back side, and provide a highly compressible backer to minimize possibility of sealant extrusion when joint is compressed.

2.03 MISCELLANEOUS MATERIALS

- A. Joint Cleaner Compound: Use type recommended by sealant and caulking compound manufacturer for joint surfaces to be cleaned.

- B. Joint Primer/Sealer: Use type recommended by sealant manufacturer for joint surfaces to be primed or sealed.
- C. Bond Breaker Tape: Use self adhesive polyethylene tape or plastic tape recommended by sealant manufacturer. Apply to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of sealant.
- D. Joint Filler: W.R. Meadows, Sealtight Standard Cork, Expansion Joint Filler produced from clean, selected, granulated cork bonded with a phenolic resin, or approved equal meeting ASTM D 1752, Type II.

2.04 GENERAL APPLICATION GUIDE

- A. Interior caulking, except joints with ceramic tile, metal, glass and aluminum: Acrylic Latex Caulk.
- B. Sound rated walls, partitions and ceilings: Acoustical Sealant.
- C. Interior and Exterior joints with metal, glass and aluminum: Silicone sealant.
- D. Joints with ceramic tile and plumbing fixtures: Mildew resistant Silicone sealant.
- E. Horizontal and Vertical building joints: Polyurethane sealant.
- F. Paving Joints: Refer to Division 32

PART 3 - EXECUTION

3.01 CHOICE OF CAULKING MATERIAL

- A. Use sealant and caulking materials best suited to the installation and recommended by caulking material manufacturer.

3.02 INSPECTION

- A. Installer must examine substrates, (joint surfaces) and conditions under which joint sealer work is to be performed. Do not proceed with joint sealer work until unsatisfactory conditions are corrected.

3.03 JOINT PREPARATION

- A. Clean joint surfaces immediately before installation of gaskets, sealants and caulking compounds. Remove dirt, insecure coatings, moisture and substrates which could interfere with gasket seal and bond of sealant or caulking compound. Etch concrete and masonry joint surfaces when recommended by sealant manufacturer. Roughen vitreous and glazed joint surfaces recommended by sealant manufacturer.

- B. Prime or seal joint surfaces where required, and when recommended by sealant manufacturer. Confine primer/sealer to areas of sealant bond. Do not allow spillage and migration onto adjoining surfaces.

3.04 INSTALLATION

- A. Comply with manufacturer's printed instructions except when more stringent requirements are specified, and except when manufacturer's technical representative directs otherwise.
- B. Set joint filler units at depth and position in joint as required to coordinate with other work, including installation of bond breakers, backer rods and sealants. Do not leave voids or gaps between ends of joint filler units.
- C. Install sealant backer rod except when required to be omitted or recommended to be omitted by sealant manufacturer for application required.
- D. Install bond breaker tape when required by manufacturer's recommendations to ensure liquid-applied sealants will perform as intended.
- E. Employ proven installation techniques, which ensure sealants are deposited in uniform, continuous ribbon without gaps or air pockets, and with complete "wetting" of joint bond surfaces equally on opposite sides. Except as otherwise required, fill sealant rabbet to a slightly concave surface, slightly below adjoining surfaces. Where horizontal joints occur between a horizontal surface and vertical surface, fill joint to form a slight cove, so joint will not trap moisture and dirt.
- F. Install liquid-applied sealant to depths required and as recommended by sealant manufacturer.
- G. Spillage: Do not allow sealants and compounds to overflow from joint confines or to spill onto adjoining work, or to migrate into voids of exposed finished. Clean adjoining surfaces to eliminate evidence of spillage without damaging adjoining surfaces.
- H. At joints in face brick and precast concrete, apply sand and ground up mortar to uncured sealant to match appearance of mortar joints.

3.05 CURE AND PROTECTION

- A. Cure sealants and caulking compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability. Cure and protect sealants in manner which will minimize increases in modulus of elasticity and accelerated aging effects.

END OF SECTION 07 92 00

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Provide hollow metal doors, door frames and window frames required.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 REFERENCES

- A. ANSI A224.1 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
- B. ANSI A250.3 - Test Procedure and Acceptance Criteria for Factory-Applied Finish Painted Steel Surfaces for Steel Doors and Frames.
- C. ANSI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcements.
- D. ANSI/ISDI-104 -Water Penetration Performance Standard for Insulated Steel Door Systems.
- E. ANSI/ISDSI-103 - Acoustical Performance Standard for Insulated Steel Door Systems.
- F. ANSI/ISDSI-105 - Mechanical Performance Standard for Insulated Steel Door Systems.
- G. ANSI/SDI 100 - Recommended Specifications for Standard Steel Doors & Frames; Steel Door Institute.
- H. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

- I. ASTM B 117 - Standard Method of Salt Spray (Fog) Testing.
- J. ASTM C 236 - Standard Test Method for Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box.
- K. ASTM D 1735 - Standard Practice for Testing Water Resistance of Coating Using Water Fog Apparatus.
- L. ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
- M. ASTM E 152 - Standard Methods of Fire Tests of Door Assemblies.
- N. ASTM E 283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- O. ASTM E 331 - Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure.
- P. NFPA 80 - Standard for Fire Doors and Windows.
- Q. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.
- R. SDI 105 - Recommended Erection Instructions for Steel Frames
- S. SDI 111 - Recommended Standard Details - Steel Doors and Frames.
- T. SDI 113 - Test Procedure and Acceptance Criteria for Apparent Thermal Performance for Steel Door and Frame Assemblies.
- U. SDI 114 - Test Procedure and Acceptance Criteria for Acoustical Performance for Steel Door and Frame Assemblies.
- V. SDI 116 - Test Procedure and Acceptance Criteria for Rate of Air Flow Through Closed Steel Door and Frame Assemblies.
- W. Warnock Hersey International Inc. (WHI) - Certification Listings.
- X. Uniform Building Code (UBC).
- Y. UL 10B - Standard for Fire Tests of Door Assemblies.
- Z. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Underwriters Laboratory Inc.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Member of Steel Door Institute (SDI) or Hollow Metal Manufacturers Association (HMMA).
- B. Use skilled workmen thoroughly trained and experienced and completely familiar with specified requirements and methods needed for proper performance of work of this Section.
- C. Codes and Standards:
 - 1. Manufacture labeled units in strict accordance with specifications and procedures of Underwriters Laboratories, Inc. Labels must be affixed to rated assemblies.
 - 2. In guarantee and Shop Drawings, apply and use definitions and nomenclature established in American National Standards Institute publication A 123.1 "Nomenclature for Steel Doors and Steel Door Frames."
 - 3. ANSI/SDI A250.8-2017 - Specifications for Standard Steel Doors and Frames.
 - 4. Fire-Rated Units: **Affix metal plates to jamb side or top of door and/or frame stating the appropriate fire rating. Paper labels will not be accepted. Do not apply paint or stain over metal labels. Mask off the label before applying finish and remove masking after finish is dry.**

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Protection:
 - 1. Deliver, store, and handle hollow metal units to prevent damage and deterioration.
 - 2. Provide packaging of cardboard or containers, separators, banding, spreaders, and paper wrapping to completely protect hollow metal units during transportation and storage.
 - 3. Store units upright, in protected dry area, at least one inch off ground and with at least 1/4" air space between individual pieces. Protect primed and hardware surfaces.
 - 4. Protect installed work and materials of other trades.
 - 5. Avoid use of non-vented plastic or canvas shelters which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide 1/4" spacing between stacked units to promote air circulation.
- B. Replacements: Inspect hollow metal work upon delivery for damage. Minor damages may be repaired provided finish items are equal in all respects to new work, otherwise, remove and replace damaged items as directed at Contractor's expense.

1.07 WARRANTY

- A. Provide Manufacturer's standard warranty, effective on date of purchase, against defects in product workmanship and materials; minimum 12 months for doors and frames.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Fabricate hollow metal items rigid, neat in appearance, and free from defects, warp, or buckle.
- B. Provide clean cut, straight and true molded members with well-formed and aligned miters.
- C. Dress exposed weld joints smoothly for a seamless appearance at frames. **[and doors.]**
Provide interlocking visible edge seams at door panel corners, not at middle of door edge.
- D. Door Clearances: Maximum 1/8" at jambs and heads, 1/8" at meeting edges of pairs of doors, and 3/4" at bottom from finished floor line.
- E. **Close top and bottom edges of exterior doors flush. Seal against water penetration with flush steel channel fillers.**

2.02 ACCEPTABLE MANUFACTURERS

- A. Provide hollow metal units by the following or other approved equal manufacturers:
 - 1. **National Custom Hollow Metal, 800-334-3070, 1701 E 22nd St, Little Rock, AR, 72206.** Exterior doors and frames; (Interior doors and frames optional).
 - 2. Amweld
 - 3. Ceco Door Products
 - 4. Curries Company
 - 5. Mesker Door
 - 6. Pioneer
 - 7. Republic
 - 8. Commercial Door Solutions and Supply, LLC, 8000 Assembly Court, Suite 30, Little Rock, AR 72209, (501) 257-0054.

2.03 FACTORY PREPARATION

- A. Prepare units to receive hardware scheduled in "Hardware" Section of these specifications and in accordance with ANSI/DHI A 115.
- B. Cut, mortise, reinforce, drill, and tap units at factory, except drill and tap for surface applied hardware at work when hardware is applied.
- C. Prepare door frames for rubber silencers to be provided with frames.

2.04 SHOP PRIME COAT FOR FIELD FINISHED DOORS AND FRAMES

- A. Clean, treat, and prime exposed surfaces of hollow metal units, including galvanized surfaces. All exterior doors and frames shall be galvanized.

- B. Clean steel surfaces free of mill scale, rust, oil, grease, dirt, and foreign materials before applying paint.
- C. Apply shop coat of rust-inhibiting prime paint of even consistency to provide uniformly finished surface ready to receive finish paint.

2.05 FULL FLUSH TYPE DOORS

- A. Construct exterior/interior doors to the designs and gages specified:
 - 1. **Exterior Doors:** Hot dipped galvanized steel, ASTM A653, ZF180, Class A60 coating, 16-gauge Extra Heavy Duty (except where heavier gauge required), with closed tops.
 - a. Include galvanized components and internal reinforcements.
 - b. Core: Rigid Pre-Formed Closed Cell Polyisocyanurate (polyurethane) Board. 2 lb. PCF Density Average to conform to ASTM D2856.
Core U- Factor = 0.100, R-Value = 10.0. STC Rating 28-30.
 - 2. **Interior Doors:** Hot Dipped galvanized steel, ASTM A 653, ZF120, Class A40 coating, 18-gauge Heavy Duty (except where heavier gauge required), with no exposed face seams.
- B. **Core material at Interior Doors:** To be either water-resistant honeycomb insulation core glued in place, rigid insulation core glued in place or rigid insulation core foamed in place. **Core material at exterior doors to be rigid insulation core foamed in place.**
 - 1. Honeycomb Insulation Core (Glued, Interior Only): Crushing strength of not less than 4,000 psf, and with lamination withstanding not less than 1,500 psf surface shear.
- C. **Core material at Exterior Doors:** Shall be Polyurethane (ISO) insulation, R-Value 1.97, placed in the hollow core of the door. Verify testing if applicable as a fire rated door.
 - 1. Therma Hold, 800-334-3070 for door and frame. Lab Tested NCHM Thermal Rating Level Per ASTM C1363-19. Insulate Thermal Brake Frame Cavity with Mineral Wool. Caulk Frame Edge to adjacent wall. Apply Gasketing Door to Frame preventing air flow. Include Thermal Break Threshold and Sweep (NGP).
- D. Provide doors complete with glazed panels as required. Glass is specified in Section 08 80 00.
- E. Louvers: Not less than 20-gauge, with inverted V- or Y-shaped blades, set into 18-gauge frame. Provide fusible links, overlapping, operable blades on fire-rated doors.
- F. Astragals: All pairs of doors on which the active leaf has latching hardware shall be provided with overlapping astragals. Exceptions are pairs of doors equipped with vertical rod exit devices and where open back strikes are provided.
 - 1. Exterior openings are to have astragals applied in such a manner as to cover the gap at the meeting stiles at the exterior side.

2. Doors are to be sized to allow a 1/8" clearance between the meeting edges when an astragal is a part of the assembly as well as when there is no astragal required.
3. The door supplier shall coordinate the need for astragals based upon the hardware specified and the label requirements of the door manufacturer. Shop drawings shall clearly indicate the type of astragals and where they are to be provided.
4. The astragals can be either shop or field applied. Field applied astragals are to be shipped with necessary mounting fasteners.

2.06 FIRE DOORS

- A. At fire rated openings, furnish doors bearing Underwriters' Laboratories or Warnok-Hersey label for fire rating required. Furnish overlapping metal astragal on pairs of fire doors except at locations equipped with approved rim type exit hardware and provided with a removable mullion.
- B. For 1-1/2-hour (B) and 1-hour (B) doors used in stairway enclosures the average temperature developed on the unexposed side shall not exceed 450 degrees F at the end of 30 minutes of standard fire test exposure when tested in accordance with ASTM E 2074. The label attached to the door shall indicate compliance with this requirement.

2.07 METAL DOORS WITH VISION PANELS

- A. Construct from "Flush Type Doors" and factory prepare to receive glass vision panels. Provide non-removable glazing stops on outside of exterior doors and on secure side of interior doors. Furnish glazing beads on inside side of glass panels. Muntins, if required, to interlock at intersections and be securely fastened to door. Glass requirements specified in Section 08 80 00 - Glazing of these specifications.
- B. All doors occurring in a smoke partition are to have an approved, rated vision panel of not less than 100 square inches.

2.08 WELDED DOOR FRAMES

- A. Construct exterior/interior welded door frames to the designs and gauges specified:
 1. **Exterior Door Frames:** Hot dipped galvanized steel, ASTM A 653, ZF180, Class A60 coating, 16-gauge Extra Heavy Duty (except where heavier gauge required), with closed tops.
 - a. Include galvanized components and internal reinforcements.
 - b. **Overhead Rain Drip Guard:** Provide Anodized or Dark Bronze Aluminum Drip Strip 1.5" high x 2.5" wide x required length(s) by NGP or approved equal, including stainless steel furnished fasteners. Coordinate with Door Hardware Schedule in Section 08 71 00 - Door Hardware. Rain Drip not required where exterior cover is provided.
 - c. **Therma Hold Exterior Thermal Break Frames:** Two-part frame applied to Thermal Gasketing and secured every 12" with #8 sheet metal screw.

This method separates both sides of the frame jamb and header along the stop to create a barrier preventing temperature transfer from outside to inside.

- 1) Insulate Thermal Brake Frame Cavity with Mineral Wool.
- 2) Use Polyurethane (ISO) Core A60 Galvanneal.
- 3) Caulk Frame Edge to adjacent wall.
- 4) Apply Gasketing Door to Frame.
- 5) Include Thermal Break Threshold and Sweep

2. **Interior Door Frames:** Hot Dipped galvanized steel, ASTM A 653, ZF120, Class A40 coating, 18-gauge Heavy Duty (except where heavier gauge required), with no exposed face seams.
- B. Secure headers and jambs at corners by external welding of faces. Grind smooth to provide invisible joints.
 - C. Provide frames with minimum of 3 anchors per jamb for adjoining wall construction and floor anchors for attachment to the floor. Construct anchors using minimum 18-gauge steel.
 - D. At fire rated openings, furnish frames bearing Underwriters Laboratories, Inc. or Warnock-Hersey, International, Inc. label for fire rating required with anchors approved for type installation required.

2.09 FIXED GLASS METAL FRAMES

- A. Fabricate hollow metal framing using 14-gauge cold rolled steel conforming to ASTM Designation A 366. Apply steel tube glass stops with flush head, countersunk screws, spaced maximum of 12" o.c. unless otherwise required. Fit joints neatly, miter at corners, and make welds invisible by grinding smooth. Provide tamper-proof type anchors.
- B. Anchor frames to wall construction with anchors set not less than 2'-0" o.c. around perimeter of frame.
- C. Glass requirements specified in Section 08 80 00.
- D. At fire rated openings, furnish frames bearing Underwriters Laboratories or Warnock-Hersey International, Inc. label for fire rating required with anchors approved for type installation required.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

- A. Examine areas and conditions for work of this Section. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

- A. Install hollow metal units in strict accordance with approved Shop Drawings and manufacturer's recommendations.
- B. Set frames accurately, plumbed, aligned, and securely anchored.
- C. Install finish hardware in strict accordance with manufacturers' recommendations. Eliminate hinge-bound conditions, making items operate smoothly with secure locking and latching.

3.03 ADJUST AND CLEAN

- A. Immediately after installation, sand smooth rusted and damaged prime coat. Apply compatible touch-up air-drying primer.
- B. Check and adjust operating finish hardware items, leaving hollow metal units undamaged and in proper operating condition.
- C. Excessive filing or grinding of strike plate will not be accepted. Filing and grinding not to exceed 1/8" in any direction.

3.04 RELOCATED ITEMS

- A. Carefully remove existing hollow metal doors, frames and hardware indicated to be relocated under this Contract. Securely reinstalling in new locations, plumb, in true alignment, with doors and hardware working properly.

END OF SECTION 08 11 13

PART 1 - GENERAL**1.01 DESCRIPTION**

- A. Work Included: Provide wood doors, complete. Refer to Door Schedule for types and sizes.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

- A. Markings: Furnish door with stamp, brand, or identifying mark indicating door quality and construction. Identifying mark or separate certification to include inspection organization name, identification of standard for door construction, and identity of plant to which stamp was issued.
- B. Identifying Label: Each door shall bear identifying label indicating:
 - 1. Door manufacturer.
 - 2. Order number.
 - 3. Door number.
 - 4. Fire rating, if applicable.
- C. Tolerances for Warp, Telegraphing, Squareness, and Pre-fitting Dimensions: WDMA I.S.1-A.

1.05 REFERENCE STANDARDS

- A. American Society for Testing and Materials: (ASTM) E 152, "Fire Tests of Door Assemblies".
- B. Architectural Woodwork Institute (AWI) Quality Standards: Specifications and Quality Certification Program, Section 1300, "Architectural Flush Doors".

- C. U.S. Dept. of Commerce Commercial Standards: CS 236, "Mat-formed Wood Particle Board".
- D. Rated doors and frames must meet NFPA 80. **Affix metal plates to jamb side or top of door and frame stating the appropriate fire rating. Paper labels will not be accepted. Do not apply paint or stain over metal labels. Mask off the label before applying finish and remove masking after finish is dry.**

1.06 WARRANTY

- A. Warranty: Submit written agreement using door manufacturer's standard form, signed by manufacturer, contractor, and installer, agreeing to repair or replace defective doors which have warped (bow, cup or twist) or which show photographing of construction below in face veneers, or do not conform to NWMA and AWI tolerance limitations. Warranty period is for lifetime of installation.
- B. Limitation and Exclusions:
 - 1. Defects are not natural variations in color or texture of wood. Improper finishing is considered a defect.
 - 2. Warp not considered a defect unless it exceeds 1/4-inch in the plane of the door itself. Warp is distortion in the door itself and does not refer to relationship of door to frame. Term "warp" includes bow, cup and twist. Amount of warp in door is measured by placing a straight-edge on the suspected concave face of door at any angle (horizontally, vertically, diagonally), with door in installed position. Measurement of bow, cup, and twist is made at point of maximum distance between bottom of straight-edge and face of door.

1.07 PRODUCT HANDLING

- A. Protect wood doors during transit, storage and installation to prevent damage, soiling and deterioration. Comply with the "On-Site Care" recommendations of NWMA pamphlet "Care and Finishing of Wood Doors" and with manufacturer's instructions.
- B. Protection: Store doors in fully covered, well ventilated area. Protect from extreme changes in temperature and humidity.
- C. Replace damaged doors at Contractor's expense.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Provide doors manufactured by one of the following:
 - 1. Algoma
 - 2. Eggers

3. Graham
4. Marshfield
5. Mohawk
6. Oshkosh
7. VT Industries (**Basis-of-Design**)

2.02 GENERAL

- A. Provide wood doors complying with applicable referenced standards for specified door kinds and door types.
 1. ANSI/WDMA I.S. 1A, Extra Heavy Duty.
 2. Adhesive: Type II.
 3. Core: Structural composite lumber, except when mineral core is required for fire rating.

2.03 ACCESSORY COMPONENTS

- A. Provide metal edges at all concealed vertical rod devices and at fire rated doors. Provide matching hardwood edges at all non-rated doors.
- B. Provide solid wood glazing beads to match door facing at vision panels in non-rated doors and in sound rated doors. Provide metal glazing beads at rated doors with vision panels. Finish on metal glazing bead to match finish on hollow metal door frame.
- C. Astragals: All pairs of doors on which the active leaf has latching hardware shall be provided with overlapping astragals. Exceptions are pairs of doors equipped with vertical rod exit devices and where open back strikes are provided.
 1. Exterior openings are to have astragals applied in such a manner as to cover the gap at the meeting stiles at the exterior side.
 2. Doors are to be sized to allow a 1/8" clearance between the meeting edges when an astragal is a part of the assembly as well as when there is no astragal required.
 3. The door supplier shall coordinate the need for astragals based upon the hardware specified and the label requirements of the door manufacturer. Shop drawings shall clearly indicate the type of astragals and where they are to be provided.
 4. The astragals can be either shop or field applied. Field applied astragals are to be shipped with necessary mounting fasteners.

2.04 SOLID CORE, ARCHITECTURAL FLUSH DOORS

- A. All Solid Core and Architectural Flush Doors are to be manufactured in strict accordance with AWI Section 1300. Furnish, 5-Ply doors with AWI 1300-T-6 Type #5 Edge and with core fully bonded to stiles and rails with Type I Adhesive.
- B. Particle Core Doors: AWI Type PC-5ME particle core doors meeting or exceeding requirements of AWI Section 1300 with ANSI A208.1, Grade 1-LD-2 particleboard core.

- C. Fire Rated Doors: AWI Type FD-5. Provide fire retardant treated wood blocking inside labeled doors to receive door hardware.
1. Furnish fire doors tested in accordance with ASTM Standard E 152 of latest issue and bearing Underwriters' Laboratories, Inc. label for fire rating required. Refer to door and frame schedule in drawings for fire rating.
 2. For 1-1/2-hour (B) and 1-hour (B) doors used in stairway enclosures the average temperature developed on the unexposed side shall not exceed 450 degrees F at the end of 30 minutes of standard fire test exposure when tested in accordance with ASTM E152. The label attached to the door shall indicate compliance with this requirement.
 3. Positive Pressure Requirements for all doors with a fire rating greater than 20 minutes:
 - a. Fire doors must comply with positive pressure testing requirements of UL 10C.
 - b. Category: Provide Category "A" doors with no visible intumescent on doors or frames.
 - c. Smoke Label: Certify all fire doors to comply with smoke seal requirements and apply an "S" label.
- D. Face Veneers:
1. Painted Finish: Provide "A" Grade per AWI 1300, minimum 1/50" thick face veneers using Premium Quality, Medium Density Overlay.
 2. Stained Finish: Provide "A" Grade per AWI 1300, minimum 1/50" thick face veneers using Premium Quality. Matched (pairs of doors to be Pair Matched), Slip-Running.
 - a. Veneer Cut:
 - 1) Plain Sliced Red Oak (match existing)
- E. All doors occurring in a smoke partition are to have an approved, rated vision panel of not less than 100 square inches.

2.05 WOOD PANEL DOORS

- A. Provide wood raised panel doors conforming to AWI standards for a custom grade architectural quality door as described in Section 1400 AWI Quality Standards and Guide Specifications. Construct doors to designs and patterns shown on Door Schedule using a veneer construction as follows (match existing):
1. Stiles - veneered stave core with matching edge bands. Veneer 1/8" before sanding. All doors are doweled using #1 PVA glue.
 2. Panels and Rails - 3-ply laminated lumber. Panels are the same thickness as the stiles and rails.
 3. Sticking - Profile is 3/8" quarter round.
 4. Sanding - Wide belt sanded to uniform thickness.
 5. Grain and Color - Matched for compatibility.
- B. Provide Fire-Rated units where required.

- C. Provide louvered doors of similar construction where required.
- D. Finish: Paint Grade Hardwood | Stain Grade Red Oak.

PART 3 - EXECUTION

3.01 FABRICATION

- A. Fabricate wood doors complying with Contract Drawings, with this Section and with the referenced standards for types specified.
- B. Prefit doors at factory with following clearances:
 - 1. 1/8" on top and hinge side
 - 2. 1/8" on lock edge of single doors
 - 3. 1/16" per leaf on pair meeting edges
 - 4. 1/2" from finished floor
 - 5. 3/4" max. from combustible floor
 - 6. 3/8" max. from non-combustible sill or threshold
 - 7. Bevel both edges of door (1/8" in 2"). Specific clearances to be shown on door schedule. Field trimming of fire doors will not be allowed.
 - 8. Seal and refinish edges that are field cut to match factory finish.
- C. Pre-machine doors for hardware as required by Hardware Schedule in Bid Documents and in accordance with requirements of AWI Section 1300. Hardware Schedule by hardware supplier to be furnished complete with templates for all hardware requiring door preparation. Hollow metal frame schedule to be furnished and to include exact location and size of hardware preparation. No door machining to be required for any totally surface-mounted hardware.

3.02 FACTORY FINISH

- A. Factory finish doors in accordance with requirements of AWI Section 1500 for Custom finish.
 - 1. Finish System: AWI Section 1500, Conversion Varnish with custom stain color to be selected by architect.
 - a. Close Grain Woods:
 - Washcoat
 - Custom Stain
 - Sealer
 - Sand
 - Top Coat
 - Top Coat
 - b. Open Grain Woods:
 - Custom Stain
 - Sealer
 - Sand

Top Coat

Top Coat

2. Apply factory finish to both faces and all edges including top and bottom of all doors.

3.03 INSPECTION

- A. Examine door frames and verify frames are correct type and have been installed for proper hanging of corresponding doors.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected in manner acceptable to Architect.
- C. Install doors only after completion of other work which would raise moisture content of doors or damage surface of doors.

3.04 INSTALLATION

- A. Fit, hang, and trim doors by openings.
- B. Seal cuts made on job immediately after cutting, using clear water-resistant varnish or sealer.
- C. Excessive filing or grinding of strike plate will not be accepted. Filing and grinding not to exceed 1/8" in any direction.

END OF SECTION 08 14 00

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Provide doors and grilles specified including hardware, operating devices, and accessories for complete installation.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 GUARANTEE

- A. Warranty provisions for Work under this Contract are specified in General Conditions. Supplementary to General Conditions, furnish written guarantee stating work is guaranteed to serve intended purpose under normal use and that defects in materials and workmanship within 1-year period after Contract substantial completion date will be repaired, replaced or made good at Contractor's expense.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Provide doors manufactured by Cookson, 24 Elemwood Avenue, Mountain Top, PA 18707, Tel.: (800) 233-8366 or approved equal.
 - 1. ASTA AMERICA by Janus International, 800-423-0659.
 - 1. Clopay Commercial Door Products, 800-225-6729.
 - 2. Raynor Worldwide, 888-598-4790.
 - 3. Wayne-Dalton, 855-493-3667.
 - 4. Overhead Door Corp., Dallas, Texas, 1-800-275-3290

2.02 INSULATED ROLLING SERVICE DOORS

- A. Provide Thermiser® Max Model ESD20 Rolling Service Doors, face-of-wall mounted, as manufactured by Cookson. Telephone: (800) 233-8366.
- B. Curtain: Air infiltration rate of less than .3 CFM/FT², as tested per ASTM E283 validated by an independent testing agency.
 - 1. Fabrication:
 - a. Slat Material: No. 6F, (Listed Exterior/Interior):
 - 1) Galvanized Steel/Galvanized Steel: Manufacturer recommended gauge based on performance requirements. Minimum 24/24 gauge, Grade 40, ASTM A 653 galvanized steel zinc coating.
 - b. Insulation: 7/8 inch foamed-in-place, closed cell urethane
 - c. Total Slat Thickness: 15/16 inch
 - d. Flame Spread Index of 0 and a Smoke Developed Index of 10 as tested per ASTM E84
 - e. R-value: 8.0
 - f. STC Rating: Sound Transmission Class (STC) rating up to 30 for the curtain and up to 22 for the entire assembly. If an STC of 32 is desired, additional options are required. All configurations are evaluated per ASTM E90 and based on testing a complete, operable assembly
 - 2. Exterior Slat Finish:
 - a. Atmoshield® Powder Coating System (Color Selected by Architect):
 - 1) ASTM A 653 galvanized base coating treated with dual process rinsing agents in preparation for chemical bonding, gray baked-on base coat and gray baked-on polyester finish coat
 - 3. Interior Slat Finish:
 - a. Atmoshield® Powder Coating System (Color Selected by Architect):
 - 1) ASTM A 653 galvanized base coating treated with dual process rinsing agents in preparation for chemical bonding, gray baked-on base coat and gray baked-on polyester finish coat
- C. Bottom Bar:
 - 1. Configuration:
 - a. Insulated Bottom Bar: Reinforced extruded aluminum interior face with full depth insulation and exterior skin slat to match curtain material and gauge. Minimum 4" tall x 1-1/16" thickness.
 - 2. Finish:
 - a. Exterior: Match slats
 - a. Interior: Mill finish

- D. Guides:
1. Fabrication:
 - a. Thermal break required. Minimum 3/16 inch structural steel angles. Provide windlock bars of same material when windlocks are required to meet specified wind load. Top of inner and outer guide angles to be flared outwards to form bellmouth for smooth entry of curtain into guides. Provide removable guide stoppers to prevent over travel of curtain and bottom bar.
- E. Counterbalance Shaft Assembly:
1. Barrel: Steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot of width.
 2. Spring Balance: Oil-tempered, heat-treated steel helical torsion spring assembly designed for proper balance of door to ensure that maximum effort to operate will not exceed 25 lbs (110 N). Provide wheel for applying and adjusting spring torque.
- F. Brackets: Fabricate from minimum 3/16 inch steel plate with permanently lubricated ball or roller bearings at rotating support points to support counterbalance shaft assembly and form end closures
1. Finish:
 - a. Atmoshield® Powder Coating System (Color Selected by Architect):
 - 1) ASTM A 653 galvanized base coating treated with dual process rinsing agents in preparation for chemical bonding, gray baked-on base coat and gray baked-on polyester finish coat
- G. Hood: Minimum 24 gauge galvanized steel with reinforced top and bottom edges. Provide minimum 1/4 inch steel intermediate support brackets as required to prevent excessive sag.
1. Finish:
 - a. Atmoshield® Powder Coating System (Color Selected by Architect):
 - 1) ASTM A 653 galvanized base coating treated with dual process rinsing agents in preparation for chemical bonding, gray baked-on base coat and gray baked-on polyester finish coat
- H. Weatherstripping:
1. Bottom Bar:
 - a. Motor Operated Doors: Sensing/weather edge with neoprene astragal extending full width of door bottom bar
 2. Guides: Replaceable vinyl strip on guides sealing against [fascia side] [both sides] of curtain
 3. Lintel Seal: Double brush seal with EPDM sandwiched between the two brush seals at door header to impede air flow.
- I: Electric Operation: Provide UL listed electric operator, Cookson Model EverGard Operator, Electric Motor Operator with back-up power control box
1. Entrapment Protection: Electric Sensing Edge with concealed wire reel. Exposed coiled wire is unacceptable.

2. Operation Controls: Push Button operated control stations with open, close and stop buttons for surface mounting at interior. Also, provide surface mounted key operated switch with open, close and stop positions where indicated at exterior of doors.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine substrates and conditions under which overhead rolling doors are to be installed. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

- A. Install door and operating equipment, complete with necessary hardware, jamb and head mold strip, anchors, inserts, hangers, and equipment supports complying with final Shop Drawings, and manufacturer's installation instructions.

3.03 ADJUSTING

- A. Following completion of installation, including related work by others, lubricate, test, and adjust doors for ease of operation, free from warp, twist, or distortion.

3.04 CLEANING

- A. Clean surfaces soiled by work as recommended by the manufacturer.
- B. Remove surplus materials and debris from the site.

3.05 DEMONSTRATION

- A. Demonstrate proper operation to Owner's Representative.
- B. Instruct Owner's Representative in maintenance procedures.

END OF SECTION 08 33 00

PART 1 - GENERAL

1.01 SCOPE

- A. Provide aluminum doors, framing and hardware specified.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

- A. Fabricate exterior door and frame units to withstand the wind pressure loading shown or, or if not shown, 20 lbs. per sq. ft. on the gross area of the frames, doors, panels and glass, acting inward and also outward.

1.05 WARRANTY

- A. Submit a warranty signed by the manufacturer, contractor, installer, agreeing to replace aluminum doors, windows, framing and glazing which fail in materials and workmanship within 2 years of the date of acceptance. Failure of materials or workmanship shall include, but not be limited to, failure in operation of doors, windows, and hardware, excessive leakage of air infiltration, excessive deflections, delamination of panels, deterioration of finish or metal in excess of normal weathering, and defect in accessories, weatherstripping, and other components of the work.

DUSTIN STATES WHITE FINISH

- 1. Submit 10-year warranty by manufacturer of polyvinylidene fluoride (PVDF) coating.

1.06 ADJUSTMENT

- A. After installation, make adjustments as necessary to insure proper operation of all hardware items.

- B. Door Opening Force: In accordance with the Americans With Disabilities Act (ADA), adjust all door hardware so that the maximum force required for pushing or pulling open a door shall be as follows:
1. Fire doors shall have the minimum opening force allowable by the appropriate administrative authority.
 2. Exterior hinged doors: 8.5 lbf
 3. Interior hinged doors: 5.0 lbf
 4. These forces do not apply to the force required to retract latch bolts or disengage other devices that may hold the door in a closed position.
- C. Door Closer: If door is equipped with a closer, then the sweep period of the closer shall be adjusted so that from an open position of 70°, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers who produce products that may be submitted to Architect for review are:
1. Kawneer (Basis-of-Design)
 2. Oldcastle Building Envelope (OBE)
 3. Tubelite
 4. YKK AP America Inc.
 5. EFCO
 6. Approved equal

2.02 SWINGING GLASS DOORS

- A. Kawneer Model 350, or approved equal, medium width stile, single acting, sizes as indicated, complete with all hardware, except cylinders.

Material Standard: ASTM B 221; 6063-T6 alloy and temper.

1. The door stile and rail face dimensions of the 350 entrance door will be as follows:

Door	Vertical Stile	Top Rail	Cross Rail	Bottom Rail
350	3-1/2"	3-1/2"	[? NA]	10" (to meet ADA)

2. Major portions of the door members to be 0.125" nominal in thickness and glazing molding to be 0.05" thick.

- B. Door corner construction shall consist of mechanical clip fastening, SIGMA 1-1/8" long fillet welds along top and bottom of rail extrusion at stile and rail intersection, and deep penetration plug weld at all four corners of door. MUST BE FULL PENETRATION

PLUG WELD TO LEG OF CLIP, 1-1/8" LONG FILLET WELDS ALONG TOP AND BOTTOM OR RAILS AT STILES INTERSECTION, NO TIE-ROD CONSTRUCTION OF ANY TYPE OR PARTIAL DESIGN ALLOWED. Meeting rail to still joint fillet weld "only" is NOT ACCEPTABLE. Glazing stops shall be hook-in type with EPDM glazing gaskets reinforced with non-stretchable chord.

- C. Door Corner Warranty Period: Limited Warranty shall begin in no event later than six months from date of shipment. In addition, welded door corner construction shall be supported with a LIMITED LIFETIME WARRANTY for the life of the door under normal use.
- D. Finish:
 - 1. Factory finish with oven cured Kynar 500 based polyvinylidene fluoride (PVDF) coating, 70% resin formulation in color to be selected by Architect from manufacturer's standard complete line.
 - a. Primer is applied to 0.20 - 0.30 mils DFT (Dry Film Thickness) and the topcoat at 1.0 - 1.2 mils DFT.

2.07 ALUMINUM FINISHES

- A. Finish designations that are prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Factory Finishing:
 - 1. Kawneer Permafluor™ (70% PVDF), AAMA 2605, Fluoropolymer Coating
Color: White

2.03 HARDWARE

- A. Provide hardware by Kawneer Co. or approved equal products from aluminum door and frame manufacturer's standard selections, subject to Architect's review.
 - 1. Push Bars: Equal to Kawneer Architect's Classic, Style CP-II Stainless Steel. Omit push bar at panic devices. NOT BY HARDWARE SUPPLIER.
 - 2. Pulls: Equal to Kawneer Architect's Classic, Style CO-12 Stainless Steel with Heavy Duty 5/16" Stainless Steel through bolts. NOT BY HARDWARE SUPPLIER.
 - 3. Threshold: Refer to Hardware Schedule.
 - 4. Pivots: Manufacturer's standard, top and bottom offset pivots. Provide intermediate pivots if required due to door size/weight.
 - a. **Do not provide continuous hinges. If provided, match adjacent finish.**
 - 5. Closers: Refer to Hardware Schedule.
 - 6. Locks: Refer to Hardware Schedule.
 - 7. Panic Devices: Refer to Hardware Schedule.
 - 8. Integrated Security Components: Refer to Hardware Schedule.
 - 9. Door Bottoms: Refer to Hardware Schedule.
 - 10. Cylinders: Refer to Hardware Schedule.
 - 11. Removable Mullions: Refer to Hardware Schedule.

- B. All exit devices, door closers, mullions, continuous hinges and cylinders will be furnished under Section 08 71 00 - Finish Hardware, and furnished to the aluminum door supplier for installation either at the factory or on site.
- C. Recommendation: Door frames should have fixed or surface-applied door stops to avoid any issues with installing electric strikes and door closers in lieu of snap-in type door stops.

2.04 FRAMING

- A. Door, Storefront, and Windows: Provide standard shapes and moldings of Kawneer Trifab® VersaGlaze® 451 and 451T glazed framing system or approved equal.
 - 1. Center Set
 - 2. Provide SSG Vertical mullions and accessories where noted on the drawings.
 - 3. Provide 90 degree Outside SSG Dart Corner where noted on the drawings.
- B. Finish:
 - 1. Factory finish with oven cured Kynar 500 based polyvinylidene fluoride (PVDF) coating, 70% resin formulation in color to be selected by Architect from manufacturer's standard complete line.
 - 1. Primer is applied to 0.20 - 0.30 mils DFT (Dry Film Thickness) and the topcoat at 1.0 - 1.2 mils DFT.
- D. Aluminum Sheet Breakmetal: Provide 3003-0 alloy.

2.05 ALUMINUM SUB-SILL FLASHING

- A. Aluminum window and framing supplier is to provide aluminum sub-sill flashing "pans" of same aluminum alloy as frames and of minimum .050" thickness. Form pans by turning up ends and interior side 1-1/2". Lap end splices minimum of 2". Provide in maximum length possible to minimize number of splices. Apply bituminous paint to concealed surfaces in contact with dissimilar metal, concrete or mortar. Set sub-sill in continuous bed of sealant and seal around all anchors penetrating sub-sill. Do not anchor window sill through sub-sill for openings 5' or less in width. For windows greater than 5' in width, anchor window sill through sub-sill at manufacturer required locations. Fill screw holes to full depth with sealant and install anchor. Apply 2 ribbons of sealant at 2" lap. Finish shall match aluminum frame.

2.06 ALUMINUM FLASHING MATERIAL

- A. Aluminum Sheet: Provide 3003-0 alloy for flashings.
- B. Finish:
 - 1. Factory finish with oven cured Kynar 500 based polyvinylidene fluoride (PVDF) coating, 70% resin formulation in color to be selected by Architect from manufacturer's standard complete line.
 - 1. Primer is applied to 0.20 - 0.30 mils DFT (Dry Film Thickness) and the topcoat at 1.0 - 1.2 mils DFT.

2.09 OTHER MATERIALS

- A. Provide all other materials, not specifically described but required for a complete, weathertight, and proper installation of doors, windows, and framing systems, subject to acceptance by the Architect.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. With installer present, examine openings, substrates, structural support, anchorage, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work:
 - 1. Verify rough opening dimensions.
 - 2. Verify levelness of sill plate.
 - 3. Verify operational clearances.
 - 4. Examine all relative wall flashing, vapor retarders, water and weather barriers, and other built-in components for proper water management.
 - 5. Masonry Surfaces:
 - a. Masonry surfaces must be visibly dry and free of excess mortar, sand, and other construction debris.
 - 6. Wood Frame Walls:
 - a. Wood frame walls must be dry, clean, sound, well nailed, free of voids, and without offsets at joints.
 - b. Ensure that nail heads are driven flush with surfaces in opening and within 3" of opening.
 - 7. Metal Surfaces:
 - a. Metal surfaces must be dry and clean (free of grease, oil, dirt, rust, corrosion, and welding slag).
 - b. Ensure that metal surfaces are without sharp edges or offsets at joints.
- B. Proceed with installation only after correcting unsatisfactory conditions.

3.02 INSTALLATION

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing aluminum-framed storefront system, accessories, and other components.
- B. Install aluminum-framed storefront system so that components:
 - 1. Are level, plumb, square, and true to line
 - 2. Are without distortion and do not impede thermal movement
 - 3. Are anchored securely in place to structural support
 - 4. Are in proper relation to wall flashing and other adjacent construction
- C. Set sill members in bed of sealant or with gaskets, as indicated, for weather-tight construction.
- D. Install aluminum-framed storefront system and components to drain condensation, water penetrating joints, and moisture migrating within aluminum-framed storefront system to the exterior.
- E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.02 FIELD QUALITY CONTROL

- A. Field Tests:
 - 1. Architect shall select storefront units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured.
 - 2. Conduct tests for air infiltration and water penetration with manufacturer's representative present.
 - 3. Tests that do not meet the specified performance requirements and units that have deficiencies shall be corrected as part of the contract amount.
 - 4. Testing shall be performed per AAMA 503 by a qualified independent testing agency. Refer to Testing Section for payment of testing and testing requirements.
 - 5. Air Infiltration Tests:
 - a. Conduct tests in accordance with ASTM E 783.
 - b. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft², whichever is greater.
 - 6. Water Infiltration Tests:
 - a. Conduct tests in accordance with ASTM E 1105.
 - b. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 6.2 psf.
- B. Manufacturer's Field Services:
 - 1. Upon owner's written request, provide periodic site visit by manufacturer's field service representative.

3.02 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjusting: Not applicable.
- B. Protection:
 - 1. Protect installed product's finish surfaces from damage during construction.
- C. Cleaning:
 - 1. Clean glass immediately after installation.
 - a. Comply with glass manufacturer's written recommendations for final cleaning and maintenance.
 - b. Remove non-permanent labels and clean surfaces.
 - 2. Clean aluminum surfaces.
 - 3. Avoid damaging protective coatings and finishes.
 - 4. Remove excess sealants, glazing materials, dirt, and other substances.
 - 5. Repair or replace damaged installed products.
 - 6. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during the construction period.
 - 7. Remove construction debris from project site and legally dispose of debris.

END OF SECTION 08 41 13

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PART 1 - GENERAL

1.01 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.

1.02 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 – 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

1.03 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. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
 - a. Wiring Diagrams: For power, signal, and control wiring and including:
 - 1) Details of interface of electrified door hardware and building safety and security systems.
 - 2) Schematic diagram of systems that interface with electrified door hardware.
 - 3) Point-to-point wiring.
 - 4) Risers.
3. 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.

4. 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.
5. 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.
- f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

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.

1.04 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.
 - d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.
- 4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

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.

1.05 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.

1.06 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.

1.07 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) Schlage L Series: 10 years
 - b) Schlage ND Series: 10 years
 - c) Schlage ALX Series: 10 years
 - d) Falcon: 10 years
 - 2) Exit Devices
 - a) Von Duprin: 10 years
 - b) Falcon: 10 years
 - 3) Closers
 - a) LCN 4000 Series: 30 years
 - b) LCN 1460 Series: 30 years
 - c) LCN 4050 Series: 25 years
 - d) LCN 1450 Series: 25 years
 - e) LCN 1260 Series: 20 years
 - f) LCN 1250 Series: 15 years
 - g) LCN Concealed: 15 years
 - h) Falcon SC Series: 10 years
 - i) Falcon Concealed: 5 years
 - 4) Automatic Operators
 - a) LCN: 2 years
 - b) Falcon: 1 year
 - b. Electrical Warranty

- 1) Locks
 - a) Schlage: 3 years
 - b) Falcon: 1 years
- 2) Exit Devices
 - a) Von Duprin: 3 years
 - b) Falcon: 1 Year
- 3) Closers
 - a) LCN: 2 years

1.08 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.

C. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Ives 5BB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
 - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
 - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
 - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. 2 inches or thicker doors:
 - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) 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 (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) 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 CONTINUOUS HINGES

A. Manufacturers:

1. Scheduled Manufacturer:

a. Ives

B. Requirements:

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.06 COORDINATORS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives

B. Requirements:

1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers, surface vertical rod exit device strikes, or other stop mounted hardware. Factory-prepared coordinators for vertical rod devices as specified.

2.07 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Schlage ND series

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. Indicators: Where specified, provide escutcheon with lock status indicator window on top of lockset rose:
 - a. Escutcheon height (including rose) 6.05 inches high by 3.68 inches wide.
 - b. Indicator window measuring a minimum 3.52-inch by .60 inch with 1.92 square-inches of front facing viewing area and 180-degree visibility with a total of .236 square-inches of total viewable area.
 - c. Provide snap-in serviceable window to prevent tampering. Lock must function if indicator is compromised.
 - d. Provide messages color-coded with full text and symbol, as scheduled, for easy visibility.
 - e. Unlocked and Unoccupied message will display on white background, and Locked and Occupied message will display on red background.
3. Cylinders: Refer to "KEYING" article, herein.
4. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
5. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
6. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
7. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
8. Provide electrified options as scheduled in the hardware sets.

2.08 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Von Duprin 99/33A series

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 pool gates with weather-resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.

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 (51 mm) x 3 inches (76 mm) 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. 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.
17. 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 (13 mm) of the door face.

2.09 CYLINDERS

A. Manufacturers:

1. Scheduled Manufacturer and Product:
 - a. Match Owner's 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.

2.10 KEYING

A. Scheduled System:

1. New factory registered system:
 - a. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Construction Keying:

- a. Temporary Construction Cylinder Keying.
 - 1) Provide construction cores that permit voiding construction keys without cylinder removal, furnished in accordance with the following requirements.
 - a) Split Key or Lost Ball Construction Keying System.
 - b) 3 construction control keys, and extractor tools or keys as required to void construction keying.
 - c) 12 construction change (day) keys.
 - 2) Owner or Owner's Representative will void operation of temporary construction keys.
- 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).
 - d. 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.

2.11 KEY CONTROL SYSTEM

A. Manufacturers:

- 1. Scheduled Manufacturer:
 - a. Telkee

B. Requirements:

- 1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
 - a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
 - b. Provide hinged-panel type cabinet for wall mounting.

2.12 DOOR CLOSERS

A. Manufacturers and Products:

- 1. Scheduled Manufacturer and Product:
 - a. LCN 4040XP series

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 (38 mm) diameter piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
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.

2.13 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives

B. Requirements:

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

2.14 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.

3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.15 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:
 - a. Glynn-Johnson

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

2.16 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of 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.

2.17 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

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

A. Scheduled Manufacturer:

1. Zero International

- B. 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.
- C. 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.
- D. 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 UL10C Standard for Positive Pressure Fire Tests of Door Assemblies and UBC 7-2, Fire Tests of Door Assemblies.
- E. Sound-Rated Gasketing: Provide acoustic gasketing to meet Sound Transmission Class (STC) rating required.
- F. Meeting-Stile Gasketing: Provide meeting-stile gasketing that fastens to the meeting stiles forming a continuous seal when doors are closed.
- G. 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.
- H. Automatic Door Bottoms:
 - 1. Provide closed cell sponge, bulb neoprene. or EPDM type of seal as specified in hardware sets.
 - 2. Door bottom to be mortised, semi mortised, or surface mount as with a minimum thickness as specified in hardware sets.
- I. 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
- J. 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.

2.19 FINISHES

A. FINISH: BHMA 613/640 (US10B); EXCEPT:

1. Door Closers: Powder Coat to Match.
2. Latch Protectors: US32D (BHMA 630).
3. Weatherstripping: Dark Bronze Anodized Aluminum.
4. Thresholds: Extruded Architectural Bronze, Oil-Rubbed

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. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- L. Continuous Hinges: Re-locate the door and frame fire rating labels where they will remain visible so that the hinge does not cover the label once installed.
- M. 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.
- N. Overhead Stops/Holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
- P. 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.
- Q. 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.
- R. 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.
- S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- T. 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:

Version 1

Legend:

 Link to catalog cut sheet

 Electrified Opening

Hardware Group No. 002

For use on Door #(s):

116A 201

Provide each RU door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	MORTISE CYLINDER	MORTISE CYLINDER MATCH OWNERS KEYWAY	613	
1	EA	Match Owner Key System NOTE	Permanent Core HARDWARE BY DOOR MFG	613	OWN

-OMIT CYLINDER IF NOT NECESSARY

Hardware Group No. 003

For use on Door #(s):

108 202 216

Provide each CO door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
		NOTE	CASED OPENING, NO HARDWARE		

Hardware Group No. 101

For use on Door #(s):

204	205	206	207	208	210
211	212	214	215		

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		613	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50HD RHO		613	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	STOP	WS407/407 Wall Stop or FS18 Floor Stop as REQ		613	
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)		BR	ZER

-CONFIRM FUNCTION WITH OWNER

-CLOSER MAY BE OMITTED AT OWNER'S DISCRETION

-OVERHEAD STOP MAY BE SUBSTITUTED FOR WALL OR FLOOR STOP IF DOOR DOES NOT RETURN TO PROXIMITY WALL.

Hardware Group No. 200

For use on Door #(s):

209

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5		613	IVE
1	EA	AUTO FLUSH BOLT	FB31P/FB41P AS REQ		613	IVE
1	EA	DUST PROOF STRIKE	DP2		US10B	IVE
1	EA	STOREROOM LOCK	ND80HD RHO		613	SCH
1	EA	Permanent Core	Match Existing Keyway		613	OWN
1	EA	COORDINATOR	COR X FL X MB X HW PREPS X LENGTH AS REQUIRED		628	IVE
2	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ		695	LCN
2	EA	PROTECTION PLATE	8400 10" X 1" LDW B-CS		613	IVE
2	EA	WALL STOP	WS406/407CCV		613	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)		BR	ZER
1	SET	MEETING STILE	328AA (2 PCS - 1 SET) HEIGHT AS REQUIRED (OMIT @ NON-RATED DOORS)		B-ORB	ZER

-Use 3/4" latchbolt at fire rated doors.

Hardware Group No. 201

For use on Door #(s):

003	005	006A	007	101	102
106	110B	110E	116B	116C	213

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		613	IVE
1	EA	STOREROOM LOCK	ND80HD RHO		613	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	WALL STOP	WS406/407CCV		613	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)		BR	ZER

Hardware Group No. 203

For use on Door #(s):

112	217

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		613	IVE
1	EA	STOREROOM LOCK	ND80HD RHO		613	SCH
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	WALL STOP	WS406/407CCV		613	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)		BR	ZER

Hardware Group No. 203S

For use on Door #(s):

219	220	221

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		613	IVE
1	EA	STOREROOM LOCK	ND80HD RHO		613	SCH
1	EA	OH STOP	900S SERIES X SIZE & MTG AS REQ		613	GLY
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)		BR	ZER

Hardware Group No. 205

For use on Door #(s):

008 200B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	HINGE	5BB1HW 4.5 X 4.5 USE NRP AT OUTSWING LOCKABLE DOORS		613	IVE
1	EA	STOREROOM LOCK	ND80HD RHO		613	SCH
1	EA	LOCK GUARD	LG1 OR AS REQ		SP313	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	RAIN DRIP	142D (OMIT @ COVERED OPENINGS)		D	ZER
1	SET	GASKETING	328D-S		D	ZER
1	EA	DOOR SWEEP	8198D		D	ZER
1	EA	THRESHOLD	65B-ORB-223		B-ORB	ZER

Hardware Group No. 210

For use on Door #(s):

107

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5		613	IVE
1	EA	CONST LATCHING BOLT	FB51P/FB61P AS REQ		613	IVE
1	EA	DUST PROOF STRIKE	DP2		US10B	IVE
1	EA	STOREROOM LOCK	ND80HD RHO		613	SCH
1	EA	Permanent Core	Match Existing Keyway		613	OWN
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ		695	LCN
2	EA	PROTECTION PLATE	8400 10" X 1" LDW B-CS		613	IVE
2	EA	WALL STOP	WS406/407CCV		613	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)		BR	ZER
1	SET	MEETING STILE	8193AA (2 PCS - 1 SET)		D	ZER

Hardware Group No. 303

For use on Door #(s):

218

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		613	IVE
1	EA	PRIVACY LOCK	ND40S RHO		613	SCH
1	EA	WALL STOP	WS406/407CCV		613	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 401

For use on Door #(s):

002

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		613	IVE
1	EA	PASSAGE SET	ND10S RHO		613	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	WALL STOP	WS406/407CCV		613	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)		BR	ZER

Hardware Group No. 700

For use on Door #(s):

103A 103B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 USE NRP AT OUTSWING LOCKABLE DOORS		613	IVE
2	EA	PANIC HARDWARE	9947-L-LBR-06		313_U S10B	VON
2	EA	RIM CYLINDER	CR3000 AS REQ TO MATCH EXISTING KEY SYSTEM		613	C-R
2	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ		695	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		613	IVE
2	EA	WALL STOP	WS406/407CCV		613	IVE
2	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 701

For use on Door #(s):

104B 104C 105A 105B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 USE NRP AT OUTSWING LOCKABLE DOORS		613	IVE
1	EA	PANIC HARDWARE	99-L-06		313_U S10B	VON
1	EA	RIM CYLINDER	AS REQ TO MATCH EXISTING KEY SYSTEM		613	UNK
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	GASKETING	488S PSA H & J		BR	ZER

Hardware Group No. 701C

For use on Door #(s):

200A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY		710	IVE
1	EA	FIRE EXIT HARDWARE	99-L-F-06		313_U S10B	VON
1	EA	RIM CYLINDER	CR3000 AS REQ TO MATCH EXISTING KEY SYSTEM		613	C-R
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	GASKETING	488S PSA H & J		BR	ZER

Hardware Group No. 701CR

For use on Door #(s):
105C

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY		710	IVE
1	EA	FIRE EXIT HARDWARE	99-L-F-06		313_U S10B	VON
1	EA	RIM CYLINDER	CR3000 AS REQ TO MATCH EXISTING KEY SYSTEM		613	C-R
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	GASKETING	488S PSA H & J		BR	ZER

Hardware Group No. 714

For use on Door #(s):
100 109

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112XY		710	IVE
1	EA	PANIC HARDWARE	9947-EO LENGTH & HEIGHT AS REQ		313_U S10B	VON
1	EA	PANIC HARDWARE	9947-L-LBR-06		313_U S10B	VON
1	EA	RIM CYLINDER	AS REQ TO MATCH EXISTING KEY SYSTEM		613	UNK
1	EA	Match Owner Key System	Permanent Core		613	OWN
2	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ		695	LCN
2	EA	PROTECTION PLATE	8400 10" X 1" LDW B-CS		613	IVE
1	EA	RAIN DRIP	142D		D	ZER
1	SET	MEETING STILE	(OMIT @ COVERED OPENINGS) 328AA (2 PCS - 1 SET) HEIGHT AS REQUIRED (OMIT @ NON- RATED DOORS)		B-ORB	ZER
1	SET	MEETING STILE	8193AA (2 PCS - 1 SET)		D	ZER
2	EA	DOOR SWEEP	8198D		D	ZER
1	EA	THRESHOLD	65B-ORB-223		B-ORB	ZER

Hardware Group No. 714A

For use on Door #(s):
117

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112XY		710	IVE
1	EA	PANIC HARDWARE	9947-EO LENGTH & HEIGHT AS REQ		313_U S10B	VON
1	EA	PANIC HARDWARE	9947-NL-OP LENGTH & HEIGHT AS REQ		313_U S10B	VON
1	EA	RIM CYLINDER	AS REQ TO MATCH EXISTING KEY SYSTEM		613	UNK
1	EA	Match Owner Key System	Permanent Core		613	OWN
2	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ		695	LCN
1	EA	RAIN DRIP	142D (OMIT @ COVERED OPENINGS)		D	ZER
1	SET	MEETING STILE	8193AA (2 PCS - 1 SET)		D	ZER
1	SET	SEAL	PERIMETER SEAL BY FRAME MANUFACTURER			
2	EA	DOOR SWEEP	8198D		D	ZER
1	EA	THRESHOLD	65B-ORB-223		B-ORB	ZER

Hardware Group No. 714M

For use on Door #(s):
104A

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 USE NRP AT OUTSWING LOCKABLE DOORS		613	IVE
1	EA	PANIC HARDWARE	99-DT LENGTH AS REQ		313_U S10B	VON
1	EA	PANIC HARDWARE	99-L-06		313_U S10B	VON
1	EA	RIM CYLINDER	AS REQ TO MATCH EXISTING KEY SYSTEM		613	UNK
1	EA	Match Owner Key System	Permanent Core		613	OWN
2	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ		695	LCN
2	EA	PROTECTION PLATE	8400 10" X 1" LDW B-CS		613	IVE
1	EA	RAIN DRIP	142D (OMIT @ COVERED OPENINGS)		D	ZER
1	SET	MEETING STILE	328AA (2 PCS - 1 SET) HEIGHT AS REQUIRED (OMIT @ NON- RATED DOORS)		B-ORB	ZER
1	SET	MEETING STILE	8193AA (2 PCS - 1 SET)		D	ZER
2	EA	DOOR SWEEP	8198D		D	ZER
1	EA	THRESHOLD	65B-ORB-223		B-ORB	ZER

-EXISTING DOOR TO REMAIN. GC TO EVALUATE DOOR AND HARDWARE PREPS TO ENSURE
DOORS CAN BE PREPPED TO FOR REUSE WITH THIS HARDWARE SET
- WRAP PLATES MAY BE NECESSARY FOR EXIT DEVICE RETROFIT.
- FREE EGRESS BY PUSH PAD.

Hardware Group No. 715

For use on Door #(s):

006C 110A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY		710	IVE
1	EA	PANIC HARDWARE	99-L-06		313_U S10B	VON
1	EA	RIM CYLINDER	CR3000 AS REQ TO MATCH EXISTING KEY SYSTEM		613	C-R
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	RAIN DRIP	142D		D	ZER
			(OMIT @ COVERED OPENINGS)			
1	SET	GASKETING	328D-S		D	ZER
1	EA	DOOR SWEEP	8198D		D	ZER
1	EA	THRESHOLD	65B-ORB-223		B-ORB	ZER

Hardware Group No. 801

For use on Door #(s):

113 115

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		613	IVE
1	EA	PUSH PLATE	8200 4" X 16"		613	IVE
1	EA	PULL PLATE	8303 10" 4" X 16"		613	IVE
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	WALL STOP	WS406/407CCV		613	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)		BR	ZER

Hardware Group No. 953L

For use on Door #(s):
110C

Provide each SL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	POCKET DOOR KIT	9850 SERIES X SIZE AS REQ		HAG
1	EA	POCKET DOOR LOCK	CLASSROOM LOCK 2001ADAP- 3ST W/PULLS	613	ACC
1	EA	MORTISE CYLINDER	20-061 ICX W/KEYED CONST.  CORE	613	SCH
1	EA	Permanent Core NOTE	Match Existing Keyway HARDWARE BY DOOR MFG	613	OWN

****HARDWARE SET IS A GUIDELINE****

- VERIFY AND COORDINATE ALL HARDWARE WITH DOOR/FRAME MANUFACTURER PRIOR TO SUBMITTALS.
- CONFIRM TRACK CAN SUPPORT DOOR WEIGHT AND SIZE.
- DOOR LOCKED/UNLOCKED BY TURN PIECE OR KEY.
- ALWAYS FREE EGRESS BY LEVER.
- PROVIDE STOP IN TRACK TO KEEP DOOR 4" INTO OPENING WHEN IN FULLY OPEN POSITION.
- ENSURE 32" OF CLEAR WIDTH IS MAINTAINED IN OPENING.

PART 1 - GENERAL**1.01 DESCRIPTION**

- A. Work Included: Furnish and install glass and glazing materials and accessories for both factory and field glazed assemblies specified.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.
- C. Samples:
 - 1. Size: 305 mm by 305 mm (12 inches by 12 inches) of each type specified.
 - 2. Tinted glass.
 - 3. Reflective glass.
 - 4. Transparent (one way vision glass) mirrors.
 - 5. Colored glass.
- D. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
- E. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
 - 1. For solar-control low-e-coated glass, provide documentation demonstrating that manufacturer of coated glass is certified by coating manufacturer.
- F. Qualification Data: For installers.
- G. Product Test Reports: For each of the following types of glazing products.
 - 1. Tinted float glass.
 - 2. Coated float glass.
 - 3. Insulating glass.

- H. Warranties: Special warranties specified in this Section.

1.04 QUALITY ASSURANCE

- A. Sustainable Design Certification: Glass shall be Cradle to Cradle Certified, minimum Level, Cradle to Cradle Innovation Institute.
- B. Fabricator Qualifications: Vitro Certified Fabricator Network, as acceptable to the manufacturer.
- C. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association Glazier Certification Program as Level-2 (Senior Glaziers) or Level-3 (Master Glaziers).
- D. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: Clear float glass, coated float glass and insulating glass.
- E. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- F. Glazing Publications: Comply with published recommendations of glass product manufacturers and industry organizations, including but not limited to those below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. FGIA Publication for Insulating Glass: SFGIA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units".
 2. NGA Publications: "Laminated Glazing Reference Manual"; "GANA Glazing Manual".
 3. FGIA Publications for Insulation Glass: AAMA "Sloped Glazing Guidelines".
- G. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:
1. Insulating Glass Certification Council.
 2. Associated Laboratories, Inc.
 3. Fenestration and Glazing Industry Alliance.
- H. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201 and, Fenestration and Glazing Industry Alliance ANSI Z97.1.
1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.
 2. Lites more than 9 sq ft in area are required to be Category II materials.

3. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sf in area, provide glazing products that comply with Category II materials, and for lites 9 SF or less in area, provide glazing products that comply with Category I or II materials.

1.05 APPLICABLE PUBLICATIONS

- A. ANSI Z97.1: Safety Glazing Material Used in Building Safety Performance Specifications and Methods of Test.
- B. ASTM C1036 - Standard Specification for Flat Glass
- C. ASTM C1048 - Standard Specification for Heat-Treated Flat Glass -- Kind HS, Kind FT Coated and Uncoated Glass.
- D. ASTM C 1172 - Standard Specification for Laminated Architectural Flat Glass.
- E. ASTM C1349 - Standard Specification for Architectural Flat Glass Clad Polycarbonate.
- F. ASTM C 1376 - Standard Specification for Pyrolitic and Vacuum Deposition Coatings on Flat Glass.
- G. ASTM E 2188 - Standard Test Method for Insulating Glass Unit Performance.
- H. ASTM E 2189 - Standard Test Method for Testing Resistance to Fogging in Insulating Glass Units.
- I. ASTM E 2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation.
- J. Code of Federal Regulations (CFR) - 16 CFR 1201-10 Safety Standard for Architectural Glazing Materials.
- K. International Building Code - Chapter 24: Glass and Glazing

1.06 DELIVERY, STORAGE AND HANDLING

- A. Protection: Protect glass and glazing materials before, during, and after installation. Protect installed work and materials of other trades.
- B. Storage and Protection: Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun or other causes.
- C. Replacements: In event of damage, immediately make repairs and replacements necessary and at Contractor's expense.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Acceptable Manufacturer: Vitro Architectural Glass; Glass Technology Center, 400 Guys Run Rd., Cheswick, PA 15024. ASD. Toll Free Tel: (855) 887-6457. Fax: (800) 367-2986. Web: <http://www.vitroglazings.com>.

2.02 GLASS PRODUCTS

- A. Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), Quality-Q3; of class indicated.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.
1. **Fabrication Process:** By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
 2. Provide Kind HS (heat-strengthened) float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified.
 3. For uncoated glass, comply with requirements for Condition A.
 4. For coated vision glass, comply with requirements for Condition C (other uncoated glass).
 5. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat- strengthened) float glass where safety glass is indicated or required.
- C. Sputter-Coated Float Glass: ASTM C 1376, float glass with metallic-oxide or -nitride coating deposited by vacuum deposition process after manufacture and complying with other requirements specified.
- D. Tempered Patterned Glass: ASTM C 1048, Kind FT (fully tempered), Type II (patterned flat glass), Class 1 (clear), Form 3 (patterned); and of quality, finish, and pattern specified.
- E. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace and complying with ASTM E 2188 / E 2189 for and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.
1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
 2. Provide Kind FT (fully tempered) glass lites where safety glass is indicated or required.
 3. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.

4. Sealing System: Comply with requirements in Section 07920 - Joint Sealants. Dual seal, with primary and secondary sealants of polyisobutylene and silicone.
5. Spacer Specifications: Manufacturer's standard spacer material and construction complying with the following requirements:
 - a. Spacer Material: Aluminum with mill or clear anodic finish.
 - b. Desiccant: Molecular sieve or silica gel, or blend of both.
 - c. Corner Construction: Manufacturer's standard corner construction.

2.03 GLASS TYPES

- A. No manufacturer logos are allowed on any glass, except as required by governing codes and standards. Provide certification to General Contractor that tempered, heat strengthened, annealed, laminated, etc. glass was used where required.
- B. Annealed float glass shall comply with ASTM C1036, Type I, Class 1 (clear), Class 2 (tinted), Quality-Q3.
- C. Heat-Strengthened float glass shall comply with ASTM C1048, Type I, Class 1 (clear), Class 2 (tinted), Quality Q3, Kind HS.
- D. Tempered float glass shall comply with ASTM C1048, Type I, Class 1 (clear), Class 2 (tinted), Quality Q3, Kind FT.
- E. Heat-treated glass with elastomeric coating complying with ASTM C1048, Condition C (other coated glass), Type I (transparent glass, flat), Quality Q3 (glazing select) and with other requirements as specified.
- F. GANA/GTA 89-1-31, "Specification for Environmental Durability of Fully Tempered or Heat-Strengthened Spandrel Glass with Applied Opacifiers", and with other requirements as specified.
- G. Provide type glass and thickness required and as follows:
 1. **Clear Annealed Float Glass:** 1/4" thick unless otherwise shown.
 2. **Clear Tempered Float Glass:** 1/4" thick unless otherwise shown. Conform to Safety Standard 16 CFR 1201 of the Consumer Products Safety Commission.
 3. **"Low-E" Coating:** Vitro Architectural Glass Solarban® 72 (2) Acuity™ + Acuity™, VLT 67, SHGC 0.28, Insulating Glass Unit (IGU) or approved equal.

2.05 FIRE RATED GLASS

- A. Approved Manufacturers:
 1. PYRAN® Platinum L as manufactured by SCHOTT Technical Glass Solutions and distributed by SAFTI FIRST Fire Rated Glazing Solutions, 888-653-3333. Amber-tinted glass will not be accepted.

- B. Properties:
1. Thickness: 3/8 inch overall
 2. Weight: 4 lbs./sq. ft.
 3. Appearance Must have neutral coloration free of amber tints.
 4. Fire-rating: 20 minutes to 3 hours for doors; 20 minutes to 60 minutes for other applications, with hose stream.
 5. Impact Safety Resistance: Must meet CPSC 16 CFR 1201 Category I and II.
 6. STC Rating: Approximately 36 dB.
 7. Positive Pressure Test: UL 10C, UBC 7-2 and 7-4; passes.
- C. Labeling: Each piece of Fire-rated glazing material shall be labeled with a permanent logo including name of product, manufacturer, testing laboratory and fire rating.
- D. Fire Rating: Fire rating listed and labeled by UL for fire rating scheduled at opening locations on drawings, when tested in accordance with ASTM E 152 and ASTM E 163; NPFA 252 and NFPA 257; UL 9, UL 10B and UL 10C.
- E. Glazing Compound for Fire-rated Glazing Materials: Silicone Sealant, One-part neutral curing silicone, medium modulus sealant, Type S; Grade NS; Class 25 with additional movement capability of 50 percent in both extension and compression (total 100 percent); Use (Exposure) NT; Uses (Substrates) G, A, and O as applicable. Available Products:
1. Dow Corning 795 - Dow Corning Corp.
 2. Silglaze-II 2800 - General Electric Co.
 3. Spectrem 2 - Tremco Inc.
- F. Setting Blocks: Neoprene, EPDM, or silicone; tested for compatibility with glazing compound; of 70 to 90 Shore A hardness.
- G. Cleaners, Primers, and Sealers: Type recommended by manufacturer of glass and gaskets.

2.06 HERMETICALLY SEALED INSULATING GLASS ASSEMBLIES

- A. Manufacturer is used in this section to refer to a firm that produces primary glass or fabricated glass as defined in the referenced standards.
1. Guardian Industries
 2. Oldcastle Glass
 3. Pilkington
 4. Viracon Architectural Glass
 5. Vitro Architectural Glass
 6. Approved equal
- B. Insulating glass units are certified through the Insulating Glass Certification Council (IGCC) to ASTM E 2190 Standard Specification for Insulating Glass Unit Performance and Evaluation.

- C. The following are assemblies comprised of the components listed above.
1. **"Low-E" Coated Tinted/Tempered Assembly:** 1" thick panels consisting of 1/4" clear tempered float glass on interior and 1/4" thick tinted tempered float glass on exterior with 1/2" air space and coating on #2 surface.
 2. **"Low-E" Coated Tinted/Heat-Strengthened Assembly:** 1" thick panels consisting of 1/4" clear annealed float glass on interior and 1/4" thick tinted float glass on exterior with 1/2" air space and coating on #2 surface.
 5. **Clear/Tempered Assembly:** 1" thick panels consisting of 1/4" clear tempered float glass on interior and 1/4" thick clear tempered float glass on exterior with 1/2" air space.
 6. **Clear/Annealed Assembly:** 1" thick panels consisting of 1/4" clear annealed float glass on interior and 1/4" thick clear annealed float glass on exterior with 1/2" air space.
 7. **Spacers:** Aluminum in Black Finish. Verify color selection with architect before fabrication.

2.07 FLAT GLASS

- A. Flat Glass:
1. Shall comply with ASTM C1036-25 Standard Specification for Flat Glass, Type 1, Class 1, (clear) or Class 2 (tinted, heat-absorbing and light-reducing) and Quality Q3 (Glazing Select).
 2. ASTM C 1048 Heat Treated Flat Glass, Kind HS or FT (remove ASTM Standard C 1048 if annealed glass), Condition A (un-coated), B (spandrel glass, one surface coated), or C (other coated glass).
 - a. Heated Treated Flat Glass to be by horizontal (roller hearth) process with inherent rollerwave distortion parallel to the bottom edge of the glass as installed.
 - b. Maximum peak-to-valley rollerwave 0.003" in the central area and 0.008" within 10.5' of the leading and trailing edge.
 - c. For clear or low-iron glass 1/4" to 3/8" thick without ceramic frit or ink, maximum + or - 100mD (millidiopter) over 95% of the glass surface.
 - d. Maximum bow and warp 1/32" per lineal foot.
 - e. All tempered architectural safety glass shall conform with ANSI Z97.1 and CPSC 16 CFR 1201.
 - f. For all fully tempered glass, provide heat soak testing conforming to EN14179 which includes a 2 hour dwell at 290°C±10°C.
 - g. ASTM C 1172 Specification for Laminated Architectural Flat Glass.
- B. Glass Inspection Standards:
1. Any flaws that develop as a result of the manufacturing or handling process are inspected using the most current Glass Industry Standards:
 - a. ASTM C1036 for Flat Glass.
 - b. ASTM C1048 for Heat Treated Glass.
 - c. ASTM C1376 for Low-E Coatings on Flat Glass.
 - d. ASTM C 1651 Roll Wave Optical Distortion for Heat Treated Glass.
 - e. ASTM C 1503 for Mirrors.
 - f. ASTM C 1172 for Laminating Process Blemishes.

- g. **Safety Glazing:** CPSC 16 CFR 1201 and ANSI Z97.1.
- h. The Standards herein at a minimum meet that of ASTM or have tighter tolerances.
- 2. Surface imperfections: All inspections shall be done with the viewing angle at 90 degrees to the glass surface, uniform diffused lighting that simulates daylight, and with the inspector looking thru rather than at the glass surface.
- 3. **Architect requires that inspection reports be provided.**

2.08 GLAZING ACCESSORIES

- A. Provide glazing accessories required to complete glazing work that are compatible with various components of the glazing system(s), and subject to approval of Architect.
- B. Glazing Sealants: Provide Tremco "Proglaze", Bostik "Chem-Calk 2000", Pecora "836", Dow Corning Silicon 795, or approved equal. Color to be selected by Architect from manufacturer's standard line.
- C. Glazing Tapes: Provide Tremco "Pre-shimmed 440", Bostik "Chem Tape 60", Pecora "Shim-Seal", or approved equal. Color to be selected by Architect from manufacturer's standard line.
- D. Setting Blocks: Neoprene or other resilient blocks of 70 to 90 Shore A durometer hardness, adhesive backed on one face only and tested for compatibility with specified glazing sealants.
- E. Spacers: Neoprene or other resilient blocks of 40 to 50 Shore A durometer hardness and tested for compatibility with specified glazing sealants.
- F. Compressible Filler Rod: Closed-cell or waterproof jacketed foam of polyethylene, butyl rubber, neoprene, polyurethane or vinyl, tested for compatibility with specified glazing sealants, of 5 to 10 psi compression strength (25% deflection), recommended by sealant manufacturer for use in glazing channel to prevent sealant exudation from the channel.

PART 3 - EXECUTION

3.01 GLASS SIZES

- A. Measure sizes for glass from actual frames, doors and windows. Contract requires glass to be set in place, and Contractor assumes responsibility for correct sizes. Use sizes shown on Drawings for estimating only as approximate dimensions.

3.02 GLAZING SURFACES

- A. Glaze only dry surfaces, free from dust or ice. Clean dirty surfaces with cloth saturated with turpentine or mineral spirits before glazing. Remove loose dirt particles and mortar from recesses prior to installation of glass and glazing materials.

3.03 SETTING GLASS

- A. Set glass to provide equal bearing for entire width of each pane. Contractor responsible for broken glass due to improper setting. Set using glazing stops furnished by door or fixed framing manufacturer unless otherwise shown or specified. Accurately set glass to fit frame, with all edges smooth. Sharp ragged edges are not acceptable. Cushion glass in fixed interior view windows with felt strips around entire perimeter.

3.04 CLEANING GLASS

- A. Contractor shall employ services of a professional window washer at completion of all work to wash glass which has been installed under this contract, removing all stains.
- B. Clean glass on both sides after painting operations are complete and dry. Do not use acid solutions or caustic soaps to clean glass.
- C. Do not use razor blades to clean glass. Any scratches on the glass caused by the cleaning process will be cause for the removal and replacement of the damaged glass at the Contractor's expense.

3.05 SETTING AND CLEANING PLASTIC SHEET

- A. Due to relatively high co-efficient of thermal expansion, make allowances in sizing of plastic sheets complying with manufacturer's instructions. Do not clean with abrasive or highly alkaline cleaners. Do not scrape with razor blades or sharp instruments.

END OF SECTION 08 80 00

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PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Provide metal supports and fastenings, gypsum board, and related accessories specified.
- B. Refer to the mechanical and electrical and plumbing drawings for extent of patching and repair work required in adjacent areas for accommodation of renovation work. The finish and fire rating of areas where demolition will be necessary and not specifically shown or noted on Drawings is required to match the existing conditions.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

- A. Qualifications of Installers: Use only skilled and experienced gypsum drywall installers. Fully supervise at all times helpers and apprentices used for drywall work with thoroughly skilled gypsum drywall installers.
- B. Manufacturers' Recommendations: Manufacturers' recommended use of materials, fastenings, and methods of installation is basis for acceptance or rejection of drywall and cementitious backer units work where not specifically otherwise shown or detailed.

1.05 REFERENCE STANDARDS

- A. Aluminum Association:
 - 1. Designation for Aluminum Finishes
- B. American Society for Testing and Materials International (ASTM):
 - 1. ASTM C475/C475M, Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

2. ASTM C514, Specification for Nails for the Application of Gypsum Board.
3. ASTM C557, Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.
4. ASTM C645 Standard Specification for Nonstructural Framing Members .
5. ASTM C840, Specification for Application and Finishing of Gypsum Board.
6. ASTM C954, Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. to 0.112 in. in Thickness.
7. ASTM C1002, Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
8. ASTM C1047, Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
9. ASTM C1177/C1177M, Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
10. ASTM C1178/C1178M, Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel.
11. ASTM C1280, Specification for Application of Gypsum Sheathing Board.
12. ASTM C1396/C1396M, Standard Specification for Gypsum Board.
13. ASTM C1629/C1629M, Standard Classification for Abuse-Resistant Non-decorated Interior Gypsum Panel Products & Fiber-Reinforced Cement Panels.
14. ASTM C1658/C1658M, Standard Specification for Glass Mat Gypsum Panels.
15. ASTM D3273, Standard test Method for Resistance to Growth of Mold on the Surface on Interior Coatings in an Environmental Chamber.
16. ASTM C1766 Standard Specification for Factory-Laminated Gypsum Panel Products.

C. Gypsum Association:

1. GA-216, Specification for the Application and Finishing of Gypsum Panel Products.
 - a. A control joint shall be installed where a partition, wall, or ceiling traverses a construction joint (expansion, seismic or building control element) in the base building structure.
 - b. Control joints shall be installed where a wall or partition runs in an uninterrupted straight plane exceeding 30 linear feet.
 - c. Control joints in interior ceilings with perimeter relief shall be installed so that linear dimensions between control joints do not exceed 50 ft and total area between control joints does not exceed 2500 sq ft.
 - d. Control joints in interior ceilings without perimeter relief shall be installed so that linear dimensions between control joints do not exceed 30 ft and total area between control joints does not exceed 900 sq ft.
 - e. Control joints in exterior ceilings and soffits shall be installed so that linear dimensions between control joints do not exceed 30 ft and total area between control joints does not exceed 900 sq ft.
2. GA-214, Levels of Finish for Gypsum Panel Products.
3. GA-253, Application of Gypsum Sheathing.
4. GA-600-2024, "Fire Resistance Design Manual".

5. GA-800, "Materials Handling Manual".
 6. GA-234-2019, "Control Joints for Fire-Resistance Rated Systems".
- D. International Organization for Standardization:
1. ISO 14024- Environmental Labels and Declaration, Type I Environmental Labeling Principles and Procedures
 2. ISO 14025 - Environmental Labels and Declarations, Type III Environmental Declarations Principles and Procedures
- E. Underwriters' Laboratories of Canada (ULC):
1. ULC-S101, Fire Endurance Tests of Building Construction and Materials
 2. ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies
 3. ULC-S114, Standard Method of Test for Determination of Non-Combustibility in Building Materials

1.06 FIRE RESISTANCE RATINGS AND IDENTIFICATION

- A. Where gypsum drywall systems with fire resistance ratings are indicated or are required to comply with governing regulations, provide materials and installation methods identical to applicable assemblies which have been tested and listed by recognized authorities, including Underwriters Laboratories, Warnock-Hersey and Factory Mutual.
- B. All joints in fire rated gypsum board construction are required to be taped and floated. This includes all joints in concealed and exposed partitions, ceilings and other applications where gypsum board is utilized as a fire barrier. All screws are to be floated over.
1. Do not use self adhesive Tape at fire rated construction. Provide standard Tape and Drywall Mud.
- C. All rated partitions are to extend to the underside of the roof or floor deck above and are to be sealed at the point of intersection with the deck in accordance with requirements of Section 07 84 00 - Firestopping.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original packages, containers or bundles bearing manufacturers brand name and identification.
- B. Store materials inside, level, under cover. Keep dry. Protect from weather, other elements and damage from construction operations and other causes.
- C. Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect metal accessories and trim from being bent or damaged.
- D. Replacements: In event of damage, immediately make repairs and replacements necessary and at Contractor's expense.

1.08 WASTE MANAGEMENT AND DISPOSAL

- A. Separate and recycle waste materials in accordance with standard practices.
- B. Collect and separate for disposal paper, plastic, polystyrene, and corrugated cardboard packaging material in appropriate on-site for recycling in accordance with Waste Management Plan.
- C. Do not dispose of unused paint and caulking materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

PART 2 - PRODUCTS

2.01 GYPSUM MATERIALS

- A. **Manufacturers:** Use products and materials by one of the following manufacturers:
 - 1. Certaineed
 - 2. National Gypsum Company
 - 3. Georgia-Pacific Company
 - 4. Temple-Inland, Inc.
 - 5. United States Gypsum
 - 6. James Hardie Building Products
 - 7. Approved Equal
- B. **Gypsum Wallboard:** Conform to ASTM C1396, have tapered edges and furnished in largest practical sheet size to minimize number of joints. Provide thickness as indicated on Drawings; typically provide 5/8" thickness at walls.
- C. **Backerboard for Ceramic Tile:**
 - 1. Provide 5/8 inch DensShield® FireGuard® Tile Backer gypsum board as manufactured by Georgia Pacific Company, GlasRoc® Diamondback® Tile Backer by CertainTeed, or approved equal. Furnish largest size sheets practical to minimize joints. Conform to manufacturer's instructions for installation given the conditions detailed on the drawings. Caulk all joints where backer board comes into contact with dissimilar material.
 - 2. Provide 5/8 inch (interior) Durock® Brand Cement Board with EdgeGuard™ protection as manufactured by United States Gypsum Co., or approved equal. Furnish largest size sheets practical to minimize joints. Conform to manufacturer's instructions for installation of cement board given the conditions detailed on the drawings. Caulk all joints where backer board comes into contact with dissimilar material.
- D. **Fire Retardant Gypsum Board:** 5/8" fire retardant gypsum board conforming to UL Design Numbers listed on drawings for type and manufacturer.

- E. **Moisture-, Mold- and Mildew-Resistant Drywall:** Provide National Gypsum Services PURPLE® XP® where Fluid-Applied multi-purpose epoxy coating is applied at shower walls (Refer to Section 09 67 00 - Fluid-Applied Flooring). “Greenboard” not allowed.
- F. **Finish:** In general, all gypsum board walls are to be taped and floated for a smooth finish. A slight egg-shell texture may be acceptable if approved by Architect prior to application. Heavy "knockdown" texturing is not acceptable.
 - 1. All screw and/or nail heads are to be floated smooth both above and below ceiling line.
 - 2. Refer to Drywall Finishing Council document titled, “Recommended Specification For Preparation of Gypsum Board Surfaces Prior To Texture Application. When subjected to critical lighting, a Level 5 gypsum board finish as defined in GA-214-2021 (“Levels of Finish for Gypsum Panel Products”) is recommended.
 - 3. For Levels 3, 4, and 5, job-site mock-up(s) shall be used to determine acceptance of the finish within the building. The design professional shall specify the mockup procedure and mock-up construction details within the project documents, unless waived in writing. Finish joints, edges, corners, and fastener heads in accordance with ASTM C840. **Use Level 4 finish for all finished areas open to public view.** Level 5 skim coating is required at areas exposed to severe lighting conditions, gloss, semi-gloss, or enamel paint applications. Refer to the drawings for specific area locations.

2.02 WALL AND PARTITION FRAMING

- A. Provide type, size, gauge and physical properties as described by the manufacturers load and height tables and in accordance with the current local building code. All section properties shall be calculated in accordance with the AISI Specification for the Design of Cold-Formed Steel Structural Members (latest edition).
- B. Structural calculations specifically related to this project and performed by the manufacturer's structural engineer will indicate depths, gages and spacings of studs required to meet deflection and load bearing requirements.
- C. At all instances where radius steel stud and drywall construction is shown on drawings it is intended that the radius be smooth not faceted. Contractor is required to provide smooth face radius by whatever means necessary.
- D. Runners: Match studs; type recommended by stud manufacturer for floor and ceiling support of studs, and for vertical abutment of drywall work at other work.
- E. Install supplementary framing, blocking and bracing in the metal framing system wherever walls or partitions are indicated to support work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with the stud manufacturer's recommendations and industry standards in each case, considering the weight or loading resulting from the item supported.

1. Screw attach blocking between studs for support of surface mounted items.
 - a. Plumbing fixtures.
 - b. Toilet partitions.
 - c. Wall cabinets.
 - d. Toilet accessories
 - e. Hardware.
 - f. Architectural woodwork.
 - g. Grab bars.
 - h. Handrails and railings.
 - i. Signage.
 - j. Other items requiring backing for attachment.

2.03 METAL FURRING MEMBERS

- A. "Hat" Type Channels: ASTM C 645, 25 gage minimum, hat-shaped, depth and thickness as indicated. Provide 22 gage min. Galvalume® (GVM) Vented Hat Channel (HCV) at exterior rainscreen for spacing between insulation and exterior cladding.
- B. "C" Type Channels: 16 gauge, 1-1/2" deep cold rolled steel channels painted black and weighing not less than 475 lbs. per 1,000 LF.
- C. Z-Furring Members: Manufacturer's standard Z-shaped furring members with slotted or nonslotted web, fabricated from 26-gage galvanized steel, steel sheet complying with ASTM A 525 or ASTM A 568; with a minimum base metal (un-coated) thickness of 0.0179 inch, face flange of 1-1/4 inch, wall-attachment flange of 7/8 inch, and of depth required to fit insulation thickness indicated.
- D. Furring Brackets: Serrated-arm type, adjustable, fabricated from corrosion-resistant steel sheet complying with ASTM C 645, minimum thickness of base (un-coated) metal of 0.0329 inch, designed for screw attachment to steel studs and steel rigid furring channels used for furring.

2.04 ACOUSTICAL INSULATION

- A. In partitions, provide un-faced Owens-Corning Sound Attenuation Batt (SABs) Insulation, or approved equal, complying with ASTM C 665, Type I and ASTM E 136. Flame spread rating shall not exceed 25 and smoke developed shall not exceed 50 when tested complying with ASTM E 84.

2.05 DIRECT CEILING SUSPENSION SYSTEMS

- A. Manufacturer: Chicago Metallic or approved equal.
 1. Armstrong® Pre-Engineered FrameAll™ Drywall Grid.
- B. System: Provide Chicago Metallic Drywall Furring System(s) as follows:
 1. Typical System: 640-C or 660-C as recommended by manufacturer.
 2. Fire Rated System: Fire front 650-C or 670-C as recommended by manufacturer.

- C. Provide all runners, tees, cross channels, cross tees, wall track, hanger wire and accessories required for a complete installation.
- D. Where ceiling is subject to wind uplift, provide adequate bracing above ceiling to prevent uplift.

2.06 FASTENERS

- A. Drywall Screws: Self-drilling type, 1" long for single layer application of gypsum board to metal studs and furring channels and of longer length for multiple layer installation.
- B. Powder-Actuated Fasteners: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- C. Furring Anchorages: 16-gage galvanized wire ties, manufacturer's standard wire-type clips, bolts, nails or screws as recommended by furring manufacturer and complying with C754.

2.07 PROTECTIVE COATING

- A. Galvanized steel studs, runners (track), rigid (hat section) furring channels, "Z" shaped furring channels, and resilient furring channels, with coating designation of G40 or equivalent.

2.08 ACCESSORIES

- A. Casing Bead: "Goldbond" No.500 galvanized steel by National Gypsum Co., or approved equal. Furnish and install metal reveal strips where shown and detailed.
- B. Corner Beads: 0.014 inch thick, hot dip galvanized steel with 1" flanges with 1/16" radius nose with large openings in flange similar to 5/8" diameter holes 7/8" on center.
- C. Control and Expansion Joints: "Sheetrock" zinc control joint No.093 by USG, or approved equal. Provide safin and/or acoustical insulation behind control joints as required for adjacent partition construction. Use fire rated control joints in partitions requiring a fire rating.

2.09 ACCESS PANELS AND FRAMES

- A. Manufacturer: Milcor Limited Partnership, 1150 North Cable Road, Lima, OH 45805, 1-800-528-1411 or approved equal.
 - 1. BAUCO Access Panel Solutions, Inc., (877) 592-0033.

- B. **Access Locations:** Install removable access panels directly below each valve, flow indicator, damper, air splitter or other utility requiring access that is located above ceilings, other than at acoustical panel ceilings, and that would otherwise not be accessible. Install access doors and panels permitting access to service valves, traps, dampers, clean-outs, and other mechanical, electrical and conveyor control items concealed in walls and partitions. Verify types, fastening and locations with architect during shop drawing review submission.
1. When possible, avoid locating access panels in wet areas. When such locations cannot be avoided, provide moisture resistant assemblies.
 2. Install fire-rated access doors in fire-rated partitions and ceilings in accordance with NFPA 80.

2.10 OTHER MATERIALS

- A. Provide materials, not specifically described but required for complete and proper installation of gypsum drywall, selected by Contractor subject to approval of Architect.

PART 3 - EXECUTION

3.01 GENERAL PROVISIONS

- A. Comply with specified requirements, manufacturer's instructions and recommendations, and referenced standards.
- B. In cold weather, heat building to provide uniform temperature of 50° to 70° and provide ventilation to eliminate excess moisture.
- C. Deliver materials to job in original unopened containers or bundles and store protected from damage and exposure to the elements.
- D. Provide casing beads where edges of gypsum board meet dissimilar materials.
- E. Cooperate with carpenters in placing of backing and blocking required for millwork, fixtures, fittings, and accessories.
- F. Make cut-outs in panels for pipes, fixtures and small openings. Make holes and cut-outs by method that will not fracture wallboard core or tear covering. Cut holes with accuracy so plates, escutcheons and trim cover edges.
- G. Seal cut edges, holes, and areas where wallboard covering is broken, with resistant sealer.
- H. Install trim in strict accordance with manufacturers' recommendations. Install trim plumb, level, and true to line with firm attachment to supporting members.
- I. At any change in direction of gypsum board, provide sufficient auxiliary framing, blocking or nailers to allow secure attachment along every edge of every individual piece of gypsum board. Do not leave any loose edges.

3.02 INSTALLATION OF METAL SUPPORT SYSTEMS

- A. Do not bridge building expansion joints with support system, frame both sides of joints with furring and other support as indicated.
- B. Ceiling Support Suspension System: Install in accordance with manufacturers recommendations.
- C. Wall/Partition Support System
 - 1. Install supplementary framing, blocking and bracing to support fixtures, equipment, services, heavy trim, furnishings and similar work which cannot be adequately supported on gypsum board alone.
 - 2. Isolate stud system from transfer of structural loading to system, both horizontally and vertically. Provide slip or cushioned type joints to attain lateral support and avoid axial loading.
 - 3. Do not attach stud system to ductwork, piping, conduit, etc.
 - 4. Install runners (tracks) at floors, ceiling and structural walls and columns where gypsum drywall stud system abuts other work, except as otherwise indicated.
 - 5. Extend partition stud system through acoustical ceilings and elsewhere as indicated to the structural support and substrate above the ceiling as indicated. Install angle bracing at 4'0" on center from ceiling runner to structure above.
 - 6. Frame door openings with vertical studs securely attached by screws at each jamb either directly to frames or to jamb anchor slips on door frame; install runner track sections (for jack studs) at head and secure to jamb studs. Install angle bracing above ceiling to structural in each direction at strike side of door. Double studs at all door openings.
 - 7. Provide runner tracks of same gage as jamb studs. Space jack studs same as partition studs.
 - 8. Frame openings other than door openings in same manner as required for door openings; and install framing below sills of openings to match framing required above door heads. Opening for duct work, piping must allow clearance for insulation, dampers, etc. Provide double 20 gauge studs at both sides of door openings less than 4'-0" wide and triple 20 gauge studs at door openings greater than 4'-0" wide.
 - 9. Install wall/partition support system to maximum tolerances of 1/8" in 12'-0" measured horizontally and vertically.
 - 10. At rated partitions, provide "5 sided" gypsum board enclosures where items (i.e. toilet accessories, electrical items, fire extinguisher cabinets, etc.) penetrate the surface of the wall, in order to maintain fire resistive integrity of the wall. Provide necessary related blocking.
 - a. "5 sided" enclosures may be omitted where metal electrical back-boxes not exceeding 16 square inches occur at one side only of a wall within a single stud cavity.
 - b. In this case, provide fire stopping material described in Section 07 84 00 to completely encompass the back box and its annular space.

- c. If 5 sided gypsum board enclosures are not to be provided at any fire rated partitions, all provisions for installation of electrical boxes in rated partitions as described by Underwriters Laboratories shall be adhered to AND prior approval shall be given in written form by the Architect.
11. Provide "5 sided" enclosures similar to those described above at all penetrations into "sound" partitions and insulated exterior walls regardless of size. The provisions for the omission of the 5 sided enclosures at certain fire rated partitions do not apply to these sound and exterior partitions.

3.03 GENERAL GYPSUM BOARD INSTALLATION REQUIREMENTS

- A. Pre-Installation Conference: Meet at the project site with the installers of related work and review the coordination and sequencing of work to ensure that everything to be concealed by gypsum drywall has been accomplished, and that chases, access panels, openings, supplementary framing and blocking and similar provisions have been completed.
 - 1. At finished areas exposed to public view, encapsulate pipes, conduit, ductwork and similar utility components below ceiling levels, whether indicated on the drawings or not.
- B. Install sound attenuation blankets where indicated, prior to gypsum board unless readily installed after board has been installed.
- C. Locate exposed end-butt joints as far from center of walls and ceilings as possible, and stagger not less than 1'-0" in alternate course of board.
- D. Install ceiling boards in the direction and manner which will minimize the number of end-butt joints, and which will avoid end joints in the central area of each ceiling. Stagger end joints at least 1'-0".
- E. Install wall/partition boards vertically to avoid end-butt joints wherever possible. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs. Do not butt boards to concrete floor. Maintain a minimum 1/4" to a maximum 3/8" space between bottom of board and concrete.
- F. Install exposed gypsum board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1/16 inch open space between boards. Do not force into place.
- G. Locate either edge or end joints over supports, except in horizontal applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Position boards so that like edges abut, tapered edges against tapered edges and mill-cut or field-cut ends against mill-cut or field cut ends. Do not place tapered edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions.

- H. Attach gypsum board to framing and blocking as required for additional support at openings and cutouts. Space between recessed boxes and cut edges shall not exceed 1/8 inches.
- I. Form control joints and expansion joints with space between edges of boards, prepared to receive trim accessories described below in article entitled "INSTALLATION OF DRYWALL TRIM ACCESSORIES".
- J. Cover both faces of partition framing with gypsum board in concealed spaces (above ceilings, etc.) except in chase wall which are braced internally.
- K. Space fasteners in gypsum boards in accordance with referenced standards and manufacturer's recommendations, except as otherwise indicated.

3.04 INSTALLATION OF CEILING ACCESS PANELS

- A. General Contractor is required to coordinate locations and number of access panels with affected trades in order to minimize the number of access panels required.
- B. Provide ceiling access panels in gypsum board ceilings as specified. Provide quantity required for access to the following items commonly found above the ceiling plain:
 - 1. Operable portion of fire, smoke and other dampers
 - 2. Valves and other operable portions of sprinkler system
 - 3. Valves to mechanical, domestic and other piping systems
 - 4. Mechanical devices
 - 5. Fire alarm devices
 - 6. Communication system devices and connection points
 - 7. Sanitary and storm sewer clean outs
 - 8. Also included are any other items located above an otherwise inaccessible ceiling that will require adjustment, maintenance, inspection, connection or replacement in whole or in part at any time after the initial installation of the item or the ceiling.

3.05 METHODS OF GYPSUM BOARD APPLICATION

- A. On ceilings:
 - 1. Apply gypsum board prior to wall/partition board application to the greatest extend possible. For single-ply construction, use perpendicular application. For two-ply assemblies use perpendicular application and apply face ply of gypsum board so that joints of face ply do not occur at joints of base ply with joints over framing members.
 - 2. Where screws are used, they shall be spaced not more than 12 in. o.c. for ceilings where the framing members are 16 in. o.c..
 - 3. Screws shall be spaced not more than 12 in. o.c. for ceilings where framing members are 24 in. o.c..
 - 4. For applications on wood or other applications, refer to Gypsum Association GA-216 for fastener type and spacing.

- B. On partitions except shaft wall:
1. Use maximum length sheets practical to minimize end joints.
 2. When gypsum board is installed parallel to framing members, space fasteners 12 inches on center in field of the board, and 8 inches on center along edges.
 3. For applications on wood or other applications, refer to Gypsum Association GA-216 for fastener type and spacing.
 4. When gypsum board is installed perpendicular to framing members, space fasteners 12 inches on center in field and along edges.
 5. Stagger screws on abutting edges or ends.
 6. For single-ply construction, apply gypsum board with long dimension either parallel or perpendicular to framing members as required to minimize number of joints except gypsum board shall be applied vertically over "Z" furring channels.
 7. For two-ply gypsum board assemblies, apply base ply of gypsum board to assure minimum number of joints in face layer. Apply face ply of wallboard to base ply so that joints of face ply do not occur at joints of base ply with joints over framing members.
 8. On Z-furring members apply gypsum board vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
- C. Wall Tile Base: Where drywall is base for thin set ceramic tile and similar rigid applied wall finishes, install gypsum backing board. At "wet" areas, install with un-cut long edge at bottom of work, and space 1/4" above fixture lips. Seal ends, cut-edges and penetrations of each piece with water resistant compound before installation.

3.06 INSTALLATION OF DRYWALL TRIM ACCESSORIES

- A. General: Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to the supports. Otherwise, fasten flanges to comply with manufacturer's recommendations.
- B. Install metal corner beads at external corners of drywall work. Corner beads are to be completely bedded and taped.
- C. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed, and except where plastic trim is indicated. Provide type with face flange to receive joint compound except where semi-finishing type is indicated. Install L-type trim where work is tightly abutted to other work, and install special kerf-type where other work is kerfed to receive long leg of L-type trim. Install U-type trim where edge is exposed, revealed, gasketed, or sealant-filled (including expansion joints).
- D. Install metal control joints where indicated on drawings. If not indicated on drawings, install in accordance with the following:
1. Interior Partitions: Maximum Single Dimension not to exceed 20 feet. Maximum Single Area not to exceed 400 SF.
 2. Interior Ceiling With Perimeter Relief: Maximum Single Dimension not to exceed 40 feet. Maximum Single Area not to exceed 1,600 SF. Install control joint at any change of direction of ceiling framing or support system.

3. Interior Ceiling Without Perimeter Relief: Maximum Single Dimension not to exceed 20 feet. Maximum Single Area not to exceed 400 SF. Install control joint at any change of direction of ceiling framing or support system.

3.07 INSTALLATION ON WOOD

- A. Install gypsum board on wood blocking and wood furring by double nailing using annular ringed nails specified in Part 2 of this Section. Space nails not less than 3/8" from ends and edges of wallboard. Hold wallboard in firm contact with nailing member while nails are being driven. Dimple heads slightly below surface of wallboard with final hammer blow, taking care not to break the paper face.

3.08 JOINT TREATMENT

- A. General: Joint treatment for gypsum board surfaces is also described in Section 09 91 00 and may be performed under either the gypsum board or painting subcontract.
- B. **All joints in gypsum board construction are to be taped and floated. This includes work above ceilings, at concealed places and anywhere else joints in gypsum board construction occur.**
- C. Base for Ceramic Tile: Treat joints and fasteners to comply with directions of water resistant joint compound manufacturer. In areas to be tiled treat fastener heads with water resistant joint compound. Fill tapered edges in gypsum panels with water resistant joint compound, embed joint tape firmly and wipe off excess compound; follow immediately with a second coat of water resistant joint compound over taping coat, being careful not to crown the joint. Fold and embed tape in all interior angles to form true angle.

3.09 FINISHING OF GYPSUM BOARD

- A. Finish joints, edges, corners, and fastener heads in accordance with ASTM C840. Use Level 4 finish for all finished areas open to public view.
- B. Before proceeding with installation of finishing materials, assure the following:
 1. Gypsum board is fastened and held close to framing or furring.
 2. Fastening heads in gypsum board are slightly below surface in dimple formed by driving tool.
- C. Finish joints, fasteners, and all openings, including openings around penetrations, on that part of the gypsum board extending above suspended ceilings to seal surface of gypsum board construction. After the installation of hanger rods, hanger wires, supports, equipment, conduits, piping and similar work, seal remaining openings and maintain the integrity of the construction.

3.10 REPAIRS

- A. After taping and finishing has been completed, and before decoration, repair all damaged and defective work, including non-decorated surfaces.
- B. Patch holes or openings 1/2-inch or less in diameter, or equivalent size, with a setting type finishing compound or patching plaster.
- C. Repair holes or openings over 1/2-inch diameter, or equivalent size, with 5/8-inch thick gypsum board secured in such a manner as to provide solid substrate equivalent to undamaged surface.
- D. Tape and refinish scratched, abraded or damaged finish surfaces including cracks and joints in non decorated surface to provide smoke tight construction, fire protection equivalent to the fire rated construction and STC equivalent to the sound rated construction, where applicable.

3.09 INSTALLATION

- A. ASTM C840-08 or GA-216-2024 provides the following requirements for installing control joints in gypsum board assemblies:
 - 1. Section 20.2 (GA 4.7.1.1 & GA 4.7.2) – Control joints shall be installed where indicated on the plans. Full height door frames shall be considered equivalent to a control joint.
 - 2. Section 20.3 (GA 4.7.3) – Control joints in the gypsum board shall be specified by the architect or designer where any of the conditions described in 20.3.1-20.3.5 exist (GA 4.7.3.1 – 4.7.3.7).
 - 3. Section 20.3.1 (GA 4.7.3.1) – A control joint shall be installed where a partition, wall, or ceiling traverses a construction joint (expansion, seismic or building control element) in the base building structure.
 - 4. Section 20.3.2 (GA 4.7.3.2) – Control joints shall be installed where a wall or partition runs in an uninterrupted straight plane exceeding 30 linear feet.
 - 5. Section 20.3.3 (GA 4.7.3.3) – Control joints in interior ceilings with perimeter relief shall be installed so that linear dimensions between control joints do not exceed 50 ft and total area between control joints does not exceed 2500 sq ft.
 - 6. Section 20.3.4 (GA 4.7.3.4) – Control joints in interior ceilings without perimeter relief shall be installed so that linear dimensions between control joints do not exceed 30 ft and total area between control joints does not exceed 900 sq ft.
 - 7. Section 20.3.5 (GA 4.7.3.5) – Control joints in exterior ceilings and soffits shall be installed so that linear dimensions between control joints do not exceed 30 ft and total area between control joints does not exceed 900 sq ft.
 - 8. Section 20.3.6 (GA 4.7.3.6) – A control joint or intermediate blocking shall be installed where ceiling framing members change direction.
 - 9. Section 20.3.7 (GA 4.7.3.7) – Control joints shall be installed where specified by the architect or designer as a design accent or architectural feature.

10. Section 20.4 (GA 4.7.4) – Where a control joint occurs in an acoustical or fire-rated system, blocking shall be provided behind the control joint by using a backing material such as 5/8 in. type X gypsum board, mineral fiber, or other tested equivalent.

3.10 CLEANING UP

- A. Do not allow accumulation of scraps and debris arising from work of this Section. Maintain premises in neat and orderly condition at all times. Immediately remove spilled or splashed compound material and all trace of residue from adjoining surfaces.

END OF SECTION 09 21 16

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PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Definition: Drywall shaft systems include special-purpose assemblies of gypsum boards and metal components designed for erection entirely from one side of shaft.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

- A. Industry Standard: Comply with applicable requirements of GA-216 "Application and Finishing of Gypsum Board" by the Gypsum Association, except where more detailed or more stringent requirements are indicated including the recommendations of the manufacturer.
- B. Finish layer board joints must be taped to a Level 1 per GA-214, also known as fire taping. Per NGC UL listed shaftwall designs, outer layer gypsum board joints must be taped for shaftwall systems.
- C. Allowable Tolerances: On faces of work exposed in occupied spaces, including stairwells (if any), limit offsets between planes of board faces to 1/8", and limit variation from plumb and location (including warp and bow) to 1/4" in 8'-0".
- D. Fire Resistance Ratings: Provide drywall shaft systems which have fire resistance ratings indicated or required to comply with governing regulations, and which are identical in construction in forms of materials and installations to assemblies which have been tested and listed by recognized authorities, including UL.
 - 1. Comply with FM "Approval Guide" when applicable.
 - 2. Fire Resistance Rating as indicated on drawings.

- E. Corridor partitions, smokestop partitions, horizontal exit partitions, exit enclosures, and fire walls shall be effectively and permanently identified with signs or stenciling in a manner acceptable to the authority having jurisdiction. Such identification shall be above any decorative ceiling and in concealed spaces. Suggested wording shall be approved by the authority having jurisdiction.
- F. System Design Loading: Provide drywall shaft systems designed and tested by manufacturer to withstand the following lateral loadings (air pressures), applied continuously and cyclically, for maximum heights of partitions required, within the following deflections limits.
 - 1. Lateral Loading: As indicated but not less than 10 psf.
 - 2. Deflection Limit: As indicated but not less than 1/240 of partition height.
- G. Sound Transmission Class: Provide drywall shaft systems designed and tested by manufacturer to achieve the following (minimum) STC rating (ASTM E 90).
 - 1. Rating: As indicated but not less than 35 STC.

1.05 PRODUCT HANDLING

- A. Deliver drywall shaft system components and materials in sealed containers and bundles, fully identified with manufacturer's name, brand, type and grade; store in a dry, well ventilated space, protected from the weather, under cover and off the ground.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Provide drywall shaft system components produced by a single manufacturer selected from the following list:
 - 1. United States Gypsum
 - 2. National Gypsum Company
 - 3. Georgia-Pacific Company
 - 4. Temple-Inland, Inc.

2.02 BASIC SYSTEM MATERIALS

- A. General: Except as otherwise indicated or required by governing regulations, provide the manufacturer's standard materials specified in his published product literature for the system and application required.
- B. Metal Framing and Furring: Hot-dip galvanized steel, ASTM A 446, G 90 coating; except comply with ASTM C 645 for 25-gage members, provide electro-galvanized or hot-dip galvanized coating.
- C. Gypsum Shaftwall Board: Manufacturer's special gypsum backing board or coreboard, of thickness and type indicated and as required to comply with system performance requirements.

- D. Exposed Gypsum Board: ASTM C 36, Type X where required for fire-resistance rating. Long Edge Profile: Standard taper.
- E. Drywall Trim Accessories: Provide manufacturer's standard trim accessories of types indicated for drywall work, formed of galvanized steel, with either knurled and perforated or expanded flanges for nailing or stapling, and beaded for concealment of flanges in joint compound. Provide corner beads, L-type edge trim-beads, U-type edge trim-beads, special L-kerf-type edge trim-beads, and one-piece control joint beads.
- F. Joint Treatment Materials: ASTM C 475; type recommended by the manufacturer for the application indicated, except as otherwise indicated.
 - 1. Joint Tape: Perforated type.
 - 2. Joint Compound: Ready-mixed vinyl-type for interior use.
 - 3. Grade: 2 separate grades; one specifically for bedding tapes and filling depressions, and one for topping and sanding.
 - 4. Joint Compound: On interior work provide chemical-hardening- type for bedding and filling, ready-mixed vinyl-type or vinyl-type powder for topping.
- G. Miscellaneous Materials: Provide auxiliary materials for gypsum drywall work of the type and grade recommended by the manufacturer of the system.
 - 1. Laminating Adhesive: Special adhesive or joint compound specifically recommended for laminating gypsum boards.
 - 2. Gypsum Board Fasteners: Comply with GA-216.

2.03 BASIC SYSTEM DESCRIPTION

- A. General Requirements: The following descriptions indicate type of manufacturer's standard systems required; the descriptions are not intended to be comprehensive but to identify a discrete type of system. Provide a complete system, complying with requirements indicated. Modify and supplement manufacturer's standard system to comply with performance requirements, including those of governing regulations. Provide the depth, profile, gage, and anchorage system of metal support members recommended by manufacturer for heights and system design loading criteria indicated; provide runners, stiffeners, braces, and similar framing members required to form a complete system.
- B. Cavity Shaftwall Systems: Provide shaftwall assemblies consisting of gypsum shaftwall boards inserted between U-shaped metal floor and ceiling tracks; specially-shaped studs engaged in tracks and fitted between shaftwall boards; and gypsum boards on finished side or sides applied to studs in number of layers, thicknesses and arrangement indicated.
 - 1. Shaftwall Board Thickness: Not less than 1".
 - 2. Stud Shape: I, C-H or double E.
 - 3. Stud Size: As indicated.
 - 4. Room-Side Finish: As indicated on drawings.
 - 5. Shaft-Side Finish: As indicated on drawings.

PART 3 - EXECUTION

3.01 INSTALLATION OF DRYWALL SHAFT SYSTEMS

- A. Preparations and Coordination
 - 1. Pre-Installation Conference: Prior to the start of shaft system installation, meet at the project site with the installers of related work including work requiring openings, chases, frames, access panels, support and similar integrated requirements including interference and conflicts, and coordinate layout and sequencing requirements for proper integration of the work.
 - 2. Weather Exposure: Do not proceed with the installation of gypsum board until building is sufficiently enclosed and ambient conditions are adequately controlled to prevent moisture and weather deterioration of the work.
- B. Installation of Basic System Components
 - 1. General: Comply with the manufacturer's installation instructions. Comply with recognized industry standards for the installation of both light gauge metal framing and gypsum board, to the extent not specified by manufacturer's instructions. Anchor and fasten materials and components to comply with ratings and performance requirements, and to comply with governing regulations.
 - 2. Do not bridge building expansion joints with drywall shaft system, frame both sides of joints with furring and other support as indicated.
 - 3. Install supplementary framing, blocking and bracing to support fixtures, equipment, services, heavy trim, furnishings and similar work which cannot be adequately supported directly on gypsum drywall shaft system.
 - 4. Isolate shaft system from transfer of structural loading to system, both horizontally and vertically. Provide slip or cushioned type joints to attain lateral support and avoid axial loading. Comply with details shown and with manufacturer's instructions.
 - 5. Seal perimeter of each section of drywall shaft work where it abuts other work. Install a second bead of acoustical sealant in a location and manner which will prevent dislocation by air pressure differential between shaft and external spaces. Seal joints and penetrations in the work; comply with manufacturer's instructions.
- C. Installation of Drywall Trim Accessories
 - 1. General: Install metal trim accessories where room-side of drywall shaft system is indicated to receive drywall finish (tape and joint compound treatment), including spaces indicated for paint or wall coverings. Nail or staple the flanges of accessories in accordance with manufacturers instructions, and fasten integrally with gypsum board where possible. Apply trim wherever edge of gypsum board would otherwise be exposed or semi-exposed, including terminations of the work, openings in the work, external corners, expansion and control joints and similar edges, both exposed and abutting other work. Miter-cut corners of exposed trim accessories, and spline-reinforce from behind to eliminate offsets and misalignments.
 - 2. Install L-type trim where board edges abut other work without space or reveal.

3. Install U-type trim where board edges are indicated for sealant or gasket application, or would otherwise be exposed (special kerf-type where kerf is provided to receive trim).
4. Install J-type semi-finishing trim where shown.
5. Install control-joint trim (beaded type) where indicated.

3.02 INSTALLATION OF DRYWALL FINISHING

- A. Where room-side of drywall shaft work is indicated to receive drywall finish, including spaces indicated for paint or wall coverings, provide exposed boards with tapered edges and recessed fastener heads, ready for drywall finishing. Otherwise, for unfinished work, edge profile of exposed boards is Installer's option, except comply with requirements for fire-resistance and STC ratings.
- B. Apply treatment at gypsum board joints (both directions), flanges of trim accessories, penetrations, fasteners heads, surface defects and elsewhere as required to prepare work for decoration. Pre-fill open joints and rounded or beveled edges, using type of compound recommended by manufacturer.
 1. Apply joint tape at joints between gypsum boards, except where a trim accessory is indicated.
 2. Apply joint compound in 3 coats (not including pre-fill of opening in base), and sand between last 2 coats and after last coat.
 3. Refer to sections on painting, coatings and wall-coverings in Division 9 for decorative finishes to be applied to drywall work.

3.03 PROTECTION OF WORK

- A. Installer shall advise Contractor of required procedures for protecting drywall work from damage and deterioration during remainder of construction period.

END OF SECTION 09 21 16.23

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PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Non-load-bearing steel framing systems for interior partitions.
 - 2. Suspension systems for interior ceilings and soffits.
 - 3. Grid suspension systems for gypsum board ceilings.
- B. Related Requirements:
 - 1. Section 05 40 00 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 REFERENCED DOCUMENTS

- A. ASTM Standards:
 - 1. A 641 - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
 - 2. C645-18 - Standard Specification for Nonstructural Steel Framing Members.
 - 3. A 653 - Specification for Sheet Steel Zinc coated (Galvanized) by the Hot-Dip Process, Commercial Quality.
 - 4. B 69 - Specification for Roller Zinc.
 - 5. C 79 - Test Method for Gypsum Sheathing Board.
 - 6. E 84 - Test Method for Surface Burning Characteristics of Building Materials.
 - 7. E 119 - Method for Fire Tests of Building Construction and Materials.
 - 8. A1011 - Standard Specification for Structural Steel.
 - 9. F1267 - Standard Specification for Metal, Expanded, Steel.
- B. Gypsum Association
 - 1. GA-253 - Application of Gypsum Sheathing
- C. Other Code Approvals and Performance Standards
 - 1. NAAMM EMMA 557-20 Standards for Expanded Metal.
 - 2. UL File Number R19331 Full list of ProSTUD, Spazzer, Resilient Channel, Sound Clip and Barrier Mesh UL design assemblies.

3. UL 2079-Fifth Edition. Provides joint protection for up to 1" with UL 2079 Class II or III Movement Capabilities at 80% compression. Use BlazeFrame® Perimeter L-Bead where Composite Firestop/Framing for use in fire-resistant joint systems in or between fire-resistance-rated walls and floor/ceiling or roof/ceiling assemblies (Fire, Smoke and Sound).

1.04 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.

1.05 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified in accordance with product-certification program of the Certified Steel Stud Association.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials in their original sealed containers bearing manufacturer's name and identification of product.
- B. Protect coatings (pail products) from freezing and temperatures in excess of 90 deg. F. Store away from direct sunlight.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTSS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, in accordance with ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.
- C. Horizontal Deflection: For wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft..

2.02 FRAMING SYSTEMS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.
- B. Framing Members, General: Comply with ASTM C754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM A1003 requirements for metal unless otherwise indicated.
 2. Protective Coating: ASTM A653/A653M, G40 (Z120), hot-dip galvanized unless otherwise indicated. Galvannealed products are unacceptable.
- C. Studs and Tracks: ASTM C645. Use either conventional-thickness steel studs and tracks, engineered high-strength drywall steel studs and tracks.
1. Steel Studs and Tracks:
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Marino\WARE; or a comparable product by one of the following:
 - 1) CEMCO; California Expanded Metal Products Co.
 - 2) Telling Industries.
 - 3) Studco Building Systems, (800) 675-8023.
 - b. Min. Base-Metal Thickness (DPSAFT): As required by performance requirements for horizontal deflection 0.0359 inch (20 gauge).
 - b. Minimum Base-Metal Thickness: As required by performance requirements for horizontal deflection 0.0147 inch (9 gauge).
 - c. Depth: As indicated on Drawings.
 2. Engineered High-Strength Steel Equivalent Steel Studs and Tracks: Roll-formed and embossed with surface deformations to stiffen the framing members so that they are structurally equivalent to conventional ASTM C645 steel studs and tracks.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Marino\WARE; ViperStud or a comparable product by one of the following:
 - 1) CEMCO; California Expanded Metal Products Co.
 - 2) Phillips Manufacturing Co.
 - 3) Telling Industries.
 - 4) Studco Building Systems, (800) 675-8023.
 - b. Min. Base-Metal Thickness (DPSAFT): As required by performance requirements for horizontal deflection 0.0359 inch (20 gauge).
 - b. Minimum Base-Metal Thickness: As required by horizontal deflection performance requirements 0.0147 inch (9 gauge).
 - c. Depth: As indicated on Drawings.
 3. High performing Sound Wall Stud: Factory assembled 3-5/8", 4" or 6" sound isolating double stud using closed cell foam isolators creating sound dampening air gap. Use standard track.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Marino\WARE; SoundGuard Stud by one of the following:
 - 1) Marino\WARE
 - 2) SCAFCO
 - 3) Studco Building Systems (Resilmount™), (800) 675-8023.
 - b. Minimum Base-Metal Thickness: As required by horizontal deflection performance requirements.
 - c. Depth: As indicated on Drawings.

- D. Slip-Type Head Joints: Where indicated, provide [one of] the following:
1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing 1-1/2-inch minimum vertical movement or as required by specific conditions.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Marino\WARE; Deflex (WSC) or a comparable product by one of the following:
 - 1) CEMCO; California Expanded Metal Products Co.
 - 2) Steel Network, Inc. (The).
 - 3) Studco Building Systems, (800) 675-8023.
 2. Single Long-Leg Track System: ASTM C645 top track with 2-inch deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
 3. Double-Track System: ASTM C645 top outer tracks, inside track with 2-inch deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
 4. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Marino\WARE; FAS Track, SLT Slotted Track or a comparable product by one of the following:
 - 1) BlazeFrame Industries.
 - 2) CEMCO; California Expanded Metal Products Co.
 - 3) ClarkDietrich Building Systems.
 - 4) Metal-Lite.
 - 5) Perfect Wall, Inc.
 - 6) Steel Network, Inc. (The).
 - 7) Telling Industries.
 - 8) Studco Building Systems, (800) 675-8023.
- E. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Marino\WARE; FAS Track or a comparable product by one of the following:
 - a. BlazeFrame Industries.
 - b. CEMCO; California Expanded Metal Products Co.
 - c. ClarkDietrich Building Systems.
 - d. Fire Trak Corp.
 - e. Metal-Lite.
 - f. Perfect Wall, Inc.
 - g. Steel Network, Inc. (The).
 - h. Studco Building Systems, (800) 675-8023.

- F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Marino\WARE; Flat Strap or a comparable product by one of the following:
 - a. CEMCO; California Expanded Metal Products Co.
 - b. Telling Industries.
 - c. Studco Building Systems, (800) 675-8023.
 2. Minimum Base-Metal Thickness: 0.0296 inch.
- G. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-metal thickness, with minimum 1/2-inch wide flanges.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Marino\WARE; CRC or a comparable product by one of the following:
 - a. CEMCO; California Expanded Metal Products Co.
 - b. Telling Industries.
 - c. Studco Building Systems, (800) 675-8023.
 2. Depth: 1-1/2 inches.
 3. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.
- H. Hat-Shaped, Rigid Furring Channels: ASTM C645.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Marino\WARE; Furring Channel or a comparable product by one of the following:
 - a. CEMCO; California Expanded Metal Products Co.
 - b. Telling Industries.
 - c. Studco Building Systems, (800) 675-8023.
 2. Minimum Base-Metal Thickness: 0.0329 inch.
 3. Depth: As indicated on Drawings or 7/8 inch or 1-1/2 inches as required.
- I. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Marino\WARE; RC1 or RC-Max or a comparable product by one of the following as required:
 - a. CEMCO; California Expanded Metal Products Co.
 - b. Telling Industries.
 - c. Studco Building Systems, (800) 675-8023.
 2. Configuration: Asymmetrical or hat shaped as required.
- J. Cold-Rolled Furring Channels: 0.058-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.
1. Depth: 3/4 inch or as required.
 2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch.
 3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

- K. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Marino\WARE; Z Furring or a comparable product by one of the following:
 - a. CEMCO; California Expanded Metal Products Co.
 - b. Telling Industries.
 - c. Studco Building Systems, (800) 675-8023.

2.03 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.
- B. Hanger Attachments to Concrete:
1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 or ICC-ES AC193 or ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.
 - a. Uses: Securing hangers to structure.
 - b. Type: torque-controlled, adhesive anchor or as required.
 - c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
 - d. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) or Group 2 (A4) stainless steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).
 2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- D. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated or as required.
- E. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538-inch and minimum 1/2-inch-wide flanges.
1. Depth: As indicated on Drawings or 2-1/2 inches or 2 inches or 1-1/2 inches.
- F. Furring Channels (Furring Members):
1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
 2. Steel Studs and Tracks: ASTM C645.
 - a. Minimum Base-Metal Thickness: 0.0329 inch or as required.
 - b. Depth: As indicated on Drawings.
 3. Engineered High-Strength Equivalent Gauge Steel Studs and Tracks: ASTM C645.
 - a. Minimum Base-Metal Thickness: 0.0147 inch or 0.0181 inch as required.

- b. Depth: As indicated on Drawings.
 - 4. Hat-Shaped, Rigid Furring Channels: ASTM C645, 7/8 inch deep.
 - a. Minimum Base-Metal Thickness: 0.0329 inch or as required.
 - 5. Resilient Furring Channels: 1/2-inch-deep members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical or hat shaped.
- G. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong World Industries, Inc.
 - b. Chicago Metallic Corporation.
 - c. USG Corporation.

2.04 AUXILIARY SYSTEMS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
 - 1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), non-perforated.
 - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

- B. Coordination with Sprayed Fire-Resistive Materials:
 - 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
 - 2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.03 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.
 - 1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C841 that apply to framing installation.
 - 2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C1063 that apply to framing installation.
 - 3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C844 that apply to framing installation.
 - 4. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.04 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components in accordance with spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Single-Layer Application: As required by horizontal deflection performance requirements unless otherwise indicated.
 - 2. Multilayer Application: [As required by horizontal deflection performance requirements 16 inches (406 mm) o.c. or 24 inches (610 mm) o.c. unless otherwise indicated.
 - 3. Tile Backing Panels: As required by horizontal deflection performance requirements 16 inches (406 mm) o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
 - 6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.
- E. Direct Furring:
 - 1. Screw to wood framing.
 - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- F. Z-Shaped Furring Members:
 - 1. Erect insulation, specified in Section 07 21 00-Thermal Insulation, vertically and hold in place with Z-shaped furring members spaced 24 inches dimension o.c. or as required.
 - 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.
- G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.05 INSTALLING CEILING SUSPENSIONS

- A. Install suspension system components in accordance with spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
1. Hangers: 48 inches o.c. or as required.
 2. Carrying Channels (Main Runners): 48 inches o.c.
 3. Furring Channels (Furring Members): 16 inches or 24 inches o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Do not attach hangers to steel roof deck.
 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 09 22 16

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PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Furnish and install tile specified on floors and walls shown.
- B. Ceramic floor tile installed over concrete floor slabs using latex Portland cement mortar and latex Portland cement grout.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.
- B. Sealing of Joints: Section 07 92 00 - Joint Sealants.
- C. Metal and Resilient Edge Strips at Joints with New Resilient Flooring, and Carpeting: Section 09 65 19 - Resilient Tile Flooring and Section 09 68 13 - Tile Carpeting.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 REFERENCES

- A. ANSI A108 Installation Standards / A118 Material Specifications - American National Standard Specifications for the Installation of Ceramic Tile.
 - 1. ANSI A108.02 - Per Section 4.2.2 Substrate flatness for tiles 15 in. or longer: "For tiles with at least one edge 15 in. or longer, the substrate shall have a maximum permissible variation of 1/8 in. in 10 ft. from the required plane, and no more than 1/16 in. variation in 24 in. when measured from the high points in the surface."
- B. ANSI A136.1 American National Standard Specifications for Organic Adhesives for Installation of Ceramic Tile.
- C. ANSI A137.1 American National Standard Specifications for Ceramic Tile – 2019, and A137.2 American National Standard Specification for Glass Tile – 2019

- D. ANSI A118.3 – Chemical Resistant, Water-Cleanable Tile Setting and Grouting Epoxy and Water-Cleanable Tile Setting Epoxy Adhesive.
- E. ANSI A118.4, Modified Dry-Set Cement Mortar.
- F. ANSI A118.6, Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy.
- G. ANSI 118.7, American National Standard Specifications for High-performance Cement Grouts for Tile Installation.
- H. ANSI A118.12, American National Standard Specifications for Crack Isolation Membranes for Thin-set Ceramic Tile and Dimension Stone Installation.
- I. ANSI A118.13, American National Standard Specifications for Bonded Sound Reduction Membranes for Thin-set Ceramic Tile Installation.
- J. ANSI A118.15, American National Standard Specifications for Improved Modified Dry-Set Cement Mortar-2019.
- K. ANSI A326.3 American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Flooring Materials – 2017
- L. TCNA (HB) - Handbook for Ceramic, Glass and Stone Tile Installation; Tile Council of North America.
- M. ISO 13007 - International Standards Organization; classification for Grout and Adhesives.

1.05 QUALITY ASSURANCE

- A. Obtain each color, grade, finish, type, composition, and variety of tile from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.
- B. Obtain ingredients of a uniform quality from one manufacturer for each cementitious and admixture component and from one source or producer for each aggregate.
- C. Engage an experienced Installer who has successfully completed tile installations similar in material, design, and extent to that indicated for Project.
 - 1. Installers to be from a company specializing in performing installation of products specified and have a minimum of three (3) years' experience.
- C. Engage an experienced Installer who has successfully completed tile installations similar in material, design, and extent to that indicated for Project.

- D. Before installing tile, erect mock-ups for each form of construction and finish required to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution. Build mock-ups to comply with the following requirements, using materials indicated for final unit of Work.
 - 1. Locate mock-ups on site in location and size as directed by Architect.
 - 2. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 3. Obtain architect's acceptance of mock-ups before start of final unit of Work.
 - 4. Retain and maintain mock-ups during construction in undisturbed condition as a standard for judging completed unit of Work. When directed, demolish and remove mock-ups from Project site.
- E. Install ceramic tile in accordance with recommendations contained in "Handbook for Ceramic Tile Installation" of the Tile Council of North America, Inc., latest edition.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.
- B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.
- C. Handle tile with temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If despite these precautions coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.07 PROJECT CONDITIONS

- A. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.
- B. Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide buildup.
- C. Maintain temperatures at 50°F (10°C) or more in tiled areas during installation and for 7 days after completion unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

1.08 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials that match products installed as described below, packaged with protective covering for storage and identified with labels clearly describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed but a minimum of 12 pieces, for each type, composition, color, pattern, and size.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Tile: **DELETE or ADD AS REQUIRED**
 - a. Anatolia (Basis-of-Design)
 - b. American Olean Tile Company, Inc.
 - c. DalTile Corporation
 - d. Florida Tile
 - e. Approved Equal.
 - 2. Mortars and Grouts:
 - a. American Olean Tile Company, Inc.
 - b. Ardex Engineered Cements
 - c. Bostik, Inc.
 - d. C-Cure Chemical Co.
 - e. Custom Building Products
 - f. Laticrete International, Inc. **(Basis-of-Design)**
 - g. Litokol® S.p.A Epoxy Grout
 - h. Mapei Corporation

2.02 PRODUCTS, GENERAL

- A. ANSI Standard for Ceramic Tile: Comply with ANSI A137.1 "American National Standard Specifications for Ceramic Tile - 2012" for types, compositions, and grades of tile indicated. Furnish tile complying with "Standard Grade" requirements unless otherwise indicated.
- B. ANSI Standard for Tile Installation Materials: Comply with ANSI standard referenced with products and materials indicated for setting and grouting.
- C. Conform to ADA recommendations for slip resistance by providing minimum coefficient of sliding friction value of 0.42 DCOF AcuTest® for horizontal surfaces expected to be walked upon when wet.
- D. Large Floor Tile Mortar: Provide Polymer-Enriched Thin-Set or Medium-Bed Mortar for a regular-setting, polymer-enriched ("modified") mortar ideal for installing large- format tile on floors, and designed to bond and support large tile over a diverse range of floor substrates, interior and exterior. Can also be used to install small-format tile.
- E. Factory Blending: For tile exhibiting color variations within the ranges selected during sample submittals, blend tile in factory and package accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples.

2.03 TILE PRODUCTS

- A. Refer to Room Finish Schedule(s) and Product Schedule(s), and details on the drawings for types, colors, textures, patterns, size of Field Tile and Trim Shapes, and Color of Grout Specified, where applicable.

2.04 SETTING MATERIALS

- A. Thin-Set Applications at All Non-Wet Area Floors (TCNA F115): Latex-Portland Cement Mortar: ANSI A118.4, composition as follows: Prepackaged dry mortar mix composed of portland cement, graded aggregate, and the manufacturer's standard dry polymer additive in the form of a re-emulsifiable powder to which only water is added at job site.
- B. Thin-Set Applications at All Wet Area Floors and Upper Level Toilet Room Floors (TCNA F122): Latex-Portland Cement Mortar: ANSI A118.4, composition as follows: Prepackaged dry mortar mix composed of portland cement, graded aggregate, and the manufacturer's standard dry polymer additive in the form of a re-emulsifiable powder to which only water is added at job site.
 - 1. Waterproofing: Laticrete 9235.
 - 2. Ardex Engineered Cements, 8+9
- C. Thin-Set Applications at All Wet Area Walls (TCNA W244): Latex-Portland Cement Mortar: ANSI A118.4, composition as follows: Prepackaged dry mortar mix composed of portland cement, graded aggregate, and the manufacturer's standard dry polymer additive in the form of a re-emulsifiable powder to which only water is added at job site.
 - 1. Waterproofing: Laticrete 9235.
 - 2. Ardex Engineered Cements, 8+9
- D. Thin-Set Applications at All Non-Wet Area Walls (TCNA W243): Latex-Portland Cement Mortar: ANSI A118.4, composition as follows: Prepackaged dry mortar mix composed of portland cement, graded aggregate, and the manufacturer's standard dry polymer additive in the form of a re-emulsifiable powder to which only water is added at job site.

2.05 GROUTING MATERIALS

- A. Provide products to suit specific project requirements in accordance with TCA Handbook and ANSI A118.3 as follows.
 - 1. Ardex Engineered Cements, WA
 - 2. Custom Building Products
 - 3. Laticrete SpectraLOCK® PRO @ wet areas (pools and fountains)
 - 4. Laticrete PERMACOLOR® for floors and walls
 - 5. Mapei Corporation
- B. Minimum Grout Joint Size: The minimum allowable grout joint size will vary depending on the tile in use and how much one tile differs from another in size.

1. The actual grout size shall be at least three times the actual variation of facial dimensions of the tile supplied.
 2. Recommended: 3/16" grout joint at natural tile units and 1/8" at rectified tiles.
 3. Recommended at unglazed quarry tile: 3/8" chemical resistant epoxy (Kitchens).
- C. Offset Joint Patterns: Running bond/brick joint and any offset patterns utilizing tile where the side being offset is greater than 15", the offset pattern will be a maximum of 33% unless otherwise specified by the tile manufacturer.
1. If an offset greater than 33% is specified, design professional and owner must approve mock-up and lippage.
- D. Grout: Where indicated on the drawings, and elsewhere as required for filling the joints between tiles.
1. Polymer-Modified Portland Cement Grout:
 - a. Custom Building Products Polyblend Sanded Tile Grout; ANSI A118.6, for joints 1/8 – 1/2 inch (3 –13 mm) or approved equal.
 - b. Custom Building Products Polyblend Non-Sanded Tile Grout; ANSI A118.6 or joints up to 1/8 inch (3 mm) or approved equal.
 - c. Custom Building Products Prism® SureColor® Tile Grout, ANSI A118.7 for joints 1/8 – 1/2 inch (3 –13 mm) or approved equal.
 2. Dry-Set Grout:
 - a. Custom Building Products White Dry Tile Grout; ANSI A118.6, for joints up to 1/8 inch (3 mm) or approved equal. Note: Dry Tile Grout when gauged with Thin-Set Mortar Admix diluted with water 1:1 will yield a Latex Portland Cement Grout.
 3. Chemical Resistant, Water-Cleanable Tile Setting and Grouting Epoxy; ANSI A118.3:
 - a. Custom Building Products 100% Solids Epoxy Grout or approved equal. Available in all 48 Polyblend grout colors.
 - b. Custom Building Products CEG-Lite™ 100% Solids Commercial Epoxy Grout or approved equal.
- E. Elastomeric Joint Caulk: ANSI A108.01.3.7 Where indicated on the drawings, and elsewhere as required provide:
1. All joints between floors and walls and at joints between tile and dissimilar materials.
 - a. Commercial 100% Silicone Caulk – ideal for movement joints in traffic areas
- D. Tile Grout: Where indicated on the drawings, and elsewhere as required for filling the joints between tiles. Where indicated on the Drawings, and elsewhere as required for grouting tile as specified by ANSI A108.10 Installation of Grout in tile work.
1. Polymer-Modified Portland Cement Grout:
 - a. Custom Building Products Polyblend® Sanded Tile Grout; ANSI A118.6, for joints 1/8 inch - 1/2 inch. Standard cement grout for wide joints.

- b. Custom Building Products Polyblend® Non-Sanded Tile Grout; ANSI A118.6 or joints up to 1/8 inch. Standard cement grout for narrow joints.
 - c. Custom Building Products Prism® Consistent Color Tile Grout, ANSI A118.7 for joints 1/16 inch to 1/2 inch. Eliminates efflorescence and shade variation throughout tile assembly.
- 2. Dry-Set Grout:
 - a. Custom Building Products Polyblend® White Dry Tile Grout; ANSI A118.6, for joints up to 1/8 inch.
- 3. Chemical Resistant, Water-Cleanable Tile Setting and Grouting Epoxy; ANSI A118.3:
 - a. Custom Building Products CEG-Lite™ 100% Solids Commercial Epoxy Grout. Easy to clean up, non-sagging epoxy grout. Excellent stain and chemical resistance.
 - b. Custom Building Products CEG-IG 100% Solids Industrial Grade Epoxy Grout. Easy to clean up, non-sagging epoxy grout. Excellent stain and chemical resistance in heavy use areas.
 - c. Custom Building Products Fusion Pro™ Single Component Grout. Meeting the performance requirement of ANSI A118.3 and A118.7. No mixing required and is stain resistant.

2.06 MISCELLANEOUS MATERIALS

- A. Metal Edge Protection: Refer to drawings for size, types and finishes as manufactured by Schluter Systems, LP, 194 Pleasant Ridge Road, Plattsburgh, NY 12901-5841. Tel: (800) 472-4588 or approved equal. Web: www.schluter.com.
Approved equal manufacturer: Küberit USA, LLC, (888) 284-7567.
www.kuberitusa.com
 - 1. Edge-Protection and Transition Profiles for Floors
 - 2. Finishing and edge-protection profiles for walls and countertops.
 - 3. Movement joint and cove-shaped profiles.
 - 4. Modular screed system.
 - 5. Uncoupling membrane.
 - 6. Setting materials: adhesives, mortars, grouts, and sealants.
- B. Movement Joints-Vertical and Horizontal: In accordance with TCNA Method EJ171-18, to include but not be limited to the following:
 - 1. Construction Joint - EJ171A-18
 - 2. Contraction Joint - EJ171B-18
 - 3. Expansion Joint - EJ171C-18
 - 4. Isolation/Expansion Joint - EJ171D-18
 - 5. Expansion Joint, Cement Mortar, Bonded - EJ171E-18
 - 6. Generic Movement Joint - EJ171F-18
 - 7. Perimeter Joint - EJ171G-18
 - 8. Expansion Joint, Cement Mortar, Cleavage Membrane - EJ171H-18
 - 9. Perimeter Joint - EJ171I-18
 - 10. Perimeter Movement Joint - EJ171J-18
 - 11. Movement Joint in Tile and Backerboard - EJ171K-18

12. Generic Movement Joint with Backerboard - EJ171L-18
- C. Anti-Fracture Membrane/Cleavage Membrane: Where indicated on the Drawings, and elsewhere as required for isolating the installation from cracking due to minor substrate movement and normal structural deflections as specified in ANSI A108.17 and complying with ANSI A118.12, and TCNA F125-Partial-18 [**and F125-Full-18**] .
- D. Thin and Large Format Tile Leveling System (to prevent lippage):
1. Raimondi as supplied by Braxton-Bragg, 800-575-4401.
 2. Tuscan Leveling System™ by Pearl Abrasive Company, 100 West Burlington Avenue, Fairfield, Iowa 52556 USA. Phone: 1-312-212-3505.
 3. Unless otherwise noted on the drawings, provide for 1/8" wide grout joints.
- E. Underlayment Membrane: Schluter or Mapei (Mapeguard® UM) **DEVELOP THIS**
- F. Provide other materials, not specifically described but required for complete and proper tile installation, selected by Contractor subject to approval of Architect.
- G. Provide epoxy coated system if Relative Humidity is over 80% with cementitious self-leveling underlayment to seal concrete. Install per manufacturer of epoxy moisture barrier as supplied by Laticrete, Mapei or approved equal product.

2.07 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with requirements of referenced standards and manufacturers including those for accurate proportioning of materials, water, or additive content; type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortars and grouts of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and areas where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
1. Verify that substrates for setting tile are firm, dry, clean, and free from oil or waxy films and curing compounds.
 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Blending: For tile exhibiting color variations within the ranges selected during sample submittals, verify that tile has been blended in factory and packaged accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.03 INSTALLATION, GENERAL

- A. ANSI Tile Installation Standard: Comply with parts of ANSI 108 series of tile installation standards included under "American National Standard Specifications for the Installation of Ceramic Tile" that apply to type of setting and grouting materials and methods indicated.
- B. TCA Installation Guidelines: TCA "Handbook for Ceramic Tile Installation"; comply with TCA installation methods indicated.
- C. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions except as otherwise shown. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so that plates, collars, or covers overlap tile.
- E. Jointing Pattern: Unless otherwise shown, lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths unless otherwise shown.
- F. Lay out tile wainscots to next full tile beyond dimensions indicated.
- G. **Movement Accommodation Joints:** Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw cut joints after installation of tiles.
 - 1. Locate joints in tile surfaces directly above joints in concrete substrates.
 - 2. Provide expansion and control joints at not more than 15 feet OC, at all expansion and control joints in the concrete subfloor and where otherwise recommended by the "Handbook for Ceramic Tile Installation" of the Tile Council of America.
 - 3. Movement joints shall be provided throughout the tile and work will conform to ANSI Specification A108.01-3.7; A108.02 – 4.4. and TCA Details EJ171.
 - 4. Allow for non-linear movement accommodation joints, which would not disrupt the flow of a pattern in a layout. Utilize crack-isolation membranes in accordance with TCNA Handbook method F125.

5. Seal all joints in accordance with requirements of Section 07 92 00.

3.04 WATERPROOFING FOR TILE INSTALLATIONS

- A. Install waterproofing in compliance with waterproofing manufacturer's instructions to produce a waterproof membrane of uniform thickness bonded securely to substrate.
- B. Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight. Verify with local plumbing code and whether 24-hour Flood Testing is required at showers and other pooled components or features.

3.05 INSTALLATION METHODS

- A. Conform to TCA Handbook for installation on various substrates shown on drawings, using materials listed in Part 2 of this Specification Section.
- B. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

3.06 CLEANING AND PROTECTION

- A. Cleaning: Upon completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 1. Remove grout residue from tile as soon as possible.
 2. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's printed instructions, but no sooner than 14 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.
- B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, un-bonded, and otherwise defective tile work.
- C. Provide final protection and maintain conditions in a manner acceptable to manufacturer and installer that ensures that tile is without damage or deterioration at time of Substantial Completion.
 1. When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
 2. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION 09 31 00

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Furnish and install resilient flooring. Clean and protect resilient floor areas after installation.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.
- C. Shop Drawings:
1. Layout of patterns as shown on the construction documents.
 2. Edge strip locations showing types and detail cross sections.

1.04 REFERENCES

- A. ASTM Designations:
1. ASTM E 492 - Standard Test Method for Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine
 2. ASTM E 648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
 3. ASTM E 662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
 4. ASTM E 989 - Standard Classification for Determination of Impact Insulation Class (IIC)
 5. ASTM E 1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
 6. ASTM F 141 - Standard Terminology Relating to Resilient Floor Coverings
 7. ASTM F 710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
 8. ASTM F 1482 - Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring
 9. ASTM F 1700 - Standard Specification for Solid Vinyl Floor Tile

10. ASTM F 1861 - Standard Specification for Resilient Wall Base
11. ASTM F 1869 - Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
12. ASTM F 2170-19a - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes
13. ASTM F 2419 - Standard Practice for Installation of Thick Poured Gypsum Concrete Underlayments and Preparation of the Surface to Receive Resilient Flooring
14. ASTM F 2471 - Standard Practice for Installation of Thick Poured Lightweight Cellular Concrete Underlayments and Preparation of the Surface to Receive Resilient Flooring
15. ASTM F 2678 - Standard Practice for Preparing Panel Underlayments, Thick Poured Gypsum Concrete Underlayments, Thick Poured Lightweight Cellular Concrete Underlayments, and Concrete Subfloors with Underlayment Patching Compounds to Receive Resilient Flooring
16. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

1.05 QUALITY ASSURANCE

- A. Obtain each type, color, and pattern of flooring from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.
- B. Qualifications of Installers: Use only skilled and experienced resilient flooring installers for preparation of substrate and installation of flooring. Supervise helpers and apprentices at all times with thoroughly skilled resilient flooring installers.
- C. Manufacturers' Recommendations: Manufacturers' recommended methods of installation and the referenced applicable standards is basis for installation methods used on this work.
- D. Applicable Standards:
 1. Federal Specifications:
 - (a) SS-T-312B Tile, Floor: Asphalt, Rubber, Vinyl-Composition.
 - (b) SS-W-40A Wall Base: Rubber and Vinyl Plastic.
 2. Resilient Tile Institute:
 - (a) Recommended Installation Specifications for Vinyl Composition Tile Flooring and Asphalt Tile Flooring.
 3. Rubber Manufacturer's Association:
 - (a) Manual for the Preparation of Subfloors for the Installation of Solid Vinyl and Rubber Flooring.
 - (b) Specifications for Flexible Vinyl Cove Base.
 - (c) Specifications for Rubber Cover Base.
 - (d) Specifications for Solid Vinyl Flooring.
 4. Conform to ADA requirements for slip resistance by providing minimum coefficients of sliding friction of 0.6 COF for horizontal surfaces and 0.8 COF for ramps and other sloped surfaces.

- E. **Mockup:** Build floor tile mockup to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Size: 100 sq. ft. for each type, color, and pattern. Locations as indicated on construction documents.
 - 2. Design Professional approved mockup may become part of the completed Project if undisturbed at time of Substantial Completion.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver flooring and installation accessories to Project site in original manufacturer's unopened cartons and containers each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.
- B. Store flooring materials in dry spaces protected from the weather with ambient temperatures maintained between 50 deg F (10 deg C) and 90 deg F (32 deg C).
- C. Store flooring materials on flat surfaces. Move flooring and installation accessories into spaces where they will be installed at least 48 hours in advance of installation.

1.07 PROJECT CONDITIONS

- A. Maintain a minimum temperature of 70 deg F (21 deg C) in spaces to receive flooring for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. After this period, maintain a temperature of not less than 55 deg F (13 deg C).
- B. Do not install flooring until they are at the same temperature as the space where they are to be installed.
- C. Close spaces to traffic during installation.

1.08 SEQUENCING AND SCHEDULING

- A. Install flooring and accessories after other finishing operations, including painting, have been completed.
- B. Do not install flooring over concrete slabs until the slabs have cured and are sufficiently dry to bond with adhesive as determined by flooring manufacturer's recommended bond and moisture test.

1.09 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials, totaling 3% of the total installed, matching products installed as described below, packaged with protective covering for storage and identified with labels clearly describing contents.

PART 2 - PRODUCTS

2.01 LUXURY VINYL TILE

- A. Refer to the Room Finish Schedule and Product Schedule on the drawings.
- B. Wet spread to be backing-specific manufacturer's adhesives for non-porous sub-floor. Provide Limited Commercial Warranty against excessive surface wear, static, delamination, edge ravel, zippering and backing resiliency loss.

2.02 INSTALLATION ACCESSORIES

- A. Concrete Slab Primer: Non-staining type as recommended by flooring manufacturer.
- B. Trowelable Underlayments and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by flooring manufacturer for applications indicated. Provide materials for filling cracks and leveling floor depressions by Mapei, or approved equal.
- C. Adhesives: Water-resistant type recommended by flooring manufacturer to suit resilient flooring products and substrate conditions indicated, if required.
 - 1. Provide HENRY® 695 premium, high-strength adhesive for the permanent installation of vinyl-backed flooring as both a wet-set and a pressure-sensitive adhesive, or approved equal.
- D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edge of flooring, and in maximum available lengths to minimize running joints.
- E. Furnish beveled edge strips 1-1/8" wide where resilient flooring adjoins other floor finish of lower level.
- F. Provide Schluter®-DILEX-EKSB Series Surface Joint Profile transition strip in floor tile at all saw-cut or screed key joints in concrete, new or existing. Finish shall be stainless steel or color as selected by the design professional.

2.03 OTHER MATERIALS

- A. Provide materials, including adhesives and moisture vapor barrier, not specifically described but required for complete and proper installation of resilient flooring only as recommended by manufacturer of material to which it is applied and subject to approval of Architect.
 - 1. ARDEX VB 100™ Fast-Track, One-Component Moisture Vapor Barrier or approved equal. Install per manufacturer published recommendations.

- B. **Metal Transition Profiles:** Refer to drawings for size, types and finishes as manufactured by Küberit USA, LLC, (888) 284-7567. www.kuberitusa.com

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas where installation of flooring will occur, with Installer present, to verify that substrates and conditions are satisfactory for installation and comply with manufacturer's requirements and those specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials whose presence would interfere with bonding of adhesive. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by manufacturer.
 2. Finishes of subfloors comply with tolerances and other requirements specified in Division 3 Section "Cast-In-Place Concrete" for slabs receiving resilient flooring.
 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits of any kind.
 4. ASTM F2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in-situ Probes.
 5. ASTM F710 - Practice for Preparing Concrete Floors. Concrete ph determination.

3.02 PREPARATION

- A. Comply with manufacturer's installation specifications to prepare substrates indicated to receive flooring.
- B. Use trowelable leveling and patching compounds per manufacturer's directions to fill cracks, holes, and depressions in substrates.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.
- D. Broom or vacuum clean substrates to be covered by flooring immediately before installation. Following cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust.
- E. Apply concrete slab primer, if recommended by flooring manufacturer, prior to applying adhesive. Apply according to manufacturer's directions.

3.03 TILE FLOORING INSTALLATION

- A. Comply with tile manufacturer's installation directions and other requirements indicated that are applicable to each type of tile installation included in Project.
- B. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths at perimeter that equal less than one-half of a tile. Install tiles square with room axis, unless otherwise indicated.
- C. Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered. Cut tiles neatly around all fixtures. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles in pattern as indicated on the drawings.
- D. Where demountable partitions and other items are indicated for installing on top of finished tile floor, install tile before these items are installed.
- E. Scribe, cut, and fit tiles to butt tightly to vertical surfaces, permanent fixtures, built-in furniture including cabinets, pipes, outlets, edging, thresholds, and nosing.
- F. Extend tiles into toe spaces, door reveals, closets, and similar openings.
- G. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent marking device.
- H. Install 1-1/8" wide bullnose edging strips where edges of tile are exposed.
- I. Install tiles on covers for telephone and electrical ducts, and similar items occurring within finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on these covers. Tightly adhere edges to perimeter of floor around covers and to covers.
- J. Adhere tiles to flooring substrates without producing open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections in completed tile installation.
- K. Use full spread of adhesive applied to substrate in compliance with tile manufacturer's directions including those for trowel notching, adhesive mixing, and adhesive open and working times.
- L. Hand roll tiles where required by tile manufacturer.

3.04 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing installation:
 - 1. Remove visible adhesive and other surface blemishes using cleaner recommended by flooring manufacturers.
 - 2. Sweep or vacuum floor thoroughly.
 - 3. Do not wash floor until after time period recommended by resilient flooring manufacturer.
 - 4. Damp-mop flooring to remove black marks and soil.
- B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended by flooring manufacturer.
 - 1. Apply protective floor polish to flooring surfaces that are free from soil, visible adhesive, and surface blemishes.
 - 2. Use commercially available, metal, cross-linked acrylic product acceptable to flooring manufacturer.
 - 3. Coordinate selection of floor polish with Owner's maintenance service.
 - 4. Cover flooring with undyed, untreated building paper until inspection for Substantial Completion.
 - 5. Do not move heavy and sharp objects directly over flooring. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.
- C. Clean flooring not more than 4 days prior to dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean flooring using method recommended by manufacturer.
 - 1. Strip protective floor polish that was applied after completing installation prior to cleaning.
 - 2. Reapply floor polish after cleaning.

3.05 PATCHING AND REPAIR OF EXISTING FLOORING

- A. Use matching resilient flooring for repair and replacement of existing flooring. Match existing flooring type, size, color, and pattern. Unbroken salvaged flooring may be re-used where necessary in patching existing floor areas which are to remain. General Contractor to coordinate cutting and patching requirements and execute flooring and other subcontract agreements so quantities of cutting and patching are taken into account in preparation of bids. No additional payment made by Owner for variations in cutting and patching required to perform the Work except where changes in Work are requested by Owner after Contract is executed.

END OF SECTION 09 65 19

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PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish and install specified tile carpeting and entry mat carpet tiles, including accessories required for complete and proper installation. Clean and protect installed carpet tiles.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 REFERENCES

- A. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
- B. ASTM F1869-16a - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- C. ASTM F710-19e1 - Practice for Preparing Concrete Floors. Concrete pH determination.
- D. ASTM F2170-19a - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in-situ Probes.

1.05 QUALITY ASSURANCE

- A. Qualifications of Installers: Use only thoroughly trained and experienced carpet installers completely familiar with materials specified, manufacturer's recommended methods of installation, and requirements of this work.
- B. Manufacturer's Recommendations: Manufacturer's recommended methods of installation is basis for methods of installation used in this work.
- C. Applicable Standards: Meet OSHA requirements and flammability requirements of DOC-FF-1-70.

- D. **Pre-installation Meeting:** Conduct the meeting at work site with installers of other work adjoining carpeting including resilient base and representatives of other entities directly concerned with performance of carpet, including Port and product manufacturers.
1. Review contract documents, submittals, status of coordinating work, proposed installation schedule, and procedures.
 2. Review laydown area and logistics.
 3. Review ambient conditions and ventilation procedures.
 4. All related submittals shall be approved prior to the pre-installation meeting.
 5. Discuss carpet protection requirements for the duration of construction.
- E. **Mock-ups:** Install 10 x 10 foot minimum mockup to verify selections made under sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation. Architect approved mock-ups may become part of the completed project if undisturbed at the time of Substantial Completion.

1.06 JOB CONDITIONS

- A. **Environmental Conditions:** Maintain temperatures in space in accordance with carpet or adhesive manufacturer's recommendations, but in no case less than 65 degrees F for 24 hours prior to, during and after installation. Sub-floor temperature should be a minimum 65 degrees F for 24 hours prior to and after installation.
- B. **Precondition:** All of the carpet shall be spread in a room on site 24 hours prior to actual installation with the room preconditioned at a minimum of 65 degrees F with humidity between 10% to 65%.
- C. **Moisture:** A calcium chloride test should be performed on the concrete to detect the presence of moisture. Acceptable results require that moisture content does not exceed 3 lbs. per 1,000 square feet per 24 hours. One calcium chloride test should be performed for every 300 yards of carpet. Relative Humidity ASTM-F-2170 test method maybe be used in place of calcium chloride test. Acceptable moisture levels are 75% maximum relative humidity. Alkalinity tests must also be performed. PH should register between 5 and 9. All test should be documented and results saved.

1.07 EXTRA (ATTIC) STOCK

- A. **General:** Furnish 5% additional yardage of each carpet type required; extra yardage is over and above any overage provided by manufacturer. Normal manufacturing overage not to exceed 10% for under 1000 yards, not to exceed 5% for over 1000 yards. Deliver to the Owner uncut in clearly marked dust-proof packages prior to commencement of work; store where directed.

1.08 WARRANTY

- A. **Warranty for Carpet:** Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet installation which fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, excess static discharge, lack of color retention, poor wear, and staining, change in texture, and delamination.
2. There shall be no limitations to:
 - a. Full warranty coverage due to age of carpet or other deductive warranty considerations or pro-rations.
 - b. Duration of adhesive cure time received prior to use of the carpeted area.
3. Warranty period shall be manufacturer's standard warranty period or 10 years from date of substantial completion, whichever is greater.

PART 2 - PRODUCTS

2.01 TILE CARPETING

- A. Provide from one of the following manufacturers:
 1. Mannington
 2. Milliken & Company
 3. Mohawk
 4. Patcraft
 5. ShawContract
 6. Tarkett
- B. Refer to Product Schedule on the Drawings for types, sizes, colors and patterns.

2.03 ACCESSORIES

- A. Edge Guard and/or Transition Strip: Roberts Consolidated Industries or approved equal, edge guards and transition strips of types, sizes and profiles required. Submit color choices to Architect for selection of finish color.
- B. Installation Adhesive: Water-resistant type recommended by manufacturer, and complying with flammability requirements for installed carpet, where required.
 1. Provide HENRY® 650 R Pressure Sensitive Adhesive with releasable or permanent bonding properties or approved equal, if required. Moisture resistant up to 90% RH, solvent free and nonflammable.
- C. Seaming Cement: Hot melt seaming adhesive or similar product recommended by manufacturer, for taping seams and buttering cut edges at backing to form secure seams and prevent pile loss at seams.

2.03 OTHER MATERIALS

- A. Provide materials not specifically described but required for complete and proper carpet installation of new, first quality of their respective kinds recommended by manufacturer of carpeting, and subject to approval of Architect.

PART 3 - EXECUTION

3.01 MEASUREMENTS

- A. Dimensions for carpet tile areas are approximate. Carefully check dimensions and other conditions affecting this work in the field. Contractor responsible for proper installation in areas designated.

3.02 PRE-INSTALLATION REQUIREMENTS

- A. Installer must examine substrates for moisture content and other conditions under which carpet tile is installed, and notify Contractor in writing of conditions detrimental to proper completion of this work. Do not proceed until unsatisfactory conditions are corrected.
 - 1. Floor preparation shall be free of cracks and holes. Gaps of 1/16" or more are to be filled with latex base flashing compound.
 - 2. Floor temperature should be at 65° at least 24 hours prior to installation and 48 hours after carpet is installed.
- B. Clear debris and scrape up cementitious deposits from surfaces to receive carpet tile. Vacuum clean immediately before installation. Check concrete surfaces to ensure no "dusting" results through installed carpet. Apply sealer when required to prevent dusting.
- C. Sequence carpet tile installation with other work to minimize possibility of damaging and soiling carpet tile during remainder of construction period.

3.03 INSTALLATION OF CARPET TILE

- A. Comply with manufacturers' instructions and recommendations. At doors, center seams under doors. Do not place seams in traffic direction at doorways.
- B. Cement seams in accordance with manufacturer's instructions to produce best possible even top pile and prevent sprouting of face yarn and backing.
- C. Apply adhesive uniformly to substrate in accordance with manufacturer's instructions. Butt carpet tile edges tightly together to form seams without gaps. Roll lightly to eliminate air pockets and ensure uniform bond. Remove excess adhesive promptly from face of carpet tile.

3.04 ROOM/AREA MOCKUPS

- A. After the building is enclosed to provide weather protection, complete one typical full-size mockup of the following rooms and spaces:
 - 1. One of each room type or area, minimum 100 SF, as determined by the design professional.
- B. Mockup components shall be full size, using the same materials as those to be used in the actual Work, including details and methods of construction.

- C. Interior Room/Area Mockup: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
- D. Fabricate and erect each mockup under manufacturer's / installer's direct supervision and employ same installers as they would be employed during the actual performance of the Work at the job site. Employ same supervisory personnel who will perform site erection.

3.05 PROTECTION AND CLEANING OF CARPET TILE

- A. Adequately cover and protect against damage during shipment and delivery to job site, and until acceptance by Owner.
- B. Protect during installation using drop cloths, or heavy, reinforced, non-staining Kraft paper.
- C. Damaged carpet tile will be rejected and replaced by Contractor.
- D. At completion of work and when directed by Owner, vacuum clean carpet tile and remove soiling.
- E. Install plybar or 6 mil. visqueen protection over areas of carpet tile. Lap 12" at edges. Continuously tape down edges and joints.

3.06 MAINTENANCE

- A. Submit 2 copies of complete manual of manufacturer's maintenance recommendations.

3.07 EXTRA (ATTIC) STOCK

- A. Attic Stock: Furnish 5 percent of job required yardage of carpet tile.

END OF SECTION 09 68 13

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PART 1 - GENERAL**1.01 DESCRIPTION**

- A. Work Included: Provide specified painting and finishing of interior and exterior items.
 - 1. Provide painting of all new exposed steel and iron work, including primed metal surfaces. Paint exposed-to-view pre-finished metal surfaces of items, if required. Refer to drawings for existing metal to be painted.
 - 2. Provide touch-up of pre-finished items to match original finish.
 - 3. **Do not paint** waterproof coatings, water repellent coating, acoustical ceilings, toilet partitions, aluminum with factory applied finish, or pre-finished items, except as noted above.
 - 4. **Do not paint** over any code required metal labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates. Mask off the label before applying finish and remove masking after finish is dry.
- B. Refer to the mechanical and electrical and plumbing drawings for extent of patching and repair work required for accommodation of renovation work. The color and finish of areas where demolition will be necessary and not specifically shown or noted on Drawings is required to match the existing conditions.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 DEFINITIONS

- A. Term "paint", as used herein, includes enamels, paints, sealers, fillers, emulsions, varnishes, stains, and other coatings whether used as prime, intermediate, or finish coats.

1.05 QUALITY ASSURANCE

- A. Qualifications of Painters: Use only qualified journeyman painters for mixing and application of paint. In acceptance or rejection of painting, no allowance made for lack of skill on part of painters.
- B. Mockups - Interior: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 SF.
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.06 PRODUCT HANDLING

- A. Delivery: Deliver paint materials to job site in original unopened containers with labels intact and legible at time of use.
- B. Protection:
 - 1. Store only approved materials at job site and store only in suitable and designated area restricted to storage of paint materials and related equipment.
 - 2. Ensure safe storage and use of paint materials and prompt and safe disposal of waste.
 - 3. Protect paint materials before, during, and after application and protect installed work and materials of other trades.

PART 2 - PRODUCTS

2.01 PAINT MATERIALS

- A. Manufacturers: Provide paints, enamels, stains, varnishes, and admixtures of first line quality by Sherwin Williams or approved equal. Sherwin Williams products specified herein establish minimum quality standards. Approved equal products:
 - 1. Farrell-Calhoun
 - 2. PPG Paints
 - 3. Benjamin Moore

- B. Compatibility:
 - 1. Paint materials and equipment to be compatible. Finish coats compatible with prime coats, prime coats compatible with surface to be coated, and tools and equipment compatible with coating applied.
 - 2. Thinners (when used): Use thinners recommended for that purpose by manufacturer of material thinned.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

- A. Inspection: Carefully inspect installed work of other trades and verify work is complete to point where painting work may properly commence. Verify paint finishes may be applied in strict accordance with manufacturer's directions and requirements of these Specifications.
- B. Discrepancies: Do not proceed with installation in areas of discrepancy until discrepancies are fully resolved.

3.02 PREPARATION OF SURFACES

- A. Protection: Completely mask, remove, and adequately protect hardware, accessories, machined surfaces, plates, lighting fixtures, and similar items in contact with painted surfaces not scheduled to receive paint.
- B. Priming: Use primer recommended by manufacturer of coating system. Spot prime exposed nails and metals to be painted with emulsion paints.
- C. Cleaning: Thoroughly clean surfaces receiving paint. Schedule cleaning and painting so dust and contaminants from cleaning process will not fall on wet, newly painted surfaces.
- D. Gypsum Board: Treat and conceal joints, screw heads, and depressions in gypsum board surface in accordance with manufacturer's recommendations and instructions. Painted surfaces must be completely clean and continuously smooth. Treat internal and exterior corners and angles formed by intersection of wallboard surfaces and wallboard edges with joint reinforcements system in accordance with manufacturer's standard installation specifications where intersections and edges do not have metal trim. **All joints in gypsum board construction are to be taped and floated. This includes work above ceilings, at concealed places and anywhere else joints in gypsum board construction occur.** A slight egg-shell texture may be acceptable if approved by Architect prior to application. **Heavy "knockdown" texturing is not acceptable.**
- E. Concrete and Concrete Block: Prepare surfaces in strict accordance with paint manufacturer's instructions and recommendations. Remove chalk, dust, dirt, grease, oils and substances which negatively effect paint adhesion. Perform appropriate tests to determine alkalinity and moisture content of surfaces. If surfaces are found sufficiently alkaline to cause blistering and burning of paint, correct condition before applying paint.

- F. Wood: Clean wood surfaces free of dirt, oil, or foreign substances with scrapers, mineral spirits, and sandpaper. Sandpaper smooth those surfaces exposed to view, and then remove dust. Prime or seal wood requiring job painting immediately upon delivery to job. Prime edges, ends, faces, undersides, and backsides of this wood. Scrape and clean small, dry seasoned knots, and apply thin coat of white shellac or manufacturer's recommended knot sealer, before application of priming coat. After priming, fill holes and imperfections in finish surfaces with putty of plastic wood-filler. Sandpaper smooth when dried.
- G. Primed Ferrous Metals: Clean ferrous metals free of dust, grease and grime. Sand smooth rust spots, mars and abrasions in surfaces. Touch-up shop-applied prime coats which have damage or bare areas. Wire-brush, solvent clean, and touch up with same primer as shop coat.
- H. Non-ferrous Metals: Clean off all oxidation, dust, grease and grime.
- I. Galvanized Metal Surfaces: Clean free of oil and surface contaminates with acceptable non-petroleum based solvent. Touch up bare metal with zinc chromate primer.
- J. **Area to Receive Wall Covering:** Do NOT paint surfaces requiring wall covering finish.

3.03 WORKMANSHIP

- A. Do not perform outside painting in extremely cold, frosty, or damp weather. Do not paint in dusty rooms. If required, sprinkle floors, to lay dust. Do not apply coats of paint on either wet or damp surfaces and in no case unless preceding coat is dry and hard.
- B. Clean surfaces before priming. Remove dirt, oil, grease, rust, scale, and foreign matter. Clean with sandpaper, steel scraper, or wire brushes where necessary.
- C. Specified coats are to cover completed painting and finishing work. Where color, stain, or undercoats show through final coat, install additional coats until uniform coverage is obtained.
- D. Vary tints of undercoats slightly for identification of succeeding coats. Ample time of drying required to secure best possible results.
- E. Coats specified are in addition to shop or mill priming required under other Sections of these specifications.
- F. **All cabinet devices that require finish painting are to be painted with doors in the open position and shall be allowed to dry for a minimum of 24 hours in the open position. DO NOT PAINT DOORS CLOSED AND TRIM AFTER DRYING.**
 - 1. **Cabinets that require finish painting include, but are not limited to, wall and ceiling access doors, fire extinguisher/hose/valve cabinets, electrical panel boxes, etc.**

- G. Corridor partitions, smokestop partitions, horizontal exit partitions, exit enclosures, and fire walls shall be effectively and permanently identified with signs or stenciling in a manner acceptable to the authority having jurisdiction. Label each wall at 20'-0" maximum. Such identification shall be above any decorative ceiling and in concealed spaces. Approved wording is to be:

FIRE AND SMOKE BARRIER - PROTECT ALL OPENINGS

3.04 MOISTURE CONTROL

- A. Give back side of interior wood trim in contact with masonry units one application of water repellent preservative.

3.05 PAINT SCHEDULE

- A. Finish surfaces as follows:

<u>SURFACE</u>	<u>TREATMENT</u>
1. Exterior Steel / Ferrous Metals:	<u>1st Coat</u> - SW Pro-Cryl® Universal Acrylic Primer B66W00310 Series (Touch up only on primed surfaces) <u>2nd & 3rd Coats</u> - SW B66W01151 - Pro Industrial DTM Acrylic Semi-Gloss
2. Interior Ferrous Metals:	<u>1st Coat</u> - SW Pro-Cryl Universal Water Based Primer, B66-310 Series (Touch up only on primed surfaces) <u>2nd & 3rd Coats</u> - SW ProMar 200 Alkyd Eg-Shel B33 or S/G B34 as selected by Architect.
3. Interior Aluminum:	<u>1st Coat</u> - SW Pro-Cryl Universal Water Based Primer, B66-310 Series (Touch up only on primed surfaces) <u>2nd & 3rd Coats</u> - SW ProMar 200 Alkyd Eg-Shel B33 or S/G B34 as selected by Architect.
4. Galvanized Metals:	<u>1st Coat:</u> SW B66W00310 - Pro Industrial™ Pro-Cryl® Universal Acrylic Primer, Off White <u>2nd & 3rd Coats:</u> SW B66W01151 Pro Industrial DTM Acrylic Semi-Gloss Extra White.
5. Int. Gyp. Board - Painted:	<u>1st Coat</u> - SW PrepRite High Build Latex Wall Primer/Surfacer, B28W601 <u>2nd & 3rd Coats</u> - SW ProMar 200 Latex Eg-Shel B20-2200 or S/G B31-2200 Enamel as selected by Architect.
6. Int. Gyp. Board - Glazecoat:	SW Water Based Epoxy Resin, B70-200 Series with Gloss Hardener B60V15

7. **Interior CMU - Painted:** Prime Coats - SW PrepRite Block Filler, B25W25 as required to eliminate all pinholes.
2nd & 3rd Coats - SW ProMar 200 Latex Eg-Shel B20-2200 or S/G B31-2200 Enamel as selected by Architect.
8. **Interior CMU - Glazecoat:** Fill CMU walls with Three (3) Coats of Sherwin Williams Heavy Duty Block Filler, B42W46.
Apply another coat if more than 10 pinholes within 2' x 2' area.
SW Water Based Epoxy, B70-200 Series with Gloss Hardener B60V15
9. **Architectural Woodwork: Painted** 1st Coat - SW Prep Rite Wall and Wood Primer B49W2
2nd & 3rd Coats - SW ProMar 200 Interior Alkyd S/G, B34
10. **Exterior (Vertical) Wood: Painted** 1st Coat - SW A-100 Alkyd Exterior Primer
2nd & 3rd Coats - SW A-100 Exterior Latex Flat A6, Satin A82 or Gloss A8 as selected by Architect.
11. **Exterior (Vertical) Wood: Stained** 1st & 2nd Coat - SW Woodscapes Polyurethane Semi-Transparent Stain A15 Series.

3.06 PAINTING OF MECHANICAL AND ELECTRICAL WORK

- A. Painting of pipe and duct insulation and un-coated ferrous metal in inaccessible pipe and duct chases, in plumbing chases, and in spaces above ceiling is not required.
- B. Metal Work in Mechanical Room (finish as follows):
 1. Clean pre-finished equipment and touch up with enamel to match manufacturer's final coat.
 2. Clean exposed pipe, exposed conduit and electric outlet boxes, hangers and brackets, valve handles, and miscellaneous pipe line devices and give two coats of medium gray enamel.
 3. Clean prime painted or unfinished items of manufactured mechanical and electrical equipment, then prime and finish with two coats of enamel to match other finished items of equipment.
 4. Finish remaining exposed metal items with two coats of light grey enamel.
- C. Paint exposed interior metal work, including ferrous and non-ferrous piping, for heating ventilating, plumbing and electrical equipment, electric cabinets, ventilating grilles, metal access panels. Give exposed metal items one coat of enamel undercoater and one coat of enamel in addition to priming coat.
- D. Give pipe and duct insulation exposed to view one coat glue size and two coats enamel.
- E. **Paint all mechanical, electrical and plumbing items that are visible through registers, grilles and diffusers with Flat Black-Out paint.**

3.07 PROTECTION, CLEAN UP, AND TOUCH-UP

- A. Protect all work from paint droppings and spattering by use of masking, drop cloths, removal of items or by other approved methods.
- B. Upon completion, clean paint drops and smears from hardware, glass and other surfaces and items.
- C. Before final inspection, touch-up or refinish painted surfaces which have become damaged or discolored.
 - 1. Perform touch-up work in a manner to produce solid even color and finish texture to match surrounding color and finish texture.
 - 2. Areas that receive touch-up work and do not match surrounding color or finish texture will be refinished at Contractors expense.

3.08 REPAINTING AND REFINISHING

- A. Thoroughly clean existing surfaces in present building to be repainted and give one or more new coats of same type of paint originally used. Clean existing natural finish surfaces, sand and give new coat of varnish or finish originally used. Treat patched and repaired surfaces as new surfaces. For bidding purposes figure two coats of paint as average requirement. Scrape surfaces to be repainted, sand by hand or machine, and prepare to receive new coats.
- B. Paint rooms and areas in existing building noted on drawings to paint existing surfaces or required by Finish Schedule.
- C. Paint all rooms and areas in existing building where cutting and patching occurs. Paint after cutting, patching, and remodeling in rooms and areas is completed. Where cutting and patching is required on only one wall or surface, paint the entire room or area. Where cutting or patching occurs along a corridor wall, paint entire corridor wall from corner to corner or between termination lines designated by Architect.

END OF SECTION 09 91 00

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PART 1 - GENERAL**1.01 SUMMARY**

- A. General: Provide all labor, materials, equipment, tools and services, necessary to complete the fabrication and installation of the Work, as indicated by the Drawings.
- B. Coordination: Assign a Project Manager prior to beginning Work for coordination with the Owner for complete understanding and execution of the project requirements throughout the entire project. This includes, but is not limited to project meetings, submission review, fabrication and installation.
- C. Provide 911 address signage on outside of building as required by local municipality and NFPA:
 - 1. NFPA 1 Fire Code 2018: New and existing buildings shall have approved address numbers placed in a position to be plainly legible and visible from the street or road fronting the property. Address numbers shall be a minimum of 4 inches (100 mm) high with a minimum stroke width of 1/2 inches (13 mm).

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.
- C. Shop Drawings: List sign styles, lettering, materials, thicknesses, locations and dimensions of each interior sign.
- D. Selection Samples: One complete set of color chips representing manufacturer's full range of available colors.
- E. Verification Samples: Two full size samples representing each type, style, material, thickness, and color specified, including method of attachment.

1.04 QUALITY ASSURANCE

- A. Use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, and thoroughly familiar with requirements of this work.
- B. Regulatory Requirements: Comply with requirements of ICC/ANSI A117.1 and ADAAG.

1.05 PRODUCT HANDLING

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results.

PART 2 - PRODUCTS

2.01 BUILDING SIGNAGE

- A. Contractor to allow the sum as stipulated in Section 01 21 00 - Allowances, in the Base Bid for purchase, taxes, delivery to site and installation of all exterior and interior building signage to be selected by Architect. Allow minimum 6-8 weeks for production and installation of typical identification signage prior to local Certificate of Occupancy.
- B. All signage to be purchased under the stated allowance will comply with the 2017 ICC ANSI A117.1 Accessible and Usable Buildings and Facilities ADA Standards for size, location, color, type face and braille.
- C. Allowance does not include building plaque.
- D. Allowance shall include building address numbers as may be required by local municipality. Minimum 4" high premium vinyl decals on pre-spaced sheet in color and font as selected by architect, or as otherwise indicated on the drawings. Coordinate location with local Authority Having Jurisdiction.
- E. Comply with NFPA 101-2021, Stair Identification 7.2.2.5.4.1 for new enclosed stairs serving three or more stories and existing enclosed stairs serving five or more stories. Coordinate with local Authority Having Jurisdiction (AHJ).
 - 1. The stairs shall be provided with special signage within enclosure at each floor landing.

2.03 FEDERAL ACCESSIBLE RESERVED PARKING SIGNAGE (ACCESS SIGNS)

- A. ADA RESERVED PARKING SIGNS ARE NOT TO BE CONSIDERED AS ALLOWANCE ITEMS AND SHALL BE INCLUDED IN THE BASE BID.

1. Supplier: ADA Sign Depot, Inc., 10531 4S Commons Drive #622, San Diego, CA 92127, PHONE: 1-858-385-9095 or approved equal. Refer to Architectural and Civil drawings for types, locations and methods for mounting or displaying.
- B. Provide 12" wide x 18" high Federal R7-8 Handicap Parking sign as indicated on the drawings.
 1. Meets all Federal MUTCD (Manual of Uniform Traffic Control Devices) Specification for Design, Materials and Manufacturing
 2. Engineer Grade Prismatic Reflective sign face.
 3. Heavy-gauge .063 aluminum.
 4. Durable, Rust-Free, and Rated for a Minimum of 7 Years Outdoor No Fade Service.
 5. Parking sign is pre-drilled with standard .375-inch diameter holes at top and bottom center for easy mounting to posts or walls.
- C. Provide 12" wide x 18" high Federal R7-8-MOD Van Accessible Handicap Parking sign as indicated on the drawings and matching criteria for R7-8 sign.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examination - On Site
 1. Examine areas with Signage Contractor and Owner present, for compliance with requirements for installation and other conditions, which will adversely affect execution, permanence and quality of work. Do not proceed with installation until unsatisfactory conditions have been corrected or accommodations acceptable to the Owner have been made.
 2. Examine signage for defects prior to installation. Do not install damaged signage.

3.02 INSTALLATION - SURFACE MOUNTED SIGNS

- A. Locate signs and accessories where indicated, using mounting methods of types described and complying with Manufacturer's written instructions.
- B. Install signs level, plumb and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
- C. Wall-Mounted Signs: Comply with Manufacturer's written instructions except where more stringent requirements apply. Use mounting methods indicated.
 1. Mount with 3M VHB acrylic foam tape.
 2. Mount with screws.
 3. Mount with silicone and 3M VHB acrylic foam tape.

- D. Mechanical Fasteners: Where indicated, use nonremovable mechanical fasteners placed through pre-drilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by Manufacturer.

3.04 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to Manufacturer's written instructions. Protect signs from damage until acceptance by Agency.

END OF SECTION 10 14 00

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PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Furnish and install toilet partitions, urinal screens specified.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.
- B. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

- A. Use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, and thoroughly familiar with requirements of this work.

1.05 PRODUCT HANDLING

- A. Protection: Protect toilet partitions and other items under this Section before, during, and after installation. Protect installed work and materials of other trades.
- B. Replacements: In event of damage, immediately make repairs and replacements necessary at Contractor's expense.

PART 2 - PRODUCTS

2.01 SOLID PHENOLIC / COLOR-THRU TOILET COMPARTMENTS

- A. Acceptable Manufacturer: ASI Global Partitions, which is located at: 900 Clary Connector; Eastanollee, GA 30538; Tel: 706-827-2700; www.asi-globalpartitions.com

- B. Doors, Panels, Screens, and Pilasters: Decorative surface sheet with solid phenolic core of melamine resin impregnated kraft paper fused under high temperature and pressure; edges machine sanded with a 45 degree radius edge. Manufacturer's standard.
 - 1. Doors and Pilasters: 3/4 inch (19 mm) thick.
 - 2. Panels and Screens: 1/2 inch (13 mm) thick.
 - 3. Edges: Black core.
 - 4. Fire Rated Material: Black core is Class B. Color thru Class A
- C. Finish: Solid phenolic/color-thru, as selected from manufacturer's standard colors.
- D. Door Hardware: Vault hinge.
 - 1. Top Hinge: Heavy-duty "vault" type, die-cast aluminum alloy with brushed chrome-plated finish; wrap-around pilaster and door mounting, through bolted.
 - 2. Bottom Hinge: Same as top hinge, with gravity-acting cams.
 - 3. Latch: Non-ferrous, satin chrome-plated, slide latch.
 - 4. Strike and Keeper: Permitting emergency access by lifting the door until latch is clear of keeper; satin chrome-plated finish.
 - 5. Coat Hook and Bumper: Non-ferrous, chrome-plated, with black rubber tip for doorstop.
 - 6. Fastening Hardware: Manufacturer's standard, Type 304 stainless steel, No. 4 satin finish, with theft-resistant barrel nuts and machine screws.
- E. Mounting Brackets: Die-cast Type 304 stainless steel stirrup bracket, No. 4 satin finish, with stainless steel theft-resistant barrel nuts and machine screws of same material and finish.
- F. Headrail: Manufacturer's standard anodized aluminum rail with anti-grip profile.
- G. Pilaster Anchors, Floor Anchored/Overhead Braced: Easy Stall shoe system. 1/4 inch by 2 inch steel screws attach Easy Stall shoe to floor. Pilaster to be inserted into shoe and secured after height adjusted. Leveling adjustment to be concealed by pilaster shoe. Height/leveling adjustment to be made via machine thread bolts inserted into threaded insert in bottom of pilaster. Shoe to be constructed of type 304 stainless steel and to be 3" high.

2.02 ALCOVE FLOOR MOUNTED AND HEAD RAIL BRACED CONDITIONS

- A. Do Not Use Right Angle Head Rail Brace at ADA or other alcoves larger than 60" clear x 60" clear. Provide minimum 7" wide pilaster at or near door strike jamb from floor to head rail that is parallel with wall in the long dimension. Refer to the drawings for further clarification.

2.03 OTHER MATERIALS

- A. Provide materials, not specifically described but required for complete and proper installation of specified items, selected by Contractor subject to approval of Architect.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

- A. Inspection: Prior to work of this section, carefully inspect installed work of other trades and verify that work is complete to point where this installation may properly commence.
- B. Discrepancies: Do not proceed with installation in areas of discrepancy until discrepancies are fully resolved.

3.02 INSTALLATION

- A. Install toilet partitions and other items specified in this Section, anchoring components firmly in place for long life under hard use and in complete accordance with manufacturer's recommendations.

3.03 INSPECTION AND ADJUSTMENT

- A. Upon completion of installation and as a condition of acceptance, visually inspect entire work of this section, adjust components for proper operation and straight alignment, and touch-up scratches and abrasions to be completely invisible.

END OF SECTION 10 21 00

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PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish and install metal accessories called for in Toilet Accessory Schedule.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.
- C. Samples: Submit a sample of each component illustrating color and finish.
- D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

1.04 REFERENCES

- A. 2021 Arkansas Fire Prevention Code (IBC 2021), Chapter 11 - Accessibility.
- B. BABIES Act, or Bathrooms Accessible In Every Situation Act (2016) requiring changing tables in all publicly accessible federal buildings as determined by the GSA.
- C. 2017 ICC A117.1 - Accessible and Usable Buildings and Facilities.
- D. 2010 ADA Standards for Accessible Design.
- E. ADA Accessibility Guidelines for Buildings and Facilities, July 23, 2004 – Provisions for Children.
- F. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- G. ASTM A167-99 (Re-approved 2004) - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

- H. ASTM A269/A269M-2015 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- I. ASTM A794/A794M-2018 - Standard Specification for Commercial Steel (CS), Sheet, Carbon (0.16 % Maximum to 0.25 % Maximum), Cold-Rolled.
- J. ASTM B456-2003 - Electro-deposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.

1.05 QUALITY ASSURANCE

- A. Use personnel skilled in work required, completely familiar with manufacturers' recommended methods of installation, and thoroughly familiar with requirements of this work.

1.06 PRODUCT HANDLING

- A. Protection: Protect toilet and bath accessories before, during, and after installation. Protect installed work and materials of other trades.
- B. Replacements: In event of damage, immediately make repairs and replacements necessary at Contractor's expense.

PART 2 - PRODUCTS

2.01 METAL TOILET ACCESSORIES

- A. Manufacturers and Accessory Numbers are listed in Toilet Accessory Schedule. Manufacturers who may furnish products for review by Architect are:
 - 1. American Specialties (ASI)
 - 2. Bobrick
 - 3. Bradley Corporation
 - 4. comfortdesigns
 - 5. Delta Faucet
 - 6. McKinney
 - 7. Metpar
 - 8. Approved Equal

2.02 MATERIALS

- A. Stainless Steel: AISI Type 302/304, with "Brushed" finish, 0.034-inch (22-gage) minimum thickness.
- B. Brass: Leaded and unleaded, flat products, ASTM B 19; rods, shapes, forgings, and flat products with finished edges, ASTM B 16; Castings, ASTM B 30.
- C. Sheet Steel: Cold-rolled, commercial quality ASTM A 366, 0.04-inch (20-gage) minimum. Surface preparation and metal pretreatment as required for applied finish.

- D. Galvanized Steel Sheet: ASTM A 527, G60.
- E. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B 456, Type SC 2.

2.03 FASTENERS

- A. Provide screws, bolts, and other devices of same material as accessory unit, or of galvanized steel where concealed.

2.04 PLUMBING PIPE WRAP

- A. At all exposed lavatory piping, provide TRUEBRO Lav Guard® 2, Fast Fit Undersink Piping Covers as manufactured by IPS Corporation, 202 Industrial Park Lane, Collierville, TN 38017, 800-340-5969 or approved equal.
 - 1. Use at all sinks or lavatories that do not have removable apron.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

- A. Coordinate with other trades to ensure proper and adequate provision in framing and wall finish for installation of selected accessories.
- B. Prior to installation, inspect location of accessories and verify that necessary provisions have been made. Do not proceed with installation in areas of discrepancy until discrepancies have been fully resolved.

3.02 INSTALLATION

- A. Install accessories in accordance with manufacturers' recommendations, anchoring components firmly in place.

END OF SECTION 10 28 13

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PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Firefighting devices consist of hand-portable fire extinguishers and metal cabinets, and accessories.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 REFERENCES

- A. NFPA 10 - Standard for Portable Fire Extinguishers
- B. ADA Accessibility Guidelines
- C. IBC/IFC Tables 906.3(1) and 906.3(2) for determining extinguisher rating, fire classification, hazard classification, and travel distance.
- D. UBC Standard 7-5 (ASTM E-814-83) - Fire-rated cabinet option for combustible and non-combustible walls.

1.05 QUALITY ASSURANCE

- A. Provide fire extinguishers, cabinets, and accessories by a single manufacturer.

1.06 PRODUCT HANDLING

- A. Protection: Protect firefighting devices before, during, and after installation. Protect installed work and materials of other trades.
- B. Replacements: In event of damage, immediately make repairs and replacements necessary at Contractor's expense.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
1. **Basis of Design:** Larsen's Manufacturing Co., 7421 Commerce Ln NE, Minneapolis, MN 55432, (763) 571-1181 or (800)527-7367.
 2. Potter Roemer, 17451 Hurley St, City of Industry, CA 91744 Phone: (800) 366-3473 E-mail: info@potterroemer.com
 3. JL Industries, Activar Construction Products Group, 800-554-6077. Email: sales@activarcpg.com
- B. Abbreviations:
- | | |
|-------|---|
| SRC-1 | Semi-Recessed Cabinet |
| SMC-1 | Surface-Mounted Cabinet |
| WHE-1 | Wall Hung Extinguisher (with clip or bracket) |

2.02 FIRE EXTINGUISHERS

- A. **Type 1:** Provide multi-purpose dry chemical type, Model MP-10 with UL Rating 4A-80B:C for Class A, B and C fires manufactured by Larsen's®, or approved equal.

2.03 FIRE EXTINGUISHER CABINETS

- A. **SRC-1:** Construct cabinets from 18 gauge, or heavier, stainless steel with #4 finish. Provide Larsen's®, rolled edge semi-recessed "Architectural Series" No.SS2409-6R, or approved equal, with "Vertical Duo" doors. Lettering, if required, to be black vertical Type 'A' die cut; verify with Owner and local Authority Having Jurisdiction (AHJ) or fire code official (Note: lettering typically not required). Mount at 56" to top of housing in masonry wall construction, maintaining consistent height at all wall types. Neither the extinguisher handle nor the cabinet handle shall be mounted higher than 48" AFF, per ADA.
- B. **SMC-1:** Construct cabinets from 18 gauge, or heavier, stainless steel with #4 finish. Provide Larsen's®, Surface Mounted ARCHITECTURAL SERIES No.SS2409-SM, or approved equal, with "Vertical Duo" doors. Lettering, if required, to be black vertical Type 'A' die cut; verify with Owner and local Authority Having Jurisdiction (AHJ) or fire code official (Note: lettering typically not required). **Comply with ADA wall projection guidelines by mounting leading edge at or below 27 inches from finished floor.**
- C. Provide fire rated cabinets if required to be installed in a fire rated wall.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

- A. Coordination: Coordinate with other trades to ensure proper and adequate provision in framing and wall covering for installation of recessed cabinets.
- B. Inspection:
 - 1. Prior to installation, inspect cabinet recesses, and verify that necessary provisions have been made.
 - 2. Do not proceed with installation in areas of discrepancy until discrepancies have been fully resolved.

3.02 INSTALLATION

- A. Install the items of this Section in strict accordance with the original design, approved shop drawings, and requirements of agencies having jurisdiction, as approved by the Architect, anchoring all components firmly into position.

3.03 SERVICE

- A. Determine approximate completion date of Work. Inspect, charge, and tag fire extinguishers at date not more than ten days before or less than one day before actual completion date of the Work.

END OF SECTION 10 44 00

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PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide other miscellaneous specialties specified.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

- A. Furnish at least one person, present at all times, thoroughly familiar with installation requirements of each item, to personally supervise installation.

1.05 PRODUCT HANDLING

- A. Protection: Protect miscellaneous specialty items before, during, and after installation. Protect installed work and materials of other trades.
- B. Replacements: In event of damage, immediately make repairs and replacements at Contractor's expense.

PART 2 - PRODUCTS

2.01 RAPID ENTRY SYSTEM

- A. Provide Knox-Box® emergency entry key box by Knox Co., 949-252-8181 or approved equal. Provide Model #3270 Recess Mount in Black color and #3290 Hinged Door Recessed Mounting Kit. Contractor to contact local fire department to apply for authorization to order box and verify location. Orders are not accepted without authorized signature of local fire official. Recommended mounting height is 72" to top of box to help deter vandalism. Verify with local Authority Having Jurisdiction (AHJ).

2.02 ROOFTOP SUPPORTS

- A. Manufacturer: MIRO Industries, Inc., 844 S 430 W, Heber City, UT 84032, Tel.: (801) 975-9993 or approved equal. Provide the following specific to the project:
1. Pillow block pipe supports.
 2. Roller support series.
 3. Baser Strut support series.
 4. Custom hanger support series.
 5. Custom duct and cable tray support series.
 6. Mechanical supports.
 7. Surefoot access products.
 8. Accessories.
- B. The work covered by this specification consists of furnishing all labor, equipment, materials and accessories, and performing all operations required for the correct installation of supports for mechanical piping and duct, and electrical conduit systems.
- C. Installation:
1. Install in accordance with manufacturer's instructions and recommendations.
 2. If gravel top roof, gravel must be removed around and under pipe support.
 3. Always consult roofing manufacturer for roof membrane compression capacities. If necessary, a compatible sheet of roofing material (rubber pad) may be installed under rooftop support to disperse concentrated loads and add further membrane protection.
 4. Gas pipe spacing subject to local gas authorities.
 5. Use properly sized clamps to suit pipe and/or conduit sizes.

2.03 SUPPORT BRACKETS FOR MILLWORK

- A. Provide Heavy-Duty (HD) Hybrid Brackets (Surface Mount or Concealed/Floating) designed specifically for detailed application, as manufactured by A&M Hardware, Inc., (888) 647-0200.
www.AandMhardware.com or approved equal manufacturer:
1. Triton Heavy-Duty (HD) Bracket designed specifically for application as detailed, as manufactured by Steel Design Solutions, 800-459-1892.
 2. Provide Model No. EH-1818 surface-mounted Counter Support Bracket as manufactured by Rakks, 800-826-6006, where indicated on drawings.

2.04 STAINLESS STEEL CORNER GUARDS

- A. Provide Type 430, 16 Gauge Flanged Stainless Steel with 2 inch leg and 1/8" radius as manufactured by Inpro Corp., IPC Door and Wall Protection Systems, 1-800-222-5556, www.inprocorp.com in a No. 4 satin finish. Lengths and locations are as indicated on the drawings. Attachment method to be Adhesive: Field applied heavy duty adhesive.

2.05 SIDEWALK TRENCH DRAIN SYSTEM

- A. Provide Zurn Z884: Channels shall be 40" long, 4-3/4" wide reveal and have a 3-1/4 [83] throat. Modular channel sections shall be made of 0% water absorbent Polypropylene. Shall have a positive mechanical connection between channel sections that will not separate during the installation and shall mechanically lock into the concrete surround a minimum of every 10". Channels shall weigh less than 2 lbs. per linear foot, have a smooth, 1.634 radiused self-cleaning bottom with a Manning's coefficient of .009 neutral 0% built in slope. Channels shall have rebar clips standard to secure trench in its final location. Shall be provided with standard HPP grates that lock down with lockdown bars to the channel and is not intended for dynamic traffic loadings. Zurn 4-1/8" wide reveal Longitudinal Heelproof Polypropylene Grate is rated class A per the DIN EN1433 top load classifications. Supplied in 20" nominal lengths

2.06 EDGE OF DOCK LEVELERS AND BUMPERS

- A. Provide Vestil FM-2078 Mechanical Edge Of Dock Leveler as manufactured by Vestil Manufacturing Corp., (800) 348-0868, <https://www.vestil.com/> .
1. Edge of dock leveler features a 20,000 LB capacity, 78" usable width, 5" above and below deck service range, and a ramping length of 28-15/16".
 2. Two 18" Wide x 8" High x 2" Deep rubber bumpers with 15" projection to protect the leveler and aid in the loading and unloading of low trucks.
 3. The Vestil FM-2078 permanently attaches to the dock face. A concrete recess is not required. Edge Of Dock Leveler is constructed of all steel for years of low maintenance service.
- B. The Vestil FM-2078 Mechanical Edge Of Dock Leveler is operated by placing the handle into the inner lip pocket and pulling downward. The handle is then pushed forward extending the lip until it rests on the trailer bed. Upon trailer departure, the lip automatically retracts behind the face of the bumpers.

2.07 CUSTOM OR PRE-FABRICATED ROOF CURBS

- A. Provide various fully assembled curbs as manufactured by Thybar Corporation, 13801 Senlac Dr, Farmers Branch, TX 75234 or approved equal. Tel.: (972) 416-6220.
1. Insulated Roof Curbs: Model TC-1, TC-2 or TC-3 meeting ASTM A653/653M.
 2. Non-Insulated Roof Curbs: Model TC-5
 3. Seismic Rooftop Curbs
 4. Filter Curbs
 5. Metal Building Curbs
 6. Catwalks and Service Platforms

2.08 RETROFIT ROOF DRAINS

- A. Provide Johns Manville Heavy-Duty TPO RetroDrain® with U-Flow® Mechanical Seal, Aluminum Roof Drain Assembly or approved equal. Product is a one-piece spun aluminum body with TPO-coated flange and depressed sump area used to replace existing drains in re-roofing applications. Refer to JM applicator guides or detail drawings for instructions.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

- A. Prior to installation, verify items may be installed in accordance with manufacturers' recommendations.
- B. Notify Architect of conditions that would adversely affect installation.
- C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install miscellaneous specialties in strict accordance with manufacturers' current recommendations and instructions.

3.03 ADJUSTMENT AND CLEANING

- A. Verify that trim is in place and adjust components.
- B. Remove labels from equipment and remove packing materials from job site.

END OF SECTION 10 80 00

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide manually-operated and motorized roll-up fabric interior window shades, including mounting and operating hardware.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.
- C. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings, field verified window dimensions, quantities, type of shade, controls, fabric, and color, and include opening sizes and key to typical mounting details.
- D. Selection Samples: For each finish product specified, two complete sets of shade cloth options and aluminum finish color samples representing manufacturer's full range of available colors and patterns.
- E. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Obtain roller shades through one source from a single manufacturer with a minimum of twenty years experience in manufacturing products comparable to those specified in this section. If manufacturer does not meet minimum experience requirement, please submit life cycle test data showing minimum 2000 complete operational cycles for each year of warranty showing no failure and that shade remains fit for use as a operable shade. **All components and materials shall be manufactured in the USA.**

- B. NFPA Flame-Test: Passes NFPA 701. Materials tested shall be identical to products proposed for use. Show complete manufacturer data (name, location, contact) and certification from manufacturer that the fabrics sourced for this project comply with the test data provided.
- C. Mock-Up: Provide a mock-up of one of each type roller shade assembly specified for evaluation of mounting, appearance and accessories.
 - 1. Locate mock-up in window(s) designated by Architect.
 - 2. Do not proceed with remaining work until mock-up is accepted by Architect.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver window shades until building is enclosed and construction within spaces where shades will be installed is substantially complete.
- B. Deliver products in manufacturer's original, unopened, undamaged containers with labels intact.
- C. Label containers and shades according to Window Shade Schedule.
- D. Store products in manufacturer's unopened packaging until ready for installation.

1.06 SEQUENCING

- A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
- B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.07 PROJECT CONDITIONS

- A. Install roller shades after finish work and ambient temperature, humidity and ventilation conditions are maintained at levels recommended for project upon completion.

1.08 WARRANTY

- A. Manufacturer to warrant its hardware components and shade fabric to be free from defects in material and workmanship under the normal and proper use for a period of twenty-five (25) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Draper, Inc.. Toll Free Tel: 800-238-7999.
- B. All work regarding shades to be coordinated with Kavanaugh Blind Shade & Shutter Co., 5208 Kavanaugh Blvd, Little Rock, AR, (501) 412-6866 (mobile); email: Brett Todd sbrettodd@outlook.com
- C. Approved Dealers:
 - 1. Shop Mr. Blinds, Searcy, AR 501-232-8382, Mandy Lloyd.
 - 2. Baker Window Coverings, 501-529-2900, Janet Baker
 - 3. Other equal dealers will be subject to approval by the architect.
- D. Approved equal manufacturers:
 - 1. Hunter Douglas
 - 2. SWF Contract (Springs Window Fashions)

2.02 MANUALLY OPERATED WINDOW SHADES

- A. Manually Operated Window Shades with Independent Control: Manually operated, vertical roll-up, fabric window shade with components necessary for complete installation.
 - 1. Operation: Bead chain and clutch operating mechanism allowing shade to stop when chain is released. Designed never to need adjustment or lubrication. Provide limit stops to prevent shade from being raised or lowered too far.
 - a. Clutch mechanism: Fabricated from high carbon steel and molded fiberglass reinforced polyester or injected molded nylon. White or Black color as selected by Architect.
 - b. Bead chain loop: Stainless steel bead chain hanging at side of window.
 - c. Idler Assembly: Provide roller idler assembly of molded nylon with adjustable or spring-loaded length idler pin to facilitate easy installation, and removal of shade for service.
 - d. Bead Chain Hold Down: P-Clip (standard).
 - 2. Mounting:
 - a. Mounting brackets.
 - b. End-caps and fascia.
 - 3. Roller Tube: Fabricated from extruded aluminum, galvanized steel, or enameled steel. Diameter, wall thickness, and material selected by manufacturer to accommodate shade type and size. Fabric connected to the roller tube with LSE (low surface energy) double sided adhesive specifically developed to attach coated textiles to metal. Adhesive attachment to eliminate horizontal impressions in fabric.
 - 4. Endcaps: Stamped steel with universal design suitable for mounting to ceiling, wall, and jamb. Provide size compatible with roller size.
 - a. Endcap covers: To match fascia or headbox color.

5. Brackets: Plated stamped steel. Provide size compatible with roller size.
 - a. Mounted to jamb.
 6. Shade slat: Slat encased in heat seamed hem.
 7. Fascia: L shaped aluminum extrusion to conceal shade roller and hardware.
 - a. Attachment: Snaps onto end-caps without requiring exposed fasteners of any kind. Fascia can be mounted continuously across two or more shade bands. No notching is required.
 - b. Shape: Square Fascia Panel.
 - c. Finish: Selected from Manufacturers standard range.
- C. Roller: Fabricated from extruded aluminum or steel. Diameter, wall thickness, and material selected by manufacturer to accommodate shade size. Provide with roller idler assembly of molded nylon and zinc-plated steel pin. Sliding pin to allow easy installation and removal of roller. Fabric connected to the roller tube with LSE (low surface energy) double sided adhesive specifically developed to attach coated textiles to metal. Adhesive attachment to eliminate horizontal impressions in fabric.
- D. Endcaps: Stamped steel with universal design suitable for mounting to ceiling, wall, and jamb. Provide size compatible with roller size.
- E. Endcap covers to match fascia/headbox finish.
- F. Brackets: 1/8-inch-thick stamped steel, black powder coat, idler height adjuster, field adjustable to wall or ceiling mount.
 1. Mounted to ceiling.
 2. Mounted to wall.
 3. Mounted to jamb.
- G. Coupling system: Couplings to join motorized shade rollers to allow operation by single motor. FlexShade Coupling System as manufactured by Draper, Inc. Provide endcaps to receive couplers and support multiple shades.
- H. Shade slat: Slat encased in heat-seamed hem.
 1. Closed pocket elliptical slat: 1" (25mm) aluminum elliptical slat inside of a 1 5/8" (41mm) pocket with heat sealed ends.
 2. Open pocket elliptical slat: 1" (25mm) aluminum elliptical slat with plastic ends inside of a 1 5/8" (41mm) pocket.
 3. Small flat exposed hem bar: 7/8" x 5/16" (22mm x 8mm) aluminum rectangular hem bar with plastic end caps. Powder coated in black, bronze, ivory, white or clear anodized.
 4. Large flat exposed hem bar: 1½" x 5/16" (38mm x 8mm) aluminum rectangular hem bar with plastic end caps. Powder coated in black, bronze, ivory, white or clear anodized.
 5. Round exposed hem bar: Small (5/8" (16mm)) and Large (13/16" (21mm)) aluminum with plastic end caps. Powder coated in black, bronze, ivory, white or clear anodized.

- I. Fascia: L shaped aluminum extrusion to conceal shade roller and hardware.
 - 1. Attachment: Snaps onto end caps without requiring exposed fasteners of any kind. Fascia can be mounted continuously across two or more shade bands.
 - a. Shape: Square Fascia Panel.
 - b. Shape: Dual Roller Fascia Panel.
 - 2. Finish: Selected from Manufacturers standard range.
- J. Headbox Ceiling/Wall Style: Aluminum fabrication with removable closure, endcaps, and back and top cover piece:
 - 1. Finish: Selected from Manufacturers standard range.
- K. Headbox, Pocket Style: Aluminum fabrication with removable closure, endcaps, and U-shaped pocket:
 - 1. Finish: Selected from Manufacturers standard range.
- L. Type D Shade pocket: Rectangular pocket designed for recessed ceiling installation of window shades.
 - 1. Material: Extruded aluminum alloy with white epoxy paint finish.
 - 2. Size: 5 inches (127 mm) by 5-5/8 inches (137 mm) high.
 - 3. Closure Panel:
 - a. 3 inch (78 mm).
 - 4. Pocket Endcap Kit: Endcaps with 7/8-inch (22 mm) lip for support of acoustical ceiling panel.
 - 5. Corners: Welded one-piece aluminum sections connecting to and matching pockets to allow continuous shade recess at ceiling corners.
 - 6. Pocket ends: Welded one-piece aluminum sections connecting to and matching pockets.
- M. Wall Clip with Closure panel: For site constructed ceiling recesses, provide removable closure panel to minimize slot for shade passage but allowing access to shade for maintenance.
 - 1. Material: Aluminum alloy with white epoxy paint finish.
 - 2. Tile Lip: Provide wall clip with 7/8-inch tile lip (22 mm).
 - 3. Closure width: 1-1/2 inches (38 mm).
 - 4. Closure width: 3 inches (75 mm).
 - 5. Closure Width: 5 inches (127 mm).
 - 6. Provide continuous wall clip, 1-3/4 (44 mm) by 3/16 inch (5 mm), for snap-in attachment of closure panel without fasteners.
- N. Aluminum Light Gap Reduction Channels
 - 1. L Angle - 3/4 inch by 1 inch (19 mm by 25 mm).
 - 2. L Angle - 1 inch by 2-3/4 inches (25 mm by 70 mm).
 - 3. U Channel - 1 inch by 2-1/2 inches (25 mm by 64 mm).
 - 4. H Channel - 1 inch (25 mm) by 5 inches (127 mm).
- O. Vinyl Light Gap Reduction Channels
 - 1. L Angle - 1-1/2 inches 3/4 inches (38 mm by 19 mm).

- P. Interior cable guide kit
 - 1. Interior cable hem bar finial.
 - 2. Cable mount.
 - 3. Cable.
 - 4. Tension Stop.

2.05 FABRIC

- A. Light-Filtering Fabrics
 - 1. Refer to the Product Schedule located in the drawings for locations, types, patterns and colors.
 - a. Openness Factor: 3%
 - b. Color: Charcoal (Verify)
- B. Room Darkening Fabrics
 - 1. Refer to the Product Schedule located in the drawings for locations, types, patterns and colors.

PART 3- EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Coordinate requirements for blocking and structural supports to ensure adequate means for installation of window shades.
- B. Coordinate requirements for blocking, construction of shade pockets, and structural supports to ensure adequate means for installation of window shades.
- C. Coordinate installation of recessed shade pockets with construction of suspended acoustical panel ceilings specified in Section 09 51 00.
- D. Coordinate installation of recessed shade pockets with construction of suspended gypsum board ceilings specified in Section 09 21 16.
- E. Coordinate requirements for power supply conduit, and wiring required for window shade motors and controls.

3.03 INSTALLATION

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

- B. Install roller shades level, plumb, square, and true. Allow proper clearances for window operation hardware.
- C. Shade pockets:
 - 1. Install shade pockets prior to installation of suspended ceiling system. Attach to supporting structure with screws through top of pocket at 24 inches minimum centers.
 - 2. Install shade pockets in conjunction with installation of suspended ceiling system. Attach to supporting structure with screws through top of pocket at 24 inches minimum centers.
 - 3. Install corner pieces securely and in alignment with pockets.
 - 4. Install pocket ends securely and in alignment with pockets.
 - 5. After interior construction is essentially complete, install shade and operating mechanism in pocket.
- D. Install the following items to conceal roller and operating mechanism. Do not use exposed fasteners.
 - 1. Fascias.
 - 2. Closure panels.
 - 3. Endcaps.
- E. Install headbox, side channels, and sill channel with sealant specified in Section 07 92 00 - Joint Protection.
- F. Position shades level, plumb, and at proper height relative to adjacent construction. Secure with fasteners recommended by manufacturer.

3.04 TESTING AND DEMONSTRATION

- A. Test window shades to verify that operating mechanism, fabric retainer, and other operating components are functional. Correct deficiencies.
- B. During daylight hours, lower shades and turn off interior lights. Verify that there are no light leaks at perimeter or within shade assembly. Correct deficiencies.
- C. Demonstrate operation of shades to Owner's designated representatives.

3.05 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

3.06 SCHEDULES

- A. Refer to Drawings for shade types and locations.

END OF SECTION 12 24 13

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MACHINE ROOM-LESS ELECTRIC TRACTION PASSENGER ELEVATORS**PART 1 - GENERAL****1.01 SUMMARY**

- A. Section includes Machine room-less electric traction passenger elevators as shown and specified. Elevator work includes:
 - 1. Gearless electric traction passenger elevators.
 - 2. Elevator car enclosures, hoistway entrances and signal equipment.
 - 3. Operation and control systems.
 - 4. Accessibility provisions for physically disabled persons.
 - 5. Equipment, machines, controls, systems and devices required for safely operating the specified elevators at their rated speed and capacity.
 - 6. Materials and accessories as required to complete the elevator installation.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are located in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.
- C. Shop drawings:
 - 1. Show equipment arrangement in the corridor, pit, and hoistway and/or optional control room. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.
 - 2. Indicate elevator system capacities, sizes, performances, safety features, finishes and other pertinent information.
 - 3. Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.
 - 4. Indicate electrical power requirements and branch circuit protection device recommendations.
- D. Paint selection: Submit manufacturer's standard selection charts for exposed finishes and materials.
- E. Integrated laminate selection: Submit manufacturer's standard selection charts for exposed finishes and materials.

- F. Metal Finishes: Upon request, standard metal samples provided.
- G. Operation and maintenance data. Include the following:
 - 1. Generic owner's manuals and no wiring diagrams.
 - 2. Parts list, with recommended parts inventory.

1.04 WORK BY OTHER TRADES

- A. Related Sections:
 - 1. Division 1 General Requirements: Meet or exceed all referenced sustainability requirements.
 - 2. Division 3 Concrete: Installing inserts, sleeves and anchors in concrete.
 - 3. Division 4 Masonry: Installing inserts, sleeves and anchors in masonry.
 - 4. Division 5 Metals:
 - a. Providing hoist beams, pit ladders, steel framing, auxiliary support steel and divider beams for supporting guide-rail brackets.
 - b. Providing steel angle sill supports and grouting hoistway entrance sills and frames.
 - 5. Division 9 Finishes: Providing elevator car finish flooring and field painting unfinished and shop primed ferrous materials.
 - 6. Division 16 Sections:
 - a. Providing electrical service to elevators, including fused disconnect switches where permitted. (Note: fused disconnect switch to be provided as part of elevator manufacture product)
 - b. Emergency power supply, transfer switch and auxiliary contacts.
 - c. Heat and smoke sensing devices.
 - d. Convenience outlets and illumination in control room (if applicable), hoistway and pit.
 - 7. Division 22 Plumbing
 - a. Sump pit
 - 8. Division 23 Heating, Ventilation and Air Conditioning
 - a. Heating and ventilating hoistways and/or control room.
- B. Work Not Included: General contractor shall provide the following in accordance with the requirements of the Model Building Code and ASME A17.1 Code. For specific rules, refer to ASME A17.1, Part 2 for traction elevators. State or local requirements must be used if more stringent. The cost of this work is not included in the TK Elevator's proposal since it is a part of the building construction.
 - 1. A plumb and legal hoistway, properly framed and enclosed and including a pit of proper depth, and a pit ladder for each elevator. Hoistway walls require a minimum two hours of fire rating. Hoistway should be clear and plumb with variations not to exceed 1/2" at any point. Drains, lights, access doors, waterproofing and hoistway ventilation, as required.

2. Elevator controller space
 - a. Door jamb controller option - controller landing wall thickness must be a minimum of 8 1/2 inches thick. This is due to the controller being mounted on the top floor landing in the door frame on the return side of the door. For center opening doors, the controller is located on the right hand frame (from inside the elevator cab looking out). Provide telephone line, light fixture (200 lx / 19 fc), and convenience outlet in the hoistway at the landing where the elevator controller is located. Final location must be coordinated with elevator contractor. These requirements must be coordinated between the general contractor and the elevator contractor.
 - b. Control room option - provide a suitable control closet with access and ventilation in accordance with all applicable codes and regulations. The control closet shall be maintained at a temperature between 32 F (0 C) and 104 F (40 C). To be measured at 6 feet (1830 mm) above the floor and 1 foot (305 mm) out from the front center of the car controller(s). Relative humidity is not to exceed 95% non-condensing. Local codes may require tighter temperature ranges, and higher ventilation levels, please check with your local code authority for the exact requirements in your area. If your control closet temperatures exceed these requirements, contact your local TK Elevator sales representative for assistance. All telephone wiring to controller room control panel, and installation of telephone instrument or other communication equipment in elevator cab with all connections to elevator in controller room.
3. Hoistway must be maintained between 32°F (0°C) and 122°F (50°C) measured at the machine.
4. Adequate supports to carry the loads of all equipment, including overhead machine and machine beams located in hoistway including supports for guide rail brackets.
5. Complete 3 phase connections from the electric power mains to each controller, including necessary circuit breakers and fused mainline disconnect switches unless otherwise specified herein by elevator manufacture.
6. Electric power of the same characteristics as the permanent supply without charge for the construction, testing and adjusting.
7. Provide proper piping and conduit.
8. Divider beams for rail bracket support as required.
9. Cutting of walls floor, etc. and removal of such obstructions as may be necessary for proper installation of the elevator.
10. Grouting of door sills, hoistway frames, and signal fixtures after installation of the elevator equipment.
11. All painting, except as otherwise specified.
12. Provide hoistway walls designed and constructed in accordance with the required fire rating (including those places where elevator fixture boxes, rail bracket fastenings, and any other penetration into the hoistway walls).

13. Temporary enclosures, barricades and other protection from open hoistways and elevator work area during the time the elevator is being installed to meet all permanent installation safety codes. A temporary work platform to be provided at the top landing across the hoistway; if required, it should conform to all code and safety requirements.
14. Smoke detector /sensing devices and contacts wired to elevator control as required by local code. A means to automatically disconnect the main line power supply to the elevator prior to the application of water in the elevator controller room shall be furnished by the electrical contractor. This means shall not be self-resetting.
15. Before erection of rough walls and doors; erect hoistway sills, headers, and frames. After rough walls are finished; erect fascias and toe guards. Set sill level and slightly above finished floor at landings.
16. A standby power source, including necessary transfer switches and auxiliary contact, where elevator operation from an alternate power supply is required.
17. Adequate storage facilities for elevator equipment prior to and during installation at ground level within 150 feet of hoistway.
18. Setting of anchors and sleeves.
19. Install bevel guards at 75° on all recesses, projections or setbacks over 2" (4" for A17.1 2000 areas) except for loading or unloading.
20. For car light and fan: provide a feeder and branch wiring circuits to elevator control cabinet.
21. Locate a light fixture (200 lx / 19 fc) and convenience outlet in pit with switch located adjacent to the access door.
22. Where pit access is by means of the lowest hoistway entrance, a vertical ladder of non-combustible material extending 42" minimum, (48" minimum for A17.1-2019 areas) shall be provided at the same height, above sill of access door or handgrips.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: An approved manufacturer with minimum 15 years of experience in manufacturing, installing, and servicing elevators of the type required for the project.
 1. The manufacturer of machines, controllers, signal fixtures, door operators cabs, entrances, and all other major parts of elevator operating equipment.
 - a. The major parts of the elevator equipment shall be manufactured by the installing company, and not be an assembled system.
 2. The manufacturer shall have a documented, on-going quality assurance program.
 3. ISO-9001:2000 Manufacturer Certified
 4. ISO-14001:2004 Environmental Management System Certified
- B. Installer Qualifications: The manufacturer or an authorized agent of the manufacturer with not less than 15 years of satisfactory experience installing elevators equal in character and performance to the project elevators.

- C. Regulatory Requirements:
 - 1. ASME A17.1 Safety Code for Elevators and Escalators, latest edition or as required by the local building code.
 - 2. NFPA 70 National Electrical Code.
 - 3. NFPA 80 Fire Doors and Windows.
 - 4. Americans with Disabilities Act - Accessibility Guidelines (ADAAG)
 - 5. Section 407 in ICC A117.1, when required by local authorities
- D. Fire-rated entrance assemblies: Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, UL10(b), and NFPA Standard 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory.
- E. Inspection and testing:
 - 1. Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
 - 2. Arrange for inspections and make required tests.
 - 3. Deliver to the Owner upon completion and acceptance of elevator work.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Manufacturing will deliver elevator materials, components and equipment and the contractor is responsible for providing secure and safe storage on job site.

1.07 PROJECT CONDITIONS

- A. Temporary Use: Elevators shall not be used for temporary service or for any other purpose during the construction period before Substantial Completion and acceptance by the purchaser unless agreed upon by Elevator Contractor and General Contractor with signed temporary agreement.

1.08 WARRANTY

- A. Warranty: Submit elevator manufacturer's standard written warranty agreeing to repair, restore or replace defects in elevator work materials and workmanship not due to ordinary wear and tear or improper use or care for 12 months after final acceptance.

1.09 MAINTENANCE

- A. Furnish maintenance and call back service for a period of 12 months for each elevator after completion of installation or acceptance thereof by beneficial use, whichever is earlier, during normal working hours excluding callbacks.
 - 1. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation. Maintenance work, including emergency call back repair service, shall be performed by trained employees of the elevator contractor during regular working hours.

2. Submit parts catalog and show evidence of local parts inventory with complete list of recommended spare parts. Parts shall be produced by manufacturer of original equipment.
3. Manufacturer shall have a service office and full time service personnel within a 100 mile radius of the project site.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Manufacturer: Design based around ThyssenKrupp Elevator's EOX Self-Supported Machine Room-Less elevator or approved equal:
 1. Ryse Elevator, 6834 Cantrell Rd., Ste. 2692, Little Rock, AR 72207.
Tel.: (501) 548-5300 or Adam Newlin: (501) 282-8450
Email: adam.newlin@ryseelevator.com

2.01 MATERIALS, GENERAL

- A. All Elevator Cab materials including frame, buttons, lighting, wall and ceiling assembly, laminates and carpet shall have an EPD and an HPD.
- B. Colors, patterns, and finishes: As selected by the Architect from manufacturer's full range of standard colors, patterns, and finishes.
- C. Steel:
 1. Shapes and bars: Carbon.
 2. Sheet: Cold- and hot-rolled stainless-steel sheet, galvanized.
 3. Finish: Factory-applied baked enamel for structural parts, powder coat for architectural parts. Color selection must be based on elevator manufacture's standard selections.
- E. Integrated laminate: Decorative surface finishes, pressure sensitive, acrylic type, nominal 0.014" thickness. Laminate selection must be based on elevator manufacture's standard selections.
- F. Flooring by others.

2.03 HOISTWAY EQUIPMENT

- A. Platform: Fabricated frame of formed or structural steel shapes, gusseted and riveted/clinched. The car platform shall be designed and fabricated to support one-piece loads weighing up to 25% of the rated capacity.
- B. Deflector Sheaves: None
- C. Guide Rails: Dry, non-lubricated steel, fastened to the building with steel brackets.

- D. Guides: Slide guides shall be mounted on top and bottom of the car.
- E. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Predefined buffer stands for 4' and 5' pit depths.
- F. Machine: The hoisting machine shall be a compact energy efficient permanent magnet Gearless traction type, consisting of PMAC motor, brake and driving sheave mounted on a rigid bedplate in the top of the hoistway. A large solid, forged shaft shall serve as a support for the motor rotor assembly and for the drive sheave and brake system. It shall be supported by roller bearings mounted in the machine housing.
- G. Drive System:
1. The drive system shall be of the Variable Voltage Variable Frequency (VVVF) regenerative.
 2. The system shall be a vector controlled pulse-width modulated AC drive. The variable voltage variable frequency drive shall convert the AC power supply using a two-step process to a variable voltage variable frequency power supply for use by the hoist motor.
 3. The speed control shall be by means of vector control providing direct torque and field excitation automatically provided by permanent magnet. A digital absolute velocity encoder shall be provided giving feedback to the controller on armature position and motor speed.
 4. Dual solid state electronics (IGBT Insulated Gate Bipolar Transistor) in series shall be used in place of mechanical contactors.
- H. Motor/Machine: The motor shall be PMAC, totally enclosed, non-ventilated with class "F" insulation. The motor armature shall be dynamically balanced and supported by roller bearings of ample capacity. The armature and driving sheave shall be properly balanced for smooth, high-speed elevator performance. The PM machine shall be mounted horizontally in the top of the hoistway in a unitized formed steel structure on bearing plates furnished by the elevator installer. The unitized formed steel structure shall be securely fastened to the supports supplied by other trades.
- I. Brake: The brake shall be a spring applied electric brake; held open by an electro-magnet actuated by a digital brake controller and designed to make smooth, positive stops. The Brake shall be designed to automatically apply in the event of interruption of power supply from any cause. Operation and control of the brake shall be all digital. The setting and lifting of the brake shall be software based and all electronic. All adjustments and setup of the brake shall be made using a PC interface. No contactors or resistors shall be used in the actuation of the brake.
- J. Suspension Belts and Governor Rope: Suspension belts shall be flat belts of polyurethane with an inner core of 14 steel cords with an FT1 fire rating such that hoistway sprinklers are not required by NFPA-13. Each belt shall have a suspension strength of 64 KN (14,388 pounds) for 150 and 200 fpm car speed. Suspension strength increases to 80 KN (17,985 pounds) for 350 fpm car speed.

1. Three belts.
 2. Suspension tension monitor shall detect differences in belt tension and for loss of tension. If fault is detected, the car shall stop at the nearest floor and an Out of Service call be registered.
 3. Trip criteria shall be monitored, and data shall be stored in redundant non-volatile locations. Belts shall be replaced prior to the end of service life. Messages shall be issued at 180, 90, and 30 days prior to the last day of service life.
 4. Governor ropes shall be of steel wire construction.
 5. Any special tools, devices, software or equipment required for monitoring the wear of suspension shall be included with the installation of the equipment and become the property of the owner at time of elevator completion. This includes special ongoing monitoring systems, special tools and instruction needed to monitor the suspension system.
- K. Counterweight: Counterbalance each elevator for smooth and economical operation by using steel and/or cement weights securely fastened in a steel counterweight frame. Counterweight shall equal the weight of the complete elevator car and approximately 50 percent of the specified capacity load.
- L. Safety and Governor: Car safety shall be mounted on the bottom members of the car frame and be operated by a centrifugal speed governor. The governor shall be designed to cut off power to the motor and apply the brake whenever the governor indicates the car has excessive speed. The governor shall function when the car over speeds.
- M. Emergency Terminal Limits: Place electric limit devices in the hoistway near the terminal landings. Limit switch(es) shall be designed to cut off the electric current and stop the car if it runs beyond either terminal landing.
- N. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the floor landings and correct for over travel or under travel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.

2.04 HOISTWAY ENTRANCES

- A. Doors and Frames: Provide complete hollow metal type hoistway entrances at each hoistway opening bolted\knock down construction.
1. Manufacturer's standard entrance design consisting of hangers, doors, hanger supports, hanger covers, fascia plates (where required), sight guards, and necessary hardware.
 2. Hoistway design: Entrance jamb has a fixed depth so provisions must be made to finish the edge of the wall that may not be covered by the entrance.

3. Communication failure indicator: A Communication failure is a jewel that is located in the jamb and lights up if the connection with the phone in the elevator becomes faulty. Communication failure is tested on the SIL3 rated devices by inspectors to ensure the car will not run or accept a car call when there is a loss of communication between the car and controller.
 4. Main landing door & frame finish: Stainless steel door panels, no. 4 brushed finish with no. 4 brushed finish entrance frame.
 5. Typical door & frame finish: Stainless steel door panels, no. 4 brushed finish with same entrance frame finish.
- B. Interlocks: Equip each hoistway entrance with an approved type interlock tested as required by code. Provide door restriction devices as required by code.
- C. Door Hanger and Tracks: Provide sheave type two point suspension hangers and tracks for each hoistway horizontal sliding door.
1. Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.
 2. Hangers: Provide an adjustable device beneath the track to limit the up-thrust of the doors during operation.
 3. Tracks: Drawn steel shapes, smooth surface and shaped to conform to the hanger sheaves.
- D. Hoistway Sills: Extruded metal, with groove(s) in top surface. Provide mill finish aluminum.

2.05 PASSENGER ELEVATOR CAR ENCLOSURE

- A. Car Enclosure:
1. Walls: Cab type, steel shell. Wall panels shall be constructed of steel with integrated laminate panels. Column panels shall be stainless steel.
 2. Canopy: Galvanized steel with chain rope exit.
 3. Ceiling: Stainless steel downlight type, metal pans with suspended LED downlights. Number of downlights shall be dependent on platform size with a minimum of four. The metal pans shall be finished with a stainless steel, no. 4 brushed finish.
 4. Cab Fronts, Return, Transom, Soffit and Strike: Provide panels faced with brushed stainless steel.
 5. Doors: Horizontal sliding car doors reinforced with steel for panel rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic sliding guides.
 - a. Door Finish: Stainless steel.
 - b. Cab Sills: Extruded, aluminum mill finish.
 6. Handrail: Provide 1.5" (38 mm) diameter formed cylindrical metal bar on side and/or rear walls on front opening cars and side walls only on front and rear opening cars. Support rails shall have a stainless steel, no. 4 brushed finish.
 7. Ventilation: Manufacturer's standard exhaust fan, mounted on the car top.
 8. Protection pads: Not required

- B. Car Top Inspection: Provide a car top inspection station with an "Auto-Inspection" switch, an "emergency stop" switch, and constant pressure "up and down" direction and safety buttons to make the normal operating devices inoperative. The station shall give the inspector complete control of the elevator. The car top inspection station shall be mounted in the door operator assembly.

2.06 DOOR OPERATION

- A. Door Operation: Provide a direct or alternating current motor driven heavy duty operator designed to operate the car and hoistway doors simultaneously. The door control system shall be digital closed loop and the closed loop circuit shall give constant feedback on the position and velocity of the elevator door. The motor torque shall be constantly adjusted to maintain the correct door speed based on its position and load. All adjustments and setup shall be through the computer based service tool. Door movements shall follow a field programmable speed pattern with smooth acceleration and deceleration at the ends of travel. The mechanical door operating mechanism shall be arranged for manual operation in event of power failure. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. AC controlled units with oil checks, or other deviations are not acceptable.
1. No Un-Necessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as a dispatch car.
 2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.
 3. Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is not registered before the door closes to within 6 inches of fully closed, the travel shall reverse and the door shall reopen to answer the other call.
 4. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer shall sound. When the obstruction is removed, the door shall begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors shall stop and resume closing only after the obstruction has been removed.
 5. Door Reversal: If the doors are closing and the infra-red beam(s) is interrupted, the doors shall reverse and reopen. After the obstruction is cleared, the doors shall begin to close.
 6. Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors shall recycle closed then attempt to open six times to try and correct the fault.

7. Door Close Watchdog: If the doors are closing, but do not fully close after a field adjustable time, the doors shall recycle open then attempt to close six times to try and correct the fault.
 8. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.
- B. Door Protection Device: Provide a door protection system using microprocessor controlled infra-red light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen.

2.07 CAR OPERATING STATION

- A. Car Operating Station, General: The main car control in each car shall contain the devices required for specific operation mounted in a surface-mounted panel requiring no applied faceplate. COP shall have a brushed stainless steel finish. The main car operating panel shall be mounted in the return and comply with handicap requirements. Pushbuttons that illuminate using long lasting LED's shall be included for each floor served, and emergency buttons and switches shall be provided per code. Switches for car light and accessories shall be provided. Visual highlight is the standard equipped, integrated multimedia display.
- B. Emergency Communications System: Integral phone system provided. For improved accessibility, there are visual and acoustic confirmation for button inputs as well as a voice synthesizer for travel and floor announcements.
- C. Column Mounted Car Riding Lantern: A car riding lantern shall be installed in the elevator cab and located in the entrance. The lantern, when illuminated, will indicate the intended direction of travel. The lantern will illuminate, and a signal will sound when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close.
- D. Special Equipment: Not Applicable
- E. Digital Services: Cloud-based IoT monitoring system comes standard with these options:
1. ADA Phone - Code Compliant Cellular Connectivity
- F. Digitally Native: Digital expansion for evolving ecosystem of digitally augmented services. DEP infotainment display comes standard.

2.08 CONTROL SYSTEMS

- A. Controller: The elevator control system shall be microprocessor based and software oriented. The system shall operate in real time, continuously analyzing the car(s) changing position, condition, and work load. All controller and operational circuits including the brake control and drive system shall be digital. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.
1. Momentary pressing of one or more buttons shall dispatch the car to the designated landings in the order in which the landings are reached by the car, irrespective of the sequence in which the buttons are pressed. Each landing call shall be canceled when answered.
 2. When the car is traveling in the up direction, it shall stop at all floors for which car buttons or "up" hall buttons have been pressed. The car shall not stop at floors where "down" buttons have been pressed, unless the stop for that floor has been registered by a car button or unless the down call is at the highest floor for which any buttons have been pressed. Pressing the "up" button when the car is traveling in the down direction shall not intercept the travel unless the stop for that floor has been registered by a car button or unless the up call is the lowest for which any button has been pressed.
 3. When the car has responded to its highest or lowest stop, and stops are registered for the opposite direction, its direction of travel shall reverse automatically and it shall then answer the calls registered for that direction. If both up and down calls are registered at an intermediate floor, only the call corresponding to the direction of car travel shall be canceled upon the stopping of the car at the landing.
 4. A car that is stopping for the last hall call in the preference direction, and that hall call is for the opposite direction with no onward car calls, shall reverse preference when the selector position advances to the landing at which the car is committed to stop. A car that is stopping for the last hall call in the preference direction, and that hall call is for the same direction, shall hold its preference until the door is almost closed allowing time for a passenger to register an onward car call which shall maintain the preference. If no car call is registered before the door is almost closed, the car shall lose its preference and shall be available to accept calls in either direction.
- B. Operation: Selective Collective - ETA based. The system is optimized to get a car to the floor where a hall call has been registered, in the shortest time. The system receives input information from standard call pushbuttons located in the hall, car position and car load information from individual car loadweighers.
1. When group operation is required, the group supervisory operation shall be embedded within selected car controllers. No separate group controller shall be supplied. The microprocessor shall constantly scan the system for hall calls. When hall calls are registered, the control system shall immediately calculate the estimated time for arrival using such information as, number of floors to travel from the current position, the time it takes to travel one floor at top

- speed, calls assigned to a car, and car reversal time to respond to a call in the opposite direction of travel. When a car's status changes or additional hall calls are registered, the estimated time of arrival shall be recalculated and calls reassigned if necessary.
2. Traffic Pattern: The microprocessor shall provide flexibility to meet well defined patterns of traffic, including up peak, down peak, and heavy interfloor demands, and adjust for indeterminate variations in these patterns which occur in buildings.
 3. Artificial Intelligence: Artificial Intelligence shall be an integral part of the group control system software. The enhanced artificial intelligence shall optimize the interfloor traffic performance. Inputs for the artificial intelligence shall include accurate passenger load from an electronic loadweigher, probable car calls generated from each hall call, type of building and observed traffic patterns.
- C. Load Weighing Device: Provide a load weighing device on each car which, when the particular car is filled to an adjustable percentage of the capacity load, shall cause the car to bypass landing calls but not car calls. The passed landing calls shall remain registered for the next following car.
1. The device shall be unaffected by the action of compensating chain or rope. The device shall detect a 50 pound load change under all conditions.
 2. The load sensor shall use a load cell to accurately measure the weight in the car. The information shall be transferred via a serial link to the elevator controller.
- D. Anti-Nuisance Call Control: The microprocessor control system shall evaluate the number of people on the car and compare that value to the number of car calls registered. If the number of car calls exceeds the number of people by a field programmable value, the car calls shall be canceled after the first call has been answered.
- E. Position Selector: The position selector shall be part of the microprocessor system. The car position in the hoistway shall be digitized through a primary position encoder. The microprocessor control system shall store the floor position and slow down points in memory.
- F. Motion Control: The drive control system shall be dual-loop feedback system based primarily on car position. The velocity profile shall be calculated by the microprocessor control system producing extremely smooth and accurate stops. The velocity encoder shall permit continuous comparison of machine speed to velocity profile and to actual car speed. This accurate position/velocity feedback shall permit a fast and accurate control of acceleration and retardation.
- G. Motor Pre-Torque: Current shall be applied to the elevator drive before the brake is released and the speed pattern is dictated to eliminate roll back and sling shot effects of unbalanced loads in the car. The electronic loadweigher shall determine the load on the car determining a pre-torque reference to send to the drive.

- H. Emergency Power Operation: In the event of power loss, this elevator(s) should be equipped with a battery powered automatic rescue operation device. This operation is designed to only move the car up or down to the nearest landing depending on the load in the car. It is NOT designed to lower the car to a specified landing such as Battery Lowering used for Hydraulic applications. An isolation transformer is required if the building voltage is NOT 480VAC. A single rescue unit is not capable of rescuing a group of cars --- this is a per car option. Maximum travel on rescue operation is 100 feet. Average time of operation for Rescue is 3 minutes. This feature is only available for jobs with 60HP and below. This battery automatic rescue operation is not allowed with the Green Drive.
- I. Automatic Light and Fan shut down: The control system shall evaluate the system activity and automatically turn off the cab lighting and ventilation fan during periods of inactivity. The settings shall be field programmable.
- J. Special Operation: Not Applicable
- K. Digital Services:
 - 1. Cloud-based IoT Monitoring System (standard): Contractor shall provide a cloud-based IoT (internet of things) monitoring system capable of tracking door movements and timing, trips, power cycles, car calls, out-of-service events and modes. This observation will continue 24/7 and it shall be capable of providing service technicians a minimum of three recommended solutions for defined failure events and automatically dispatch service technicians in the event of failure(s) while sending notifications to end users of changes in their equipment's state via both email and mobile device. Access to IoT and related equipment data and status will be made available in both a web portal and mobile application secured by password and username with at least two-factor authentication. Finally, this system must be self-contained and not require internet provision by others.
 - 2. Along with the monitoring system, options are available.
 - 3. ADA Phone - Code Compliant Cellular Connectivity: Contractor shall provide a phone service through a self-contained cellular based VoIP system. This system shall meet code, include a backup battery capable of powering the emergency communication equipment for 4+ hours in the event of a power outage. The solution shall have remote monitoring capability to ensure continuous connectivity with a means of remote troubleshooting. Remote monitoring capability shall include, at a minimum, the ability to monitor connectivity and power supply. Remote monitoring shall be capable of providing local alerts to response personnel when on-site intervention is required.
- L. Digitally Native:
 - 1. EOX has all the components needed for digital expansion from day one. No additional technician dispatching. On-site installation or modernization is required to enable new digital services giving you confidence that your elevator will remain up-to-date for years to come. It is born digital, connected to TK Elevator's evolving ecosystem of digitally augmented services.

2.09 HALL STATIONS

- A. Hall Stations, General: Buttons shall illuminate to indicate call has been registered at that floor for the indicated direction.
 - 1. Provide one pushbutton riser with faceplates having a brushed stainless steel finish, surface-mounted in the entrance jamb.
 - a. Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the entrance frame at the designated level.
- B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.
- C. Combo Hall Lantern and Position Indicator: An electronic position indicator shall be provided and mounted for optimal viewing. As the car travels, its position in the hoistway shall be indicated by the illumination of the alphanumeric character corresponding to the landing which the elevator is stopped or passing. Hall lantern is combined in the display with the directional arrow to indicate the travel direction in the same faceplate. Faceplates shall match the hall stations.
- D. Special Equipment: Not Applicable

2.10 CONTROLLER LOCATION

- A. Location: Door Jamb Mount is integrated with controller in the door jamb. Control power and cab light are provided by the elevator contractor and included with the integrated assembly. Main power disconnect is provided by others.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Before starting elevator installation, inspect hoistway, hoistway openings, pits and/or control room, as constructed, verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
- B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 INSTALLATION

- A. Install elevator systems components and coordinate installation of hoistway wall construction.
 - 1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.
 - 2. Comply with the National Electrical Code for electrical work required during installation.
- B. Perform work with competent, skilled workmen under the direct control and supervision of the elevator manufacturer's experienced foreman.
- C. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports, and bracing including all setting templates and diagrams for placement.
- D. Welded construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualification of welding operators.
- E. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.
- F. Install machinery, guides, controls, car and all equipment and accessories to provide a quiet, smoothly operating installation, free from side sway, oscillation or vibration.
- G. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.
- H. Erect hoistway sills, headers, and frames before erection of rough walls and doors; erect fascia and toe guards after rough walls finished. Set sill units accurately aligned and slightly above finish floor at landings.
- I. Lubricate operating parts of system, including ropes, as recommended by the manufacturer.

3.03 FIELD QUALITY CONTROL

- A. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required and recommended by Code and governing regulations or agencies. Perform other tests, if any, as required by governing regulations or agencies.
- B. Advise Owner, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

3.04 ADJUSTING

- A. Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

3.05 CLEANING

- A. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided. Stainless steel shall be cleaned with soap and water and dried with a non-abrasive surface; it shall not be cleaned with bleach-based cleansers.
- B. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.
 - 1. Use environmentally preferable and low VOC emitting cleaners for each application type. Cleaners that contain solvents, pine and/or citrus oils are not permitted.

3.06 PROTECTION

- A. At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.07 DEMONSTRATION

- A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.
- B. Make a final check of each elevator operation, with Owner's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.

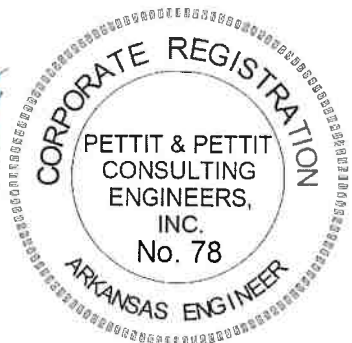
3.08 ELEVATOR SCHEDULE

- A. Elevator Qty. 1
1. Elevator Model: EOX
 2. Elevator Type: Gearless Traction Machine Room-Less, Passenger
 3. Rated Capacity: 2500 lbs.
 4. Rated Speed: 150 ft./min.
 5. Operation System: EOX controller
 6. Travel: 22'-9"
 7. Landings: 3 total
 8. Openings:
 - a. Front: 3
 - b. Rear: 0
 9. Clear Car Inside: 6'-8" wide x 4'-3" deep
 10. Inside clear height: 7'-4" standard
 11. Door clear height: 7'-0" standard
 12. Hoistway Entrance Size: 3'-6" wide x 7'-0" high
 13. Door Type: One-speed Center opening
 14. Power Characteristics: 208 volts, 3 Phase, 60 Hz.
 - a. Note: Isolation Transformer required for jobs with less than 460vac as well as 575vac and greater, 3 Phase building power. With exception of the 150 fpm speed cars for 208vac, which do not require an isolation transformer.
 15. Seismic Requirements: No
 16. Hoistway Dimensions: 8'-6" wide x 5'-9" deep
 - a. Note: Hoistway dimensions listed above are for Non-Seismic areas only. If you have chosen the option for seismic requirements, please consult your local TK Elevator Sales Representative for the proper hoistway dimensions.
 17. Pit Depth: 5'-0"
 18. Button & Fixture Style: EOX Signal Fixtures
 19. Special Operations: None
 20. Digital Services: ADA Phone - Code Compliant Cellular Connectivity
 21. Digitally Native

END OF SECTION 14 21 23.16

The Engineer of Record for Divisions 21, 22, and 23 of the Specifications for the Byrne Hall Renovation Project, St. Johns Center, Little Rock, Arkansas, Job No. 25-058 (P&P Job No. 25-112) is:

Date 6/9/26



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CONSULTING ENGINEERS, INC.

SECTION 21 0500

COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Includes furnishing and installing all components of a wet pipe fire protection sprinkler system for the entire building, and piping to a point of connection to water entrances. Refer to drawings. Building to be sprinklered as required by NFPA 13, state and local codes.

1.02 RELATED SECTIONS

- A. Painting - Section 09 90 00.
- B. Vibration and Seismic Control – Section 21 05 48
- C. Identification for Fire Suppression - Section 21 05 53.
- D. Fire Suppression Sprinkler Systems – Section 21 13 00.

1.03 REFERENCES

- A. ANSI/NFPA 13 & Ark State Fire Code- (latest accepted edition) - Installation of Sprinkler Systems.
- B. NFPA 101 & Ark State Fire Code- (latest accepted edition) - Life Safety Code.

1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittals, for Submittals Procedures.
- B. Shop Drawings:
 - 1. Submit as a complete package to the Architect for review for the State Fire Marshal under a Memo of Understanding and record purposes:
 - a. Layout drawing of complete overhead sprinkler system indicating relationship of all overhead items, including ceiling air diffusers. Any variation from designated sprinkler head locations shall be approved by the Architect. Location of risers, piping, etc. shall be as inconspicuous as possible, provide a pleasing appearance and still fulfill all functional requirements.
 - b. Complete details and sections as required to clearly define and clarify the design indicated by the aforementioned layout.
 - c. Designs requiring cutting of structural members for passage of sprinkler pipes or hangers shall be as noted on the drawings and as approved by the Structural Engineer.
 - d. Catalog data of all system components (i.e. valves, siamese, alarms, heads, etc.
 - e. All shop drawings, prior to being sent to the Architect, shall bear evidence of review by the Owner's insurance carrier. Insurance carrier review shall be by Owner's carrier at time immediately prior to shop drawing submission to Architect.

- f. Include working plans, summary sheets, detailed work sheet, and graph sheets according to NFPA 13 - 2002, 1-9, 7-3.2, 7-3.3, 7-3.4, 6.1, 6.2, and 6.3.
- C. Maintenance Manuals:
 - 1. The contractor shall provide three (3) sets in hard back looseleaf binders of a compilation of catalog data of each manufactured item of equipment used in the fire protection system and shall present this compilation to the Architect for transmittal to the Owner before final payment is made. In each maintenance catalog shall be provided a complete set of submittals on all equipment, descriptive data, installation data, operating instructions, parts lists and maintenance instructions.
 - 2. A complete double index shall be provided: (1) Listing of products alphabetically by name, and (2) listing the names of manufacturers of products alphabetically with their addresses and the address of the local sales representative.

1.05 QUALITY ASSURANCE

- A. The system shall be designed and fabricated by a firm which is regularly engaged, for a minimum of five years, in manufacturing of fire protection piping systems similar to that required for this project.
- B. At the option of the Contractor, the piping system may be hydraulically designed from the start of the sprinkler service in lieu of the standard pipe method.
- C. All system designers, supervisors and installers shall have proper NICET certification.
 - 1. Prior to installation, submit data showing that Contractor has successfully installed systems of the same type and design as specified herein, or that Contractor has a firm contractual agreement with a subcontractor having such required experience. Data shall include names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months.
 - 2. Qualifications of System Technician: Installation drawings, shop drawings and as-built drawings shall be prepared, by or under the supervision of an individual who is experienced with the types of works specified herein, and is currently certified by the National Institute for Certification in Engineering Technologies (NICET) as an engineering technician with a minimum Level III certification in the Fire Protection/Automatic Sprinkler System program. Contractor shall submit data for approval showing the name and certification of all involved individuals with such qualifications at or prior to submittal of drawings.
- D. FM Compliance: Comply with Factory Mutual "Approved Guide".
- E. FM Labels: Provide fire protection products bearing FM approved labels.
- F. UL Labels: Provide fire protection products which have been approved and labeled by UL.
- G. Local Fire Department/Marshall Regulations: Comply with governing regulations

pertaining to the fire protection system.

- H. The entire installation shall be guaranteed for a period of one (1) year from the building acceptance date.

1.06 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.

1.07 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".

1.08 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 Architect in writing of such differences.

1.09 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.

1.10 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.

1.11 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.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

- A. Fire protection piping in the ground shall be U.S. Pipe "Tyton", or approved equal, Class 50 ductile iron waterworks pipe, conforming to ANSI/AWWA C151 A21.51, cement lined, seal coated conforming to ANSI/AWWA C151 A21.4, bell and spigot type, cast in lengths not less than twelve (12) feet, exclusive of socket. Specials and fittings for pipe shall be gray iron or ductile iron with minimum pressure rating of 250 psi, conforming to the latest standard specifications of the ANSI/AWWA and shall conform in pattern, dimensions, coating and lining with the pipe furnished. Wherever special fittings or special conditions require flanges or other type of joints, the pipe and fittings shall conform to these specifications and the flanges shall be faced and drilled American Standard. All joining materials shall be of a type, make and quality approved by the Architect and shall conform to the following requirements:
 - 1. Bell and Spigot Joints - Joints shall be with rubber rings to manufacturer's recommendations.
 - 2. Bolted Joints - Material for bolted joints shall consist of bolts, nuts, washers and gaskets of a type and size to conform to the recommendations of the pipe manufacturer.
- B. Fire protection piping above grade, inside building, shall be black schedule 40 steel pipe. Fittings, generally, shall be UL approved, Victaulic grooved end fittings (To

conform to the pressure ratings of Victaulic Style 77 Couplings) and Victaulic Style 77 couplings on 3 inches and larger sizes. Where a rigid coupling is required use Victaulic Style 07. All fittings and couplings shall be screwed for pipe 2½" or smaller. All Victaulic Style 77 couplings shall have housing fabricated in two or more malleable iron castings; coupling gasket shall be Victaulic Grade "E" molded synthetic rubber; coupling bolts shall be oval neck track head type. Victaulic fittings shall be fabricated of malleable iron casting in accordance with ASTM A-47.

- C. Pipe and tubing exceptions of NFPA 13, 2-3.5 and 2-4.2 shall not be accepted in the fire protection system.

2.02 SUPPORTS, ANCHORS AND SEALS

- A. Requirements for fire protection system shall comply with requirements under Section 21 0548.

2.03 VALVES

- A. Fire protection system gate valves 2 inches and smaller shall be UL/FM approved, Class 200, solid wedge disc, OS&Y pattern, yoke bonnet, threaded, best grade brass, Stockham No. B-133, or Kennedy 7000 series, or Milwaukee No. BB-SCS. Gate valves 2-1/2 inches and larger shall be UL/FM approved, solid wedge disc, OS&Y pattern, cast iron body and bonnet, bronze trim, and flanged connections.
- B. Fire protection system check valves 2-1/2 inches and smaller shall be Stockham No. B-319, Milwaukee No. 509, or Hammond No. 1B904. Check valves 3 inches and larger shall be UL/FM approved, swing check, bolted cap, high strength cast iron body and cap, bronze trim flanges, Stockham No. G-939, or Kennedy No. 126.
- C. Alarm check valve shall be Viking Model "G-1", Reliable Model E, or approved equal. The valve shall be equipped to give signal upon operation and be provided with standard trimmings, including pressure gage, retarding chamber, testing bypass, and necessary pipe fittings and accessories required for complete installation. Retarding chamber to be provided with closed system with suitable drain outside. (Field verify and furnish equipment only as required.)

2.04 SIAMESE FITTING (FDC)

- A. Remote FDC to be Potter-Roemer, Inc. No. 5761, free-standing fire department connection, two-way, 4 X 2½, brass finish brass cover sleeve. Base plate shall have lettering "AUTO-SPKR". Remote FDC location to be noted on civil utility plans.
- B. Wall Mounted FDC to be Potter-Roemer, Inc. No.

2.05 AUTOMATIC BALL DRIP

- A. Check valves for Siamese fittings shall be provided with Potter-Roemer, Inc. No. 5980 automatic ball drip, piped to drip over a floor drain or outside exterior wall as shown on drawings.

2.06 WATER FLOW INDICATORS AND ALARMS

- A. Provide in the Fire Protection System Potter-Roemer, Inc. Fig. #6220 tamper switch on stop valves; fig. #6240 pressure gauge, Viking inc. water motor alarm bell. and

Potter-Roemer #6201-6208 water flow indicator. The wiring of the alarm and connection to the fire alarm system shall be by electrical contractor.

2.07 BACKFLOW PREVENTER

- A. Furnish and install where shown on the drawings Watts Regulator Company or Architect approved equal, double check detector assembly backflow preventer, equipped with cubic feet per minute, 5/8 inch by 3/4-inch meter and ball type test cocks, UL listed resilient seated OS&Y shut-off valves.
- B. Unit shall have epoxy coated cast iron body construction bronze seat and disc holder, stainless steel trim and durable, tight-seating rubber check valve discs, bronze body ball type test cocks and Record-all 3/4-inch bronze meter, Model 25.
- C. Unit shall be suitable for supply pressure up to 175 psi and water temperatures to 110 degrees F, tested and certified under ASSE No. 1015-1980, AWWA C506-78, UL and FM Standards, and accepted by the Arkansas State Plumbing Code.

2.08 ORIGIN

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

PART 3 - EXECUTION

3.01 All joining materials for ductile iron pipe shall be of a type, make and quality approved by the Architect and shall conform to the following requirements:

- A. Material for bolted joints shall consist of bolts, nuts, washers and gaskets of a type and size to conform to the recommendations of the pipe manufacturers.
- B. Polyethylene material in the form of flat sheet or rolls shall be placed around all mechanical joints of pipe and fittings; all valves and fire hydrants with mechanical joint ends and all saddles, sleeves, couplings, tapping saddles and any other appurtenances with exposed bolts. It is not the intent that the material form an enclosure that is absolutely air or water tight, but to prevent pipe to soil contact.
 - 1. The sheet shall be passed under the appurtenances and brought up around the body. Seams shall be made by bringing the edges together, folding over twice, and taping down. Tape polyethylene securely in place at valve stem and other penetrations.
 - 2. Openings for branches, service taps, blowoffs, air valves, and similar appurtenances shall be made by making an X-shaped cut in the polyethylene and temporarily folding the film back. After the appurtenance is installed, tape the slack securely to the appurtenance and repair the cut, as well as any other damaged areas in the polyethylene with tape.
 - 3. Where polyethylene wrapped pipe joints a pipe which is not wrapped, extend the polyethylene tube to cover the unwrapped pipe a distance of at least 2 feet and secure the end.
 - 4. The polyethylene material shall be secured around the pipe and appurtenances by at least three (3) circumferential wraps of tape.
 - 5. Polyethylene material shall be stored on the job site in such manner that it is not exposed to direct sunlight. Exposure during installation shall not exceed 48 hours.
 - 6. Backfill material shall be the same as specified for pipe without polyethylene

wrapping. Special care shall be taken to prevent damage to the polyethylene wrapping when placing backfill. Backfill material shall be free from cinders, refuse, boulders, rocks, stones, and/or other material that could damage polyethylene.

- 3.02** Prior to connecting to the overhead piping, the underground main should be flushed in the presence of a representative of the Owner and meet with his approval.
- 3.03** Piping in the areas having ceiling shall be concealed. Where ceilings have grids, sprinkler heads shall be centered with the grid. Piping in other areas may be exposed, but kept at a minimum distance from structural system. All piping shall be free of rust, clean and have a minimum of one (1) shop coat of clear rust inhibiting paint or a color as selected by Architect.
- 3.04** Valves shall be complete with all necessary items, fittings, identification tags or plates, and accessories, including water motor gong. Design shall allow for suitable drainage of same.
- 3.05** Where piping passes through walls, floors, ceilings or other building construction, sleeves must be used. Where exposed piping passes through finish work escutcheons shall be chrome plated or other finish acceptable to the Architect. Split wall plates or escutcheons shall be installed to fit snugly around piping. Where finish is not a problem, suitable plates shall be provided at each hole to assure effectiveness of construction as a fire stop.
- 3.06** Before assembly of couplings, lightly coat pipe ends and outside of gaskets with cup grease or graphite paste.
- 3.07** Pipe grooving shall be in accordance with the manufacturer's specifications contained in latest published literature.
- 3.08** OS&Y valves, where shown on the drawings, shall be electrically supervised with tamper switch wired to alarm bell at central panel. Coordinate wiring with valve and controls.
- 3.09** All openings for piping should be anticipated and indicated on the approved and accepted shop drawings. Any additional cutting of openings must have the written approval of the Architect.
- 3.10** After completion of all installations, tests, etc., and prior to the building opening date, the fire protection contractor shall instruct the Owner in the operation of the fire protection system. Special care shall be taken to make sure the Owner:
 - A. Will immediately recognize whether the main valve is in an open or closed position.
 - B. Will know how to drain the system.
 - C. Will know how to test the alarm valve.
 - D. Will know how to reset all systems and how they are interconnected.
- 3.12** Testing of the fire protection system shall be as outlined in hereinbefore listed NFPA Standards.

END OF SECTION 21 05 00

HANGERS AND SUPPORTS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Pipe and equipment hangers and supports.
- B. Equipment bases and supports.
- C. Sleeves and seals.
- D. Flashing and sealing equipment and pipe stacks.

1.02 RELATED SECTIONS

- A. Section 03 3000 - Cast-In-Place Concrete: Equipment bases.

1.03 REFERENCES

- A. ASME B31.2 - Fuel Gas Piping
- B. ASTM F708 - Design and Installation of Rigid Pipe Hangers.

1.04 SUBMITTALS

- A. Submit under provisions of Section 21 0500 and Section 01 3300.
- B. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

PART 2 - PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

- A. Sprinkler Piping:
 - 1. Conform to ASME B31.9 and ASTM F708.
 - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.
 - 3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 - 4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
 - 5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 6. Wall Support for Pipe: Welded steel bracket and wrought steel clamp.
 - 7. Vertical Support: Steel riser clamp.
 - 8. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 9. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 10. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.02 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.03 FLASHING

- A. Metal Flashing: 28 gage 304 stainless steel.
- B. Copper Flashing: 16 oz./sq. ft.
- C. Lead Flashing:
 - 1. Waterproofing: 6 lb/sq ft.
- D. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.04 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe.
- C. Sleeves for Ductwork and Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
- D. Sleeves for Round Ductwork: Galvanized steel.
- E. Sleeves for Rectangular Ductwork: Galvanized steel.

PART 3 - EXECUTION

3.01 INSTALLATION

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

3.02 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as scheduled.
- B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- C. Place hangers within 12 inches of each horizontal elbow.
- D. Use hangers with 1-1/2 inch minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- G. Where several pipes can be installed in parallel and at same elevation, provide

multiple or trapeze hangers.

- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.03 EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, where indicated on Drawings, minimum 4 inches thick and extending 6 inches beyond supported equipment. Refer to Section 03 3000. Coordinate exact size requirement for pads.
- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.04 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 4 inches minimum above finished roof surface with lead worked one inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and calk, metal counter flash, and seal.
- C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
- D. Seal floor drains watertight to adjacent materials.
- E. Adjust storm collars tight to pipe with bolts; calk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.05 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- C. Extend sleeves through floors one inch above finished floor level. Caulk sleeves.

- D. Where piping or ductwork penetrates fire or smoke rated floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and caulk. Provide close fitting metal collar or escutcheon covers at both sides of penetration. Secure collar or escutcheon to prevent blow-out. Fire stopping materials shall meet requirements of ASTM E119.
- E. Install chrome plated steel escutcheons at finished surfaces.

3.06 SCHEDULES

HANGER ROD

PIPE SIZE Inches	MAX. HANGER SPACING Feet	DIAMETER Inches
1/2 to 1-1/4	6.5	3/8
1-1/2 to 2	10	3/8
2-1/2 to 3	10	1/2
4 to 6	10	5/8

END OF SECTION 21 05 29

VIBRATION AND SEISMIC CONTROL FOR FIRE SUPPRESSION**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Includes furnishing and installing vibration and seismic components of a wet pipe fire protection sprinkler system, for the entire building.
- B. Provide seismic protection restraints and install piping system in accordance with the requirements set forth in NFPA 13.
- C. This facility is located in Arkansas, and the fire protection systems shall be designed and installed in accordance with NFPA 13, 2021 Arkansas Fire Prevention Code, ASCE 7-05, minimum design loads for buildings and other structures, Chapter 13, state and structural drawings and notes for applicable seismic design criteria. The Building Design Category is "C".

1.02 RELATED SECTIONS

- A. Painting - Section 09 90 00.
- B. Common Work Results for Fire Suppression – Section 21 05 00.
- C. Identification for Fire Suppression - Section 21 05 53.
- D. Fire Suppression Sprinkler Systems – Section 21 13 00.

1.03 REFERENCES

- A. ANSI/NFPA 13 & Ark State Fire Code- (latest accepted edition) - Installation of Sprinkler Systems.
- B. NFPA 101 & Ark State Fire Code- (latest accepted edition) - Life Safety Code.

1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittals, for Submittals Procedures.
- B. The manufacturer of vibration isolation and seismic restraints shall provide submittals for products as follows:
 - 1. Descriptive Data:
 - a. Catalog cuts or data sheets on vibration isolators and specific restraints detailing compliance with the specification.
 - b. Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and seismic restraints by referencing numbered descriptive drawings.
 - 2. Shop Drawings:
 - a. Submit fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
 - b. Provide all details of suspension and support for ceiling suspended equipment.

- c. Where walls, floors, slabs or supplementary steel work are used for seismic restraint locations, details of acceptable attachment methods for ducts, conduit and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturers' submittals must include spacing, static loads and seismic loads at all attachment and support points.
 - d. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.
 - 3. Seismic Certification and Analysis:
 - a. Seismic restraint calculations must be provided for all connections of equipment to the structure. Calculations must be stamped by a registered professional engineer with at least five years of seismic design experience, licensed in the state of the job location.
 - b. All restraining devices shall have a preapproval number from California OSHPD or some other recognized government agency showing maximum restraint ratings. Preapprovals based on independent testing are preferred to preapprovals based on calculations. Where preapproved devices are not available, submittals based on independent testing are preferred. Calculations (including the combining of tensile and shear loadings) to support seismic restraint designs must be stamped by a registered professional engineer with at least five years of seismic design experience and licensed in the state of the job location. Testing and calculations must include both shear and tensile loads as well as one test or analysis at 45° to the weakest mode.
 - c. Analysis must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and/or welded length. All seismic restraint devices shall be designed to accept, without failure, the forces detailed in section 1.06 acting through the equipment center of gravity. Overturning moments may exceed forces at ground level.
- C. Typical Applicable Codes and Standards:
 - 1. The seismic protection shall be provided as required by chapter 16 of the Arkansas Fire Code (International Building Code) Volume II. This building shall meet design classification "C" requirements.

1.05 QUALITY ASSURANCE

- A. The vibration and seismic control system shall be designed and fabricated by a firm which is regularly engaged, for a minimum of five years, in designing of piping systems similar to that required for this project.
- B. All system designers, supervisors and installers shall comply with the following.
 - 1. Prior to installation, submit data showing that Contractor has successfully installed systems of the same type and design as specified herein, or that Contractor has a firm contractual agreement with a subcontractor having such required experience. Data shall include names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months.
 - 2. Qualifications of System Technician: Installation drawings, shop drawings

and as-built drawings shall be prepared, by or under the supervision of an individual who is experienced with the types of works specified herein.

- C. FM Compliance: Comply with Factory Mutual "Approved Guide".
- D. UL Labels: Provide fire protection support products which have been approved and labeled by UL.
- E. The entire installation shall be guaranteed for a period of one (1) year from the building acceptance date.

1.06 SEISMIC FORCE LEVELS

- A. The following force levels will be used on this project.

MINIMUM F_p (G's) FORCES EQUAL TO OR EXCEEDING BUILDING CODE LIST IN 1.03.

IBC-2000 TI-809-04	IBC-2003 NFPA-5000	"G" Forces for High Deformabil- ity Pipe, Bus Ducts, Conduits & Cabletrays $a_p^*=1.0$, $R_p^*=3.5$	"G" Forces for Rigidly Mounted Equipment & Limited Deformability Pipe $a_p^*=1.0$, $R_p^*=2.5$	"G" Forces for Vibration Isolated Equipment & Pipe Pressure Vessels $a_p^*=2.5$, $R_p^*=2.5$	"G" Forces for Low Deformability Pipe $a_p^*=1.0$, $R_p^*=1.25$
Ss = 0.461		Horiz. Vert.	Horiz. Vert.	Horiz. Vert.	Horiz. Vert.
Lower Levels and Ground Level		0.17 0.11	0.17 0.11	0.23 0.11	0.18 0.11
Above Ground Level up to 1/4 of the Height of the Building		0.17 0.11	0.17 0.11	0.34 0.11	0.27 0.11
Above 1/4 up to 1/2 of the Height of the Building		0.17 0.11	0.18 0.11	0.46 0.11	0.36 0.11
Above 1/2 up to 3/4 of the Height of the Building		0.17 0.11	0.23 0.11	0.57 0.11	0.46 0.11
Above 3/4 of the Height of the Building up to the Roof		0.20 0.11	0.27 0.11	0.68 0.11	0.54 0.11

PART 2 - PRODUCTS

2.01 INTENT

- A. All vibration isolators and seismic restraints described in this section shall be the product of a single manufacturer. Mason Industries' products are the basis of these specifications; products of other manufacturers are acceptable provided their systems strictly comply with the specification and have the approval of the specifying engineer. Submittals and certification sheets shall be in accordance with section 1.04.
- B. For the purposes of this project, failure is defined as the discontinuance of any attachment point between equipment or structure, vertical permanent deformation greater than 1/8" (3mm) and/or horizontal permanent deformation greater than 1/4" (6mm).

2.02 PRODUCT DESCRIPTIONS

- A. Vibration Isolators and Seismic Restraints.

SPECIFICATION:

1. Hangers shall consist of rigid steel frames containing minimum 1 1/4" (32mm) thick neoprene elements at the top and a steel spring with general characteristics as in specification 5 seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. To maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30deg. arc from side to side before contacting the rod bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30 deg. capability. Hangers shall be type 30N as manufactured by Mason Industries, Inc.
2. Hangers shall be as described in 10, but they shall be pre-compressed and locked at the rated deflection by means of a resilient seismic upstop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30 deg. capability. Hangers shall be type PC30N as manufactured by Mason Industries, Inc.
3. Seismic Cable Restraints shall consist of galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Cables must be pre-stretched to achieve a certified minimum modulus of elasticity. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement. Cables must not be allowed to bend across sharp edges. Cable assemblies shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California verifying the maximum certified load ratings. Cable assemblies shall be type SCB at the ceiling and at the clevis bolt, SCBH between the hanger rod nut and the clevis or SCBV if clamped to a beam, all as manufactured by Mason Industries, Inc.
4. Seismic solid braces shall consist of steel angles or channels to resist

seismic loads with a minimum safety factor of 2 and arranged to provide all directional restraint. Seismic solid brace end connectors shall be steel assemblies that swivel to the final installation angle and utilize two through bolts to provide proper attachment. Seismic solid brace assembly shall have anchorage preapproval "R" number from OSHPD in the state of California verifying the maximum certified load ratings. Solid seismic brace assemblies shall be type SSB, SSBS or SSRF as manufactured by Mason Industries, Inc.

Note: Specifications 12 - 14 apply to trapeze as well as clevis hanger locations. At trapeze anchor locations piping must be shackled to the trapeze. Specifications apply to hanging equipment as well.

5. Steel angles, sized to prevent buckling, shall be clamped to pipe or equipment rods utilizing a minimum of three ductile iron clamps at each restraint location when required. Welding of support rods is not acceptable. Rod clamp assemblies shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California. Rod clamp assemblies shall be type SRC or UC as manufactured by Mason Industries, Inc.
6. Pipe clevis cross bolt braces are required in all restraint locations. They shall be special purpose preformed channels deep enough to be held in place by bolts passing over the cross bolt. Clevis cross braces shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California. Clevis cross brace shall be type CCB as manufactured by Mason Industries, Inc.
7. All-directional seismic snubbers shall consist of interlocking steel members restrained by a one-piece molded neoprene bushing of bridge bearing neoprene. Bushing shall be replaceable and a minimum of 1/4" (6mm) thick. Rated loadings shall not exceed 1000 psi (.7kg/mm²). A minimum air gap of 1/8" (3mm) shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Snubber end caps shall be removable to allow inspection of internal clearances. Neoprene bushings shall be rotated to ensure no short circuits exist before systems are activated. Snubbers shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Snubber shall be type Z-1225 as manufactured by Mason Industries, Inc.
8. All directional seismic snubbers shall consist of interlocking steel members restrained by shock absorbent rubber materials compounded to bridge bearing specifications. Elastomeric materials shall be replaceable and a minimum of 3/4" (19mm) thick. Rated loadings shall not exceed 1000 psi (.7kg/mm²). Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8" (3mm) nor more than 1/4" (6mm). Snubbers shall be installed with factory set clearances. The capacity of the seismic snubber at 3/8" (9mm) deflection shall be equal or greater than the load assigned to the mounting grouping controlled by the snubber multiplied by the applicable "G" force. Submittals shall include the load deflection curves up to 1/2" (12mm) deflection in the x, y and z planes. Snubbers shall have an anchorage preapproval "R" number from OSHPD in the state of California verifying the maximum certified horizontal and vertical load ratings. Snubbers shall be type Z-1011 as manufactured by Mason Industries, Inc.
9. Stud wedge anchors shall be manufactured from full diameter wire, not from undersized wire that is "rolled up" to create the thread. The stud

anchor shall also have a safety shoulder which fully supports the wedge ring under load. The stud anchors shall have an evaluation report number from the I.C.B.O Evaluation Service, Inc. verifying its allowable loads. Drill-in stud wedge anchors shall be type SAS as manufactured by Mason Industries, Inc.

10. All-directional acoustical pipe anchor, consisting of two sizes of steel tubing separated by a minimum 1/2" (12mm) thick 60 durometer neoprene. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction. Allowable loads on the isolation material should not exceed 500 psi (.35 kg/mm²) and the design shall be balanced for equal resistance in any direction. All-directional anchors shall be type ADA as manufactured by Mason Industries, Inc.
11. Split Wall Seals consist of two bolted pipe halves with minimum 3/4" (19mm) thick neoprene sponge bonded to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete may be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of 1" (25mm) past either face of the wall. Where temperatures exceed 240deg. F, 10# (4.5kg) density fiberglass may be used in lieu of the sponge. Seals shall be type SWS as manufactured by Mason Industries, Inc.
12. The horizontal thrust restraint shall consist of a spring element in series with a neoprene molded cup as described in specification 5 with the same deflection as specified for the mountings or hangers. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4" (6mm) movement at start and stop. The assembly shall be furnished with 1 rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit. Horizontal thrust restraints shall be type WBI/WBD as manufactured by Mason Industries, Inc.

PART 3 - EXECUTION

3.01 GENERAL

- A. All vibration isolators and seismic restraint systems must be installed in strict accordance with the manufacturers written instructions and all certified submittal data.
- B. Installation of vibration isolators and seismic restraints must not cause any change of position of equipment, piping or ductwork resulting in stresses or misalignment.
- C. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified.
- D. The contractor shall not install any equipment or piping, which makes rigid connections with the building unless isolation is not specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls.
- E. Coordinate work with other trades to avoid rigid contact with the building.

- F. Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architects/engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractors expense.
- G. Bring to the architects/engineers attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractors expense.
- H. Correct, at no additional cost, all installations which are deemed defective in workmanship and materials at the contractors expense.
- I. Overstressing of the building structure must not occur because of overhead support of equipment. Contractor must submit loads to the structural engineer of record for approval. Generally bracing may occur from:
 - 1. Flanges of structural beams.
 - 2. Upper truss cords in bar joist construction.
 - 3. Cast in place inserts or wedge type drill-in concrete anchors.
- J. Specification 2 cable restraints shall be installed slightly slack to avoid short circuiting the isolated suspended equipment, piping or conduit.
- K. Specification 2 cable assemblies are installed taut on non-isolated systems. Specification 3 seismic solid braces may be used in place of cables on rigidly attached systems only.
- L. At locations where specification 2 or 3 restraints are located, the support rods must be braced when necessary to accept compressive loads with specification 4 braces.
- M. At locations where specification 2 cable restraints are installed on support rods with spring isolators, the spring isolation hangers must be specification type 1.
- N. At all locations where specification 2 or 3 restraints are attached to pipe clevis, the clevis cross bolt must be reinforced with specification type 5 braces.
- O. Drill-in concrete anchors for ceiling and wall installation shall be specification type 18, and specification type 9 female wedge type for floor mounted equipment.
- P. Vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not permitted on this project.
- Q. Where piping passes through walls, floors or ceilings the vibration isolation manufacturer shall provide specification 12 wall seals.
- R. All fire protection piping shall be braced in accordance with NFPA 13 and 14.
- S. All fire protection equipment is considered life safety equipment and shall be seismically restrained using the seismic force levels for life safety equipment in table 1.06-1, if higher levels are shown.

3.02 VIBRATION ISOLATION OF PIPING

- A. Horizontal pipe isolation: The first four pipe hangers in the main lines near the mechanical equipment shall be as described in specification 11. Brace hanger rods with SRC clamps specification 14. Horizontal runs in all other locations throughout the building shall be isolated by hangers as described in specification 10 & 10A. Floor supported piping shall rest on isolators as described in specification 6. Heat exchangers and expansion tanks are considered part of the piping run. The first three isolators from the isolated equipment will have the same static deflection as specified for the mountings under the connected equipment. If piping is connected to equipment located in basements and hangs from ceilings under occupied spaces the first three hangers shall have 0.75" (19mm) deflection for pipe sizes up to and including 3" (75mm), 1 1/2" (38mm) deflection for pipe sizes up to and including 6" (150mm), and 2 1/2" (64mm) deflection thereafter. Hangers shall be located as close to the overhead structure as practical. Hanger locations that also have seismic restraints attached must have type RW Rebound Washers to limit uplift. Where piping connects to mechanical equipment install specification 23 expansion joints or specification 24 stainless hoses if 23 is not suitable for the service.
- B. Riser isolation: Risers shall be suspended from specification 10A hangers or supported by specification 5 mountings, anchored with specification 10 anchors, and guided with specification 11 sliding guides. Steel springs shall be a minimum of 0.75" (19mm) except in those expansion locations where additional deflection is required to limit load changes to +/- 25% of the initial load. Submittals must include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on the building structure, spring deflection changes and seismic loads. Submittal data shall include certification that the riser system has been examined for excessive stresses and that none will exist in the proposed design.
- C. Seismic Restraint of Piping
1. Seismically restrain all piping listed as a, b or c below. Use specification 2 cables if isolated. Specification 2 or 3 restraints may be used on unisolated piping.
 - a. Piping located in boiler rooms, mechanical equipment rooms, and refrigeration equipment rooms that is 1 1/4" (32mm) I.D. and larger.
 - b. All other piping 2 1/2" (64mm) diameter and larger.
 2. Transverse piping restraints shall be at 40' (12m) maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
 3. Longitudinal restraints shall be at 80' (24m) maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
 4. Where thermal expansion is a consideration, guides and anchors may be used as transverse and longitudinal restraints provided they have a capacity equal to or greater than the restraint loads in addition to the loads induced by expansion or contraction.
 5. Transverse restraint for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24" (600mm) of the elbow or TEE or combined stresses are within allowable limits at longer distances.
 6. Hold down clamps must be used to attach pipe to all trapeze members before applying restraints in a manner similar to clevis supports.
 7. Branch lines may not be used to restrain main lines.

8. Connection to the structure must be made with a non-friction connection (i.e. no “C” clamps)
9. Hanger locations that also have seismic restraints attached must have Specification 10A type RW Rebound Washers.

END OF SECTION 21 05 48

IDENTIFICATION FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Includes identification of all components of a wet pipe fire protection sprinkler system and standpipes for the entire building.

1.02 RELATED SECTIONS

- A. Painting - Section 09 9000.
- B. Common Work Results for Fire Suppression – Section 21 0500.
- C. Fire Suppression Sprinkler Systems – Section 21 1300.

1.03 REFERENCES

- A. ANSI/NFPA 13 - 2002- Installation of Sprinkler Systems.
- B. NFPA 101 - 2003 - Life Safety Code.

1.04 SUBMITTALS

- A. See Section 01 3323 – Submittals, for Submittals Procedures.
- B. Product Data: Submit product specifications and installation instructions for each identification material and device desired.
- C. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.
- D. 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 abbreviations (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.

1.05 QUALITY ASSURANCE

- A. The system shall be designed and fabricated by a firm which is regularly engaged, for a minimum of five years, in manufacturing of fire protection piping systems identification.

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 ° 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 mils 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. 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.
- 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. 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.
- E. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, and warn of hazards and improper operations.

END OF SECTION 21 05 53

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Includes furnishing and installing all components of a wet pipe fire protection sprinkler system. (All work to comply with NFPA 13, state and local code).

1.02 RELATED SECTIONS

- A. Painting - Section 09 90 00.
- B. Common Work for Fire Suppression Sprinkler Systems – Section 21 05 00.
- C. Identification for Fire Suppression - Section 21 05 53.
- D. Fire Suppression Sprinkler Systems – Section 21 13 00.

1.03 REFERENCES

- A. ANSI/NFPA 13 - 2002- Installation of Sprinkler Systems.
- B. ANSI/NFPA 14 - 2003 - Installation of Standpipe and Hose Systems.
- C. NFPA 101 - 2003 - Life Safety Code.

1.04 SUBMITTALS

- A. See Section 01 3323 – Submittals, for Submittals Procedures.
- B. Shop Drawings:
 - 1. Submit as a complete package to the Architect for review for the State Fire Marshal under a Memo of Understanding and record purposes:
 - a. Layout drawing of complete, overhead sprinkler system indicating relationship of all overhead items, including ceiling air diffusers. Any variation from designated sprinkler head locations shall be approved by the Architect. Location of risers, piping, etc. shall be as inconspicuous as possible, provide a pleasing appearance and still fulfill all functional requirements.
 - b. Complete details and sections as required, to clearly define and clarify the design indicated, by the aforementioned layout.
 - c. Designs requiring cutting of structural members for passage of sprinkler pipes or hangers shall be as noted on the drawings and as approved by the Structural Engineer.
 - d. Catalog data of all system components (i.e. valves, siamese, alarms, heads, etc.
 - e. All shop drawings, prior to being sent to the Architect, shall bear evidence of review by the Owner's insurance carrier. Insurance carrier review shall be by Owner's carrier at time immediately prior to shop drawing submission to Architect.
 - f. Include working plans, summary sheets, detailed work sheet, and graph sheets according to NFPA 13 - 2002, 1-9, 7-3.2, 7-3.3, 7-3.4, 6.1, 6.2, and 6.3.
- C. Maintenance Manuals:
 - 1. The contractor shall provide three (3) sets in hard back loose-leaf binders of a

compilation of catalog data of each manufactured item of equipment used in the fire protection system and shall present this compilation to the Architect for transmittal to the Owner before final payment is made. In each maintenance catalog shall be provided a complete set of submittals on all equipment, descriptive and installation data, operating instructions, parts lists and maintenance instructions.

2. A complete double index shall be provided: (1) Listing of products alphabetically by name, and (2) listing the names of manufacturers of products alphabetically with their addresses and the address of the local sales representative.

1.05 QUALITY ASSURANCE

- A. The system shall be designed and fabricated by a firm which is regularly engaged, for a minimum of five years, in manufacturing of fire protection piping systems similar to that required for this project.
- B. At the option of the Contractor, the piping system may be hydraulically designed from the start of the sprinkler service in lieu of the standard pipe method.
- C. All system designers, supervisors and installers shall have proper NICET certification.
 1. Prior to installation, submit data showing that Contractor has successfully installed systems of the same type and design as specified herein, or that Contractor has a firm contractual agreement with a subcontractor having such required experience. Data shall include names and locations of at least two installations where the Contractor, or the subcontractor, referred to above, has installed such systems. Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months.
 2. Qualifications of System Technician: Installation drawings, shop drawings and as-built drawings shall be prepared, by or under the supervision of an individual who is experienced with the types of works specified herein, and is currently certified by the National Institute for Certification in Engineering Technologies (NICET) as an engineering technician with a minimum Level III certification in the Fire Protection/Automatic Sprinkler System program. Contractor shall submit data for approval showing the name and certification of all involved individuals with such qualifications at or prior to submittal of drawings.
- D. FM Compliance: Comply with Factory Mutual "Approved Guide".
- E. FM Labels: Provide fire protection products bearing FM approved labels.
- F. UL Labels: Provide fire protection products which have been approved and labeled by UL.
- G. Local Fire Department/Marshall Regulations: Comply with governing regulations pertaining to the fire protection system.
- H. After completion of the installation, the entire system shall be tested for acceptance by the Insurance Service Organization according to the rules and regulations of for the State of Arkansas.
- I. The Insurance Service Organization, after reviewing the installation will issue a letter of final rating addressed to the fire protection company responsible for the installation, prepared in triplicate and given to the Owner for distribution. All costs for this service shall be borne by the fire protection contractor.

- J. The entire installation shall be guaranteed for a period of one (1) year from the building acceptance date.

PART 2 - PRODUCTS

2.01 SPRINKLER HEADS

- A. System shall include, but not be limited to: sprinkler heads (pendant), (upright), (sidewall), (recessed), (concealed) dry sidewall, spare sprinkler head box, wrenches, pressure gauge, 2-inch main drain and inspector's test line with stop valve.
- B. Furnish Owner a stock of two (2) spare sprinkler heads of each type and temperature rating used on the property with special sprinkler wrench for each type used.
- C. Suspended Ceiling:
 - 1. Type: Recessed pendant type with matching push on escutcheon plate.
 - 2. Head Finish: Chrome.
 - 3. Escutcheon Plate Finish: Chrome.
 - 4. Glass bulb type, temperature rated for specific area hazard (155 °F – typical most areas).
 - 5. Model: FIFR quick response, manufactured by Reliable.
- D. Exposed Area Type:
 - 1. Type: Standard upright type (and pendant).
 - 2. Head Finish: (Brass for Mechanical/Electrical Room, Storage Room, etc.) Black plated or special color as required by the architect for finished areas without ceiling.
 - 3. Glass bulb type, temperature rated for specific area hazard. 155 °F is typical for most areas, 200 °F for Mechanical and Electrical Rooms.
 - 4. Model: FIFR quick response, manufactured by Reliable.
- E. This facility is located at Trumann, Arkansas in Poinsett County, and the piping restraint systems shall be designed to comply with the most current Arkansas Fire Prevention Code, for the specific seismic design category of project.
- F. For Seismic Design Categories D, E, or F; provide flexible sprinkler connections to all sprinkler heads in finished ceilings. These shall be the stainless-steel braid type over stainless corrugated hose equal to “FlexHead Industries” (No Substations). Furnish all mounting hardware as required. When heads occur in ceiling tile the heads shall be in center of tile, in gyp board ceilings the heads shall be symmetrically located in rooms and spaces.

2.02 WATER FLOW INDICATORS AND ALARMS

- A. Provide in the Fire Protection System Potter-Roemer, Inc. Fig. #6220 tamper switch on stop valves; fig. #6240-pressure gauge, #6230-alarm bell, #6235-bell guard (but note water motor alarm typically used) and #6201-6208 water flow indicator. The wiring of the alarm and connection to the fire alarm system shall be by electrical contractor.

2.03 ORIGIN

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

2.04 POST INDICATOR VALVE

- A. Post indicator type gate valve shall be Mueller Company Series A-2052-20, or approved equal, for service connection as required. Indicator post shall be Mueller Company Series A-20805, of approved length and size as required. All exterior portions of the indicator post shall be painted red. Paint finish shall be from cap of post to a point 12 inches below grade or to the bottom of center barrel whichever is of lesser length. Valve shall be provided with tamper switch wired by the electrical contractor. Post indicator valve shall be installed no closer than 40 feet from the building – see civil utility site plan for location.

2.05 WATER FLOW INDICATORS AND ALARMS

- A. Provide in the Fire Protection System Potter-Roemer, Inc. Fig. #6220 tamper switch on stop valves; fig. #6240-pressure gauge, #6230 alarm bell, #6235 bell guard and #6201-6208 water flow indicator. The wiring of the alarm and connection to the fire alarm system shall be by electrical contractor.

2.06 BACKFLOW PREVENTER

- A. Furnish and install where shown on the drawings, double check detector assembly backflow preventer, equipped with cubic feet per minute, 5/8 inch by 3/4-inch meter and ball type test cocks, UL listed resilient seated OS&Y shut-off valves.
- B. Unit shall have epoxy coated cast iron body construction inside and out, bronze seat and disc holder, stainless steel trim and durable, tight-seating rubber check valve discs, bronze body ball type test cocks and Record-all 3/4-inch bronze meter.
- C. Unit shall be suitable for supply pressure up to 175 psi and water temperatures to 110 °F, tested and certified under ASSE No. 1015-1980, AWWA C506-78, UL and FM Standards, and accepted by the Arkansas State Plumbing Code.

2.07 SIAMESE FITTING (FDC)

- A. Potter-Roemer, Inc. No. 5021-D, wall mounted, flush mounted / recessed fire department connection, two-way, 4 X 2½, chrome finish. Wall plate shall have lettering “AUTO-SPKR”.

2.08 AUTOMATIC BALL DRIP

- A. Check valves for Siamese fittings shall be provided with Potter-Roemer, Inc. No. 5980 automatic ball drip, piped to drip over a floor drain or outside exterior wall as shown on drawings.

PART 3 - EXECUTION

- 3.01** All joining materials for ductile iron pipe shall be of a type, make and quality, approved by the Architect,
and to conform to the following requirements:
- 3.02** Prior to connecting to the overhead piping, the underground main should be flushed in the presence of a
representative of the Owner and meet with his approval.
- 3.03** Piping in the areas having ceiling shall be concealed. Where ceilings have grids, sprinkler heads shall be centered with the grid. Piping in other areas may be exposed, but kept at a minimum distance from structural system. All piping shall be free of rust, clean and have a minimum of one (1) shop coat of clear rust inhibiting paint or a color as selected by Architect.

- 3.04** Valves shall be complete with all necessary items, fittings, identification tags or plates, and accessories, including water motor gong. Design shall allow for suitable drainage of same.
- 3.05** Where piping passes through walls, floors, ceilings or other building construction, sleeves must be used. Where exposed piping passes through finish work escutcheons shall be chrome plated or other finish acceptable to the Architect. Split wall plates or escutcheons shall be installed to fit snugly around piping. Where finish is not a problem, suitable plates shall be provided at each hole to assure effectiveness of construction as a fire stop.
- 3.06** Before assembly of couplings, lightly coat pipe ends and outside of gaskets with cup grease or graphite paste.
- 3.07** Pipe grooving shall be in accordance with the manufacturer's specifications contained in latest published literature.
- 3.08** OS&Y valves, where shown on the drawings, shall be electrically supervised with tamper switch wired to alarm bell at central panel. Coordinate wiring with valve and controls.
- 3.09** All openings for piping should be anticipated and indicated on the approved and accepted shop drawings. Any additional cutting of openings must have the written approval of the Architect.
- 3.10** After completion of all installations, tests, etc., and prior to the building opening date, the fire protection contractor shall instruct the Owner in the operation of the fire protection system. Special care shall be taken to make sure the Owner:
 - A. Will immediately recognize whether the main valve is in an open or closed position.
 - B. Will know how to drain the system.
 - C. Will know how to test the alarm valve.
 - D. Will know how to reset all systems and how they are interconnected.
- 3.11** Testing of the fire protection system shall be as outlined in hereinbefore listed NFPA Standards.

END OF SECTION 21 13 00

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Basic Requirements for complete plumbing system.

1.02 RELATED SECTIONS

- A. Section 22 05 48 – Vibration and Seismic Controls for Plumbing Piping and Equipment.
- B. Section 22 10 05 – Plumbing Piping.
- C. Section 22 30 00 – Plumbing Equipment.
- D. Section 22 40 00 – Plumbing Fixtures.
- E. Section 31 23 16 – Excavation.

1.03 SITE INSPECTION

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

1.04 DRAWINGS

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

1.05 SUBSTITUTIONS

- A. The naming of specified items on the drawings or in the specifications is intended to establish a level of quality and performance. Substitution requests may be submitted at the time of shop drawing submittal. Review of substituted equipment or material prior to the Bid Date will not be considered unless otherwise specified.
- B. Substitution shall be submitted as specified in Division 01.

1.06 CODE REQUIREMENTS, FEES & PERMITS

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

1.07 CONTRACTOR REVISED DRAWINGS

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

1.08 COORDINATION OF WORK

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

- E. Adjust locations of pipes, etc. to accommodate work from interferences anticipated and encountered. Determine exact route and location of each pipe and duct prior to fabrication.
 - 1. Make offsets, transitions, and changes in direction of pipes, as required to maintain proper headroom and pitch of sloping lines whether or not indicated on Drawings.
- F. Slots and openings through floors, walls, ceilings and roofs shall be provided by other Divisions in their respective materials. This Division shall see that they are properly located and do any cutting and patching caused by its neglect to do so.

1.09 EXCAVATION AND TRENCHING FOR PIPING

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

1.10 BACKFILLING OF TRENCHES

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

1.11 GENERAL PIPING INSTALLATION

- A. Furnish and install a complete system of piping. The piping drawings are diagrammatic and

indicate the general location and connections. If the size of any piping is not clearly evident, obtain instructions from the Architect before proceeding with the work. The piping may have to be offset, lowered or raised as required or as directed at the site. This does not relieve the contractor from responsibility for the proper erection of systems of piping in every respect suitable for the work intended. Piping systems that are not to be installed complete shall be so noted.

- B. Erection: Piping shall be cut accurately for fabrication to measurements established at the construction site. Pipe shall be worked into place without springing and/or forcing. Remove all burrs and cutting slag by reaming or other cleaning methods. Changes in direction shall be made with fittings, except that bendings of pipe will be permitted, providing a hydraulic pipe bender is used. Bent pipe showing kinks, wrinkles, or other malformation will not be acceptable. Piping shall be arranged so as not to interfere with removal of other equipment or devices nor to block access manholes or other access openings. Piping shall be installed to insure noiseless circulation.

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

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

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

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

1.12 THERMAL AND MOISTURE PROTECTION

- A. Install flashing, counterflashing and caulk or seal all penetrations in exterior walls or floors

as required to prevent exterior moisture from entering building.

1.13 EQUIPMENT AND MATERIALS

- A. Product Approvals:
 - 1. If approval is received to use other than specified items, responsibility for specified capacities and insuring that items to be furnished will fit space available lies with this Division.
 - 2. In the event other than specified equipment is used and will not fit job site conditions, this Division assumes responsibility for replacement with items named in specification.
- B. Use domestic made pipe, pipe fittings and motors on project.
- C. Insure 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 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.

1.15 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 22 05 00

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work specified in this section.

1.02 DESCRIPTION OF WORK

- A. The extent of general demolition work is shown on drawings. Coordinate the required mechanical and plumbing work with the general demolition.
- B. Demolition includes removal of systems and removal and disposal of demolished materials, as shown on drawings and herein specified.
- C. The Owner shall have the option of retaining any items removed. The Contractor shall deliver these items to the Owner's designated storage area. Any items not retained by the Owner shall be disposed of off-site by the Contractor.

1.03 JOB CONDITIONS

- A. Condition of Structures: The Owner assumes no responsibility for actual condition of structures to be demolished.
 - 1. Conditions of the structure existing at time of inspection for bidding purposes will be maintained by Owner in so far as practicable. However, variations within structure may occur by Owner's removal and salvage operations prior to start of demolition work. The drawings are schematic and provided as an aid in bidding. The contractor shall visit the site and determine the actual conditions prior to bidding.
- B. Partial Removal: Items of salvable value to Contractor may be removed from structure as work progresses. Salvaged items must be transported from site as they are removed.
 - 1. Storage or sale of removed items on site will not be permitted.
- C. Traffic: Conduct demolition operations and removal of debris to ensure minimum interference with roads, streets, walks, occupied areas, and other adjacent occupied or used facilities.
- D. Protections; Ensure safe passage of persons around or through area of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities, and persons.

1. Install temporary mechanical services, plumbing, temperature control, etc., as required by the Owner or authorities having jurisdiction.
- E. Damages: Promptly repair damages caused to adjacent facilities by demolition operations at no cost to Owner.
- F. Utility Services: Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations. Allow no interruption in service unless coordinated with Owner at least 24 hours in advance.
 1. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.
 2. Contractor will disconnect and seal utilities serving each structure to be demolished, or interior area to be demolished, prior to start of demolition work.
- G. If Contractor is required to disconnect utility services or other services to an occupied area, the Contractor shall provide temporary or alternative service to that area, as required by Owner.

PART 2 - PRODUCTS

(Not applicable)

PART 3 - EXECUTION

3.01 DEMOLITION

- A. Remove all equipment, piping, etc., as indicated on the drawings.
- B. All items shown to remain active shall be furnished with necessary devices or accessories.

3.02 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Remove from site debris, rubbish, and other materials resulting from demolition operations. Pay all fees related to removal and dumping.
 1. Burning of removed materials from demolished structures will not be permitted on site.
- B. Removal:
 1. Transport materials removed from demolished structures and dispose of offsite.

END OF SECTION 22 05 001

COMMON ELECTRICAL REQUIREMENTS FOR PLUMBING EQUIPMENT**PART 1 - GENERAL****1.01 SECTION INCLUDES**

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

1.02 RELATED SECTIONS

- A. Section 22 30 00 – Plumbing Equipment.

1.03 REFERENCES

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

1.04 SUBMITTALS

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

1.05 QUALITY ASSURANCE

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

PART 2 - PRODUCTS**2.01 MOTORS**

- A. The following are basic requirements for simple or common motors, for special motors, more detailed and specific requirements are specified in the individual equipment specifications.
 - 1. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.

2. Motor sizes shall be large enough so that driven load will not requirement the motor to operate in the service factor range.
 3. 2-speed motors shall be 2 separate windings on polyphase motors.
 4. Temperature Rating: Rated for 40 deg. environment, with maximum 50 deg. C temperature rise for continuous duty at full load (Class A Insulation).
 5. Starting capability: Frequency of starts as indicated by automatic control system, and not less than 5 evenly timed spaced starts per hour for manually controlled motors.
 6. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.
- B. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.
1. Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit specific application.
 2. Bearings:
 - a. Ball or roller bearings with inner and outer shaft seals;
 - b. Regreasable, except permanently sealed where motor is normally inaccessible for regular maintenance.
 - c. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.
 - d. For fractional horsepower, light duty motors, sleeve type bearings are permitted.
 3. Enclosure Type:
 - a. Open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation;
 - b. Guarded drip-proof motors where exposed to contact by employees or building occupants;
 - c. Weather protected Type I for outdoor use, Type II where not housed;
 4. Overload Protection: Built-in thermal overload protection and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.
 5. Noise Rating: "Quiet" rating on motors located in occupied spaces of building.
 6. Efficiency: Provide "Energy Efficient" motors with a minimum efficiency as scheduled in accordance with IEEE Standard 112, test method B. If efficiency not specified, motors shall have a minimum efficiency as listed below.

1HP	80% Effy	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 22 05 13

PART 1 - GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED SECTIONS

- A. Section 22 05 48 – Vibration and Seismic controls for Plumbing Piping and Equipment.
- B. Section 22 10 05 – Plumbing Piping.
- C. Section 22 30 00 – Plumbing Equipment.
- D. Section 22 40 00 – Plumbing Fixtures.
- E. Section 31 23 16 – Excavation.

1.03 SUBMITTALS

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

1.04 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.01 PIPE ALIGNMENT GUIDES

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

PART 3 - EXECUTION

3.01 EXPANSION LOOPS

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

END OF SECTION 22 05 16

PART 1 - GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED SECTIONS

- A. Section 22 10 05 – Plumbing Piping.
- B. Section 22 30 00 – Plumbing Equipment.

1.03 QUALITY ASSURANCE

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

1.04 SUBMITTALS

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

PART 2 - PRODUCTS

2.01 TEMPERATURE GAGES

A. Glass Thermometers:

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

Marshalltown Instruments, an Eltra Co.
Trerice (H.O.) Co.
Weiss (Albert A) & Son, Inc.

B. Dial Type Insertion Thermometers:

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

C. Thermometer Separable Wells:

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

D. Temperature Gage Connector Plugs:

1. General: Provide temperature gage connector plugs pressure rated for 500 psi and 200 degrees F. Construct of brass and finish in nickel-plate, equip with 1/2 inch NPT fitting, with self-sealing valve core type neoprene gasketed orifice suitable for

inserting 1/8 inch O.D. probe assembly from dial type insertion thermometer. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness for insulated piping.

2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering temperature gage connector plugs which may be incorporated in the work include, but are not limited to, the following:
Peterson Engineering Co.

2.02 PRESSURE GAGES AND FITTINGS

A. Pressure Gages:

1. General: Provide pressure gages of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.
2. Type: General use, 1 percent accuracy, ANSI B40.1, Grade A, phosphor bronze bourbon type, bottom connection.
3. Case: Drawn steel or brass, clear acrylic plastic lends, 4-1/2 inch diameter.
4. Connector: Brass with 1/4 inch male NPT. Provide protective syphon when used for steam service.
5. Scale: White coated aluminum with permanent etched markings.
6. Range: Conform to the following:
 - a. Water: 0 - 100 psi.
7. Available Manufacturers: Subject to compliance with requirements, manufacturers offering pressure gauges which may be incorporated in the work include, but are not limited to, the following:
Ametek, U.S. Gauge Div.
Marsh Instrument Co., Unit of General Signal.
Marshalltown, an Eltra Company
Trerice (H.O.) Co.
Weiss (Albert A.) & Son, Inc.

B. Pressure Gage Cocks:

1. General: Provide pressure gauge cocks between pressure gages and gauge tees on piping systems. Construct gage cock of brass with 1/4 inch female NPT on each end, and "T" handle brass plug.
2. Syphon: 1/4 inch straight coil constructed of brass tubing with 1/2 inch male NPT on each end.
3. Snubber: 1/4 inch brass bushing with corrosion resistant porous metal disc, through which pressure fluid is filtered. Select disc material for fluid served and pressure rating.
4. Manufacturers: Subject to compliance with requirements, manufacturers offering pressure gage cocks which may be incorporated in the work include, but are not limited to, the following:
Ametek, U.S. Gauge Div.
Marsh Instrument Co., Unit of General Signal.
Marshalltown, An Eltra Company
Trerice (H.O.) Co.
Weiss (Albert A.) & Son, Inc

C. Pressure Gage Connector Plugs:

1. General: Provide pressure gage connector plugs pressure rated for 500 psi and 200 degrees Fahrenheit. Construct of brass and finish in nickel-plate, equip with 1/2 inch NPT fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8 inch O.D. probe assembly from dial type insertion pressure gage. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness for insulated piping.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers

offering pressure gauge connector plugs which may be incorporated in the work include, but are not limited to, the following:

Peterson Engineering Co.

PART 3 - EXECUTION

3.01 INSTALLATION OF TEMPERATURE GAGES

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

3.02 INSTALLATION OF PRESSURE GAGES

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

END OF SECTION 22 05 19

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 Plumbing equipment shall include the following items to the extent required on plans or in other sections of the following specifications:

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

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Basic Requirements – Section 22 05 00.

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

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

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

restraints shall be provided where required to resist overturning.

- 3.08** Oversized plate washers extending to the equipment wall shall be used at bolted connections through the base sheet metal if the base is not reinforced with stiffeners or not capable of transferring the required loads.

END OF SECTION 22 05 48

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**PART 1 - GENERAL****1.01 SECTION INCLUDES**

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

1.02 RELATED SECTIONS

- A. Section 22 10 05 – 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

2. 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 22 05 53

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Insulation Requirements for complete plumbing piping system.

1.02 RELATED SECTIONS

- A. Section 22 05 00 – Common Work Results for Plumbing.
- B. Section 22 05 48 – Vibration and Seismic Controls for Plumbing Piping and Equipment.
- C. Section 22 05 53 – Identification for Plumbing Piping
- D. Section 22 10 05 – Plumbing Piping.
- E. Section 22 30 00 – Plumbing Equipment.
- F. Section 22 40 00 – Plumbing Fixtures.

1.03 REFERENCES

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

1.04 SUBMITTALS

- A. Submit under provisions of Division 01 and Section 22 05 00.
- B. Product Data: Provide product description, list of materials and thickness for each service, and locations.
- C. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

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

1.06 QUALIFICATIONS

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

1.07 DELIVERY, STORAGE, AND HANDLING

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

1.08 ENVIRONMENTAL REQUIREMENTS

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

PART 2 - PRODUCTS

2.01 GLASS FIBER

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

2.02 APPROVED MANUFACTURERS

- A. Glass Fiber:
 - 1. Owens/Corning Fiberglass.
 - 2. Architect Approved - Other acceptable manufacturers offering equivalent products.
- B. Vapor Barrier Jacket Lap Adhesive - Compatible with insulation:
 - 1. Foster 25.
 - 2. Architect Approved.

PART 3 - EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

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

- I. For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- J. Valves and fittings insulated with block insulation shall be finished with insulating cement and troweled to a smooth and uniform finish.

3.03 TOLERANCE

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

3.04 GLASS FIBER INSULATION SCHEDULE

PIPING SYSTEMS		THICKNESS	PIPE SIZE
A.	Plumbing Systems		
	Domestic Hot Water Supply	1"	½" – 1"
		1½"	1¼" – 2"
		2"	2½" – 6"
	Domestic Cold Water (Indoors)	½"	
	Domestic Cold Water (Out of Doors)	1"	
	Storm Water	1"	
B.	The inside dimension of all domestic hot water insulation shall be increased by ½" to accommodate heat trace cable where applicable.		

END OF SECTION 22 07 19

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Basic Requirements for complete plumbing piping system.

1.02 RELATED SECTIONS

- A. Section 22 05 00 – Common Work Results for Plumbing.
- B. Section 22 05 53 – Identification for Plumbing Piping
- C. Section 22 05 48 – Vibration and Seismic controls for Plumbing Piping and Equipment.
- D. Section 22 30 00 – Plumbing Equipment.
- E. Section 22 40 00 – Plumbing Fixtures.
- F. Section 31 23 16 – Excavation.

1.03 QUALITY ASSURANCE

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

1.04 SUBMITTALS

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

1.05 QUALIFICATIONS

- A. Applicator: Company specializing in performing the work of this section with 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 Sil-fos brazing alloy.
- D. VALVES
 - 1. Use ball valves exclusively unless otherwise specified. All valves shall be by a single manufacturer from the approved list (reference Section 22 1006). Valves shall be for 150psi SWP.
 - 2. All valves shall be bronze, threaded ends, stainless steel ball, and extended 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. All pipe and fittings shall be manufactured in the United States of America.

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

- A. PIPING
 - 1. Piping - Reinforced Hub Type:
 - a. All piping shall be standard weight cast iron soil pipe and fittings unless noted otherwise, as manufactured by Tyler Pipe, Charlotte Pipe, or Griffin Pipe. All cast iron soil pipe and fittings shall be of the reinforced hub type, coated inside and outside with coal tar varnish and shall conform to the ASTM “Standard Specifications for Cast Iron Soil Pipe and Fittings”.
 - 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.
- B. PIPE JOINTS
 - 1. Hubless:
 - a. The cast iron hubless joint shall consist of cast iron soil pipe, fittings and Clamp All Corporation, Anaheim Foundry Co. “Husky”, or approved equal, hubless soil pipe couplings made of 24-gauge type 304 stainless steel with Hi-Torque Clamps tightened to 100-125 inch-pounds of torque. Coupling gaskets shall be made of neoprene and shall interlock with the housing assembly to make a slip free joint. Pipe and fittings shall be inserted into the sleeve and firmly seated against the center rib or shoulder of the gasket. A sound joint shall be provided in field cut lengths of pipe by having square cut

ends as smooth as possible. The stainless-steel bands shall be tightened alternately and firmly to not less than 100 inch-pounds of torque.

2. Reinforced Hub Type:
 - a. The reinforced hub cast iron soil pipes shall be joined with Tyler "Ty-Seal" neoprene joints.
 - b. Support piping at each joint and fitting and 10'-0" maximum spacing.
- 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

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-23 Basic Materials and Methods, Section 23 0500 "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 22 0719.
- B. Install copper tubing under slabs without joints where possible.
- C. Provide adaptors in copper lines for all valves.
- D. Locate cold water lines a minimum of 12 inches from hot water line.
- E. Before pipes are covered, test systems in presence of Architect at 100 psi hydrostatic pressure for two (2) hours and show no leaks.
- F. Sterilize domestic water system with solution containing at least 250 parts per million of available chloride. Introduce chlorinating materials into system in manner approved by Architect. Allow sterilization solution to remain for 24 hours and open and close valves and

faucets several times during that time.

- G. After sterilization, flush solution from system with clean water until residual chlorine content is less than 0.2 parts per million.
- H. Water system will not be accepted until a negative bacteriological test is made on water taken from system and dosing shall be repeated as necessary until such negative test is accomplished. Submit written report of test to Architect for his approval.
- I. Install water hammer arresters as noted on the drawings.
- J. Extend water service piping of size and in location indicated to water service entrance at building. Provide sleeve in foundation wall for water service entry; make entry weathertight. Provide gate valve at water service entry inside building, strainer, pressure gauge, test tee and valve.
- K. Provide hot and cold-water piping runouts to fixtures of sizes indicated, but in no case smaller than required by National Standard Plumbing Code.
- L. Connect hot and cold-water piping system to mechanical equipment as indicated, and comply with equipment manufacturer's installation instructions. Provide shut-off valve and union for each connection. Provide drain valve on drain connections.

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

3.03 INSTALLATION OF NATURAL GAS PIPING

- A. Install natural gas distribution piping in accordance with applicable codes and local Utility Company requirements.
- B. Use sealants on metal gas piping threads which are chemically resistant to natural gas. Use sealants sparingly, and apply to only male threads of metal joints.
- C. Remove cutting and threaded burrs before assembling piping.

- D. Do not install defective piping or fittings. Do not use pipe with threads which are chipped, stripped, or damaged.
- E. Plug each gas outlet, including valves, with threaded plug or cap immediately after installation and retain until continuing piping, or equipment connections are completed.
- F. Install minimum 6-inch-long drip-legs in gas piping where indicated, and where required by code or regulation.
- G. Install "Tee" fitting with bottom outlet plugged or capped, at bottom of pipe risers.
- H. Use dielectric unions where dissimilar metals are joined together.
- I. Install piping with 1 inch drop in 60-foot pipe run (0.14%) in direction of flow.
- J. Install piping parallel to other piping, but maintain minimum of 12-inch clearance between gas piping and steam or hot water piping above 200° 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 22 10 05

PART 1 – GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED SECTIONS

- A. Section 22 05 00 – Common Work Results for Plumbing.
- B. Section 22 05 48 – Vibration and Seismic Controls for Plumbing.
- C. Section 22 05 53 – Identification for Plumbing Piping and Equipment.
- D. Section 22 10 05 – Plumbing Piping.
- E. Section 22 30 00 – Plumbing Equipment.
- F. Section 22 40 00 – Plumbing Fixtures.
- G. Section 31 23 16 – Excavation.

1.03 QUALITY ASSURANCE

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

1.04 SUBMITTALS

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

PART 2 - PRODUCTS

2.01 MANUFACTURED PIPING SPECIALTIES

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

- B. Pipe Escutcheons:
1. General: Provide pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings, and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.
 2. Pipe Escutcheons for Moist and Wet Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.
 3. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.
- C. Low Pressure Y-Type Pipeline Strainers:
1. General: Comply with FCI 73-1. Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 125 psi working pressure, with Type 304 stainless steel screens, with 3/64 inch perforations at 233 sq. in. Mechanical grooved type strainer may be used in grooved piping system.
 2. Threaded ends, 2 Inches and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.
 3. Flanged Ends, 2-1/2 Inches and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.
 4. Available Manufacturers: Subject to compliance with requirements, manufacturers offering low pressure Y-type strainers which may be incorporated in the work include, but are not limited to, the following:
American Air Filter, an Allis-Chalmers Co.
Armstrong Machine Works.
Hoffman Specialty, ITT Fluid Handling Div.
Metraflex Co.
Sarco Co., Div. of White Consolidated.
Trerice (H.O.) Co.
Victaulic Co. of America
- D. High Pressure Y-Type Pipeline Strainers:
1. General: Comply with FCI 73-1. Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 250 psi working pressure, with Type 304 stainless steel screens, with 3/64" perforations at 233 sq. in. Mechanical grooved type strainer may be used in grooved piping systems.
 2. Threaded Ends, 2 Inches and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.
 3. Flanged Ends, 2-1/2 Inches and Larger: Cast-iron body, bolted steel retainer with off-center blowdown fitted with pipe plug.
 4. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high pressure Y-type strainers which may be incorporated in the work include, but are not limited to, the following:
American Air Filter, an Allis-Chalmers Co.
Armstrong Machine Works.
Hoffman Specialty, ITT Fluid Handling Div.
Metraflex Co.
Sarco Co., Div. of White Consolidated.
Trerice (H.O.) Co.
Victaulic Co. of America

- E. Dielectric Unions:
1. General: Provide standard products recommended by manufacturer for use in service indicated, which effectively isolates ferrous from non-ferrous piping (electrical conductance), 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 200, bronze body, yoke bonnet, rising stem, OS&Y, solid wedge, UL/FM approved, Stockham B-133.
 - 2. Flanged Ends 2-1/2 inches and larger: Class 200, iron body, bolted bonnet, rising stem, OS&Y, solid wedge, UL/FM approved, Stockham G-634.
- E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering gate valves which may be incorporated in the work include, but are not limited to, the following:
 - 1. Milwaukee Valve Company.
 - 2. Nibco, Inc.
 - 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-211Y.
 - 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-B.
- 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, Inc.
 - 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, Inc.
 - 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 2-1/2" inches and smaller: Class 150, bronze 2 piece body, stainless steel ball, 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, Inc.
 - 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-Y-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 200, 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, Inc.
 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-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.

2.10 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 Regulator.
 - 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 inch above finished floor. 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.
3. All domestic hot and cold-water piping shall have ball valves with threaded ends; solder ends not acceptable.
- 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.

3.04 INSTALLATION OF BACKFLOW PREVENTERS

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

3.05 PREPARATION

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

3.06 INSTALLATION OF BUILDING ATTACHMENTS

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

3.07 INSTALLATION OF HANGERS AND SUPPORTS

- A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping, ductwork or other supported mechanical or electrical items.
 - 1. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.
 - 2. Support fire-water piping independently of other piping.
 - 3. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.
- B. Provisions for Movement:
 - 1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion bends and similar units.
 - 2. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
 - 3. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 are not exceeded.

- C. Insulated Piping: Comply with the following installation requirements.
 - 1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
 - 2. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold or chilled water piping, install galvanized coated protective shields. Install Foam-Glas insulation saddles.
 - 3. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.

3.08 INSTALLATION OF ANCHORS

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

3.09 ADJUSTMENT OF HANGERS AND SUPPORTS

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

3.10 EQUIPMENT BASES

- A. Concrete housekeeping bases will be provided as work of Division 3. Furnish to Contractor, scaled layouts of all required bases with dimensions of bases, and location to column 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 10 06

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Water Heaters.
- B. Pumps.

1.02 RELATED SECTIONS

- A. Section 22 05 00 – Common Work Results for Plumbing.
- B. Section 22 05 53 – Identification for Plumbing Piping
- C. Section 22 05 48 – Vibration and Seismic Controls for Plumbing Piping and Equipment.
- D. Section 22 10 05 – Plumbing Piping.
- E. Section 22 40 00 – Plumbing Fixtures.

1.03 REFERENCES

- A. ANSI/ASHRAE 90A - Energy Conservation in New Building Design.
- B. ASME Section VIII - Pressure Vessels; Boiler and Pressure Vessel Codes.
- C. ANSI/NFPA 30 - Flammable and Combustible Liquids Code.
- D. ANSI/NFPA 54 - National Fuel Gas Code.
- E. ANSI/NFPA 70 - National Electrical Code.
- F. ANSI/NEMA 250 - Enclosure for Electrical Equipment (1000 Volts Maximum).

1.04 SUBMITTALS

- A. Submit under provisions of Division 01 and Section 22 0500.
- B. Shop Drawings:
 - 1. Include heat exchanger dimensions, size of tappings, and performance data.
 - 2. Include dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.
- C. Product Data:
 - 1. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.
 - 2. Provide electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions.

1.05 OPERATION AND MAINTENANCE DATA:

- A. Submit under provisions of Division 01 and Section 22 05 00.
- B. Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with Arkansas State Plumbing Code.
- B. Provide pumps with manufacturer's name, model number, and rating/capacity identified.
- C. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:
 - 1. National Sanitation Foundation (NSF).
 - 2. American Society of Mechanical Engineers (ASME).
 - 3. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
 - 4. National Electrical Manufacturers' Association (NEMA).
 - 5. Underwriters Laboratories (UL).
- D. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.07 REGULATORY REQUIREMENTS

- A. Conform to AGA, NSF, NBBPVI, ANSI/NFPA 54, ANSI/NFPA 58, ANSI/NFPA 70, ANSI/UL 174, and ANSI/UL 1453 requirements for water heaters.
- B. Conform to ASME Section VIII for manufacture of pressure vessels for heat exchangers.
- C. Conform to ASME Section VIII, ANSI/NFPA 30, and ANSI/NFPA 31 for tanks.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 22 0500.
- B. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.09 WARRANTY

- A. Provide one year warranty under provisions of hereinafter set forth.
- B. Warranty: Include coverage of domestic water heaters, hot water return pumps and submersible sump pumps.

PART 2 - PRODUCTS

2.01 WATER HEATERS/SUBMERSIBLE SUMP PUMPS

- A. REFER TO PLUMBING EQUIPMENT SCHEDULE ON DRAWINGS.

PART 3 - EXECUTION

3.01 WATER HEATER INSTALLATION

- A. Install water heaters in accordance with manufacturer's instructions and to AGA, NSF, ANSI/NFPA 54 and UL requirements.
- B. Coordinate with plumbing piping and related electrical work to achieve operating system.
- C. Install tanks in accordance with manufacturer's instructions.
- D. Pipe relief valves and drains to nearest floor drain or as noted on drawings.

3.02 PUMP INSTALLATION

- A. Provide line sized isolating valve and strainer on suction and line sized, soft-seated check valve and balancing valve on discharge.
- B. Support piping adjacent to pump so that no weight is carried on pump casing.
- C. Ensure pumps operate at specified system fluid temperature without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate with 25 percent of midpoint of published maximum efficiency curve.

3.03 GUARANTEE

- A. The entire installation shall be guaranteed for one (1) year against defective equipment, materials and workmanship beginning on signing of substantial completion form.

END OF SECTION 22 30 00

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Basic Requirements for Plumbing Fixtures.

1.02 RELATED SECTIONS

- A. Section 22 05 00 – Common Work Results for Plumbing Piping and Equipment.
- B. Section 22 05 48 – Vibration and Seismic Controls for Plumbing Piping and Equipment.
- C. Section 22 10 05 – Plumbing Piping.
- D. Section 22 30 00 – Plumbing Equipment.

1.03 QUALITY ASSURANCE

- A. Die-cast zinc alloy will not be accepted.
- B. All faucets, stops, and traps shall be of the same manufacturer unless herein noted otherwise.
- C. Corrosion-resistant steel (CRS).
 - 1. CRS flat products shall conform to not less than chemical composition requirements of any 300 series steel specified in ASTM A276.
 - 2. Exposed surfaces shall have standard polish (ground and polished) equal to Finish No. 4 as specified in NAAMM.
- D. All enameled ironware shall be acid resisting.
- E. All fixtures shall be new and best of their respective kinds. They shall be non-absorbent throughout and free from waves, kiln marks or discoloration.
- F. All surfaces coming in contact with walls, floors, or surface of other fixtures shall be ground truly flat and shall be bedded with fine dental plaster before being caulked to wall with silicone sealant.
- G. Job must be turned over to the Owner with all fixtures clean and free from damage. All fixtures including service sinks shall be protected during construction with application of material sufficient to prevent use and damage by personnel and equipment.

1.04 SUBMITTALS

- A. Submit under provisions of Division 01 and Section 22 0500.
- B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- C. Manufacturer's Installation Instructions.

1.05 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 01 and Section 22 0500.
- B. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 22 0500.
- B. Accept fixtures on site in factory packaging. Inspect for damage.
- C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.07 FIELD MEASUREMENTS

- A. Verify that field measurements are as instructed by the manufacturer.
- B. Confirm that millwork is constructed with adequate provision for the installation of countertop lavatories and sinks.

1.08 WARRANTY

- A. Provide year warranty under provisions of Section 22 0500.

1.09 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the test by the basic designation only.
 - 1. American National Standards (ANSI):
 - A112.1.2-42.....Air Gaps in Plumbing System
 - A112.6.1M-79.....Supports for Off-the-Floor Plumbing Fixtures for Public Use
 - A112.18.1M-79....Finished and Rough Brass Plumbing Fixture Fittings
 - A112.19.1M-79....Enameled Cast Iron Plumbing Fixtures
 - A112.19.2-82.....Vitreous China Plumbing Fixtures
 - 2. American Society for Testing and Materials (ASTM):
 - A276-83.....Stainless and Heat-Resisting Steel Bars and Shapes
 - 3. National Association of Architectural Metal Manufacturers (NAAMM):
 - Metal Finishes Manual.

PART 2 - PRODUCTS

2.01 GENERALLY

- A. This contractor shall furnish and install complete all fixtures shown on the plans and hereinafter specified.
- B. All fixtures shall be new and best of their respective kinds. They shall be non-absorbent throughout and free from waves, kiln marks or discoloration.
- C. All surfaces coming in contact with walls, floors or surface of other fixtures shall be ground truly flat and shall be bedded with fine dental plaster before being caulked to wall with silicone sealant.
- D. All fixtures shall have water hammer arresters equal to Zurn or Wade, installed in their water supplies as shown on Drawings or as recommended by the shock absorber manufacturer.

- E. Provide polished chromium plated, heavy brass lock-shield loose key or screwdriver pattern angle stops, straight stops, or stops integral with faucet, with each compression type faucet whether specifically called for or not. Locate stops centrally above or below fixture in accessible location. Furnish keys for lock-shield stops to Owner upon completion of installation. All supplies shall be I.P.S. brass.
- F. Traps shall be two-piece chrome plated cast brass P-traps with cleanout and 17 gauge tubing outlet with escutcheon.
- G. All escutcheons on supplies and wastes shall be heavy chrome plated cast brass set screw type.
- H. All faucets throughout shall have removable units comprising all the wearing parts.
- I. Unless specifically specified otherwise, all material and products shall be manufactured in the United States of America.
- J. Unless specifically specified otherwise, all fixture trim, stops, and traps shall be of the same manufacturer.
- K. Protect fixtures against use and damage during construction in a manner approved by the Architect. Job must be turned over to the Owner with all fixtures and trim clean and free from damage. Fixtures shall not be used during construction unless approved by the Owner and/or Architect/Engineer.
- L. All sink and lavatory type plumbing fixtures to have loose key type stops and flexible supply risers (unless noted otherwise).
- M. All exposed plumbing piping shall be chrome plated unless noted otherwise.
- N. The Contractor must review the Architectural Drawings for exact location of plumbing fixtures and floor drains. If a plumbing fixture or floor drain is shown on the Architectural Drawings, it must be included in the Contract even if it does not appear on the Mechanical Drawings.
- O. All thermostatic and pressure balancing mixing valves shall have check-stops on the hot and cold supplies.
- P. All hot and cold-water supplies to plumbing fixtures or to shower heads shall have a "Drop Ell" fitting securely attached, inside wall, to prevent movement.
- Q. All lavatory or sink fixtures designated for handicapped use must have insulation installed on the water supplies and P-trap equal to "Lav-Guard" by Truebro, Inc.
- R. All drinking fountain bubblers shall be chrome-plated brass.
- S. All lavatory and urinal waste arms shall be DWV copper with cast brass adapters and wrought copper fittings.
- T. All water closet flush valves that have grab bars mounted on walls behind them shall have a minimum of 1-1/2-inch flush valve pipe offset to clear grab bar. Coordinate with Architectural drawings.
- U. All handicapped water closet flush valves shall be roughed-in and installed so that the flush valve control will be on the wide side of the toilet stall. Contractor shall coordinate this.

- V. All water closet flush valves shall have cast wall flange with set screw, and be supplied with sweat-solder adapter kits.
- W. Check millwork architectural and shop drawings. Verify exact location and size of fixtures and openings before rough-in and installation. Coordinate with millwork supplier for special cutouts, blocking, special or additional supports, etc.
- X. This contractor shall furnish and install all backing for lavatories, or any equipment requiring same.
- Y. Job must be turned over to the Owner with all fixtures clean and free from damage.
- Z. Where water closets, lavatories or sinks are installed back-to-back, and carriers are specified, provide one carrier to serve both fixtures in lieu of individual carriers, unless noted otherwise on Drawings.

2.02 STOPS

- A. Provide polished chromium plated, heavy brass lock-shield loose key or screw driver pattern angle stops, straight stops, or stops integral with faucet, with each type faucet whether specifically called for or not, including sinks in wood and metal casework, laboratory furniture. Locate stops centrally above or below fixture in an accessible location with 6-inch minimum length chrome plated brass nipples from wall and escutcheon. Furnish keys for lock-shield stops to Owner upon completion of installation.

2.03 TRAPS

- A. Two-piece chromium plated cast brass with cleanout and 17-gauge tubing outlet with cast brass set screw type escutcheon.

2.04 ESCUTCHEONS

- A. All escutcheons on supplies and wastes shall be heavy pattern, chrome plated, cast brass set screw type.

2.05 FAUCETS

- A. All faucets shall be provided with aerators unless specified otherwise and shall have removable units comprising all the wearing parts.

2.06 CARRIERS

- A. Where water closets, lavatories or sinks are installed back-to-back, and carriers are specified, provide one carrier to serve both fixtures in lieu of individual carriers.

2.07 ORIGIN

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

2.08 FIXTURES

- A. REFER TO PLUMBING FIXTURE SCHEDULE ON DRAWINGS.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Fixture Setting: Opening between fixture and floor and wall finish shall be caulked with white or clear Silicone sealants, which complement the fixture color.
- B. Supports and Fastening: Secure all fixtures, equipment and trimmings to partitions, walls, etc. with brass through bolts, toggle bolts, expansion bolts, or power set fasteners, as required. Exposed heads of bolts and nuts in finished rooms to be hexagonal, polished chromium-plated brass with rounded tops.

3.02 INTERFACE WITH OTHER PRODUCTS

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.
- B. Install components level and plumb secured in place with wall carriers and bolts.

3.03 ADJUSTING

- A. Adjust work under provisions of Section 22 0500.
- B. Provide adjustment of all stops, valves faucets, etc., for intended water flow rates to fixtures as required to eliminate excessive splashing, noise, or overflow.
- C. Where water closet waste pipe has to be offset due to beam interference, provide correction and/or additional piping necessary to eliminate relocation of water closet.

3.04 CLEANING

- A. At completion of all work, fixtures, exposed materials, accessible chases and equipment shall be thoroughly cleaned of all manufacture's labels, papers, paint, paste, and other foreign material.

3.05 FIXTURE HEIGHTS

- A. Install fixtures to heights above finished floor as herein specified and indicated on the Architectural drawings. Architectural drawings shall rule where discrepancies occur.

END OF SECTION 22 40 00

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. Division 23 – All Sections.

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 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.

1.09 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 Architect. Cut carefully to minimize necessity for repairs to existing work. Do not cut beams, columns or trusses.
 - 1. Each Section of this Division shall bear expense of cutting, patching, repairing and replacing of work of other Sections required because of its fault, error, tardiness or because of damage done by it.

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

1.10 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.

1.11 BACKFILLING OF TRENCHES

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

1.12 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 <u>Fluid Conveyed</u>	Length for <u>System Component</u>	Direction <u>1" Fall</u>	<u>of Fall</u>
HVAC Condensate	Drain	20 feet	Condensate flow

- 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.

1.13 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.

1.14 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.

1.15 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.

1.16 OPERATIONS AND MAINTENANCE MANUAL FOR MECHANICAL SYSTEMS

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

OPERATION AND MAINTENANCE MANUAL
FOR MECHANICAL SYSTEMS OF
DIOCESE OF LITTLE ROCK
BYRNE HALL RENOVATIONS
LITTLE ROCK, 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 – Eight (8) hours.
 2. Temperature Controls – Eight (8) 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 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.

1.19 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 23 05 00

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work specified in this section.

1.02 DESCRIPTION OF WORK

- A. The extent of general demolition work is shown on drawings. Coordinate the required mechanical and plumbing work with the general demolition.
- B. Demolition includes removal of systems and removal and disposal of demolished materials, as shown on drawings and herein specified.
- C. The Owner shall have the option of retaining any items removed. The Contractor shall deliver these items to the Owner's designated storage area. Any items not retained by the Owner shall be disposed of off-site by the Contractor.

1.03 JOB CONDITIONS

- A. Condition of Structures: The Owner assumes no responsibility for actual condition of structures to be demolished.
 - 1. Conditions of the structure existing at time of inspection for bidding purposes will be maintained by Owner in so far as practicable. However, variations within structure may occur by Owner's removal and salvage operations prior to start of demolition work. The drawings are schematic and provided as an aid in bidding. The contractor shall visit the site and determine the actual conditions prior to bidding.
- B. Partial Removal: Items of salvable value to Contractor may be removed from structure as work progresses. Salvaged items must be transported from site as they are removed.
 - 1. Storage or sale or removed items on site will not be permitted.
- C. Traffic: Conduct demolition operations and removal of debris to ensure minimum interference with roads, streets, walks, occupied areas, and other adjacent occupied or used facilities.
- D. Protections; Ensure safe passage of persons around or through area of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities, and persons.

1. Install temporary mechanical services, plumbing, temperature control, etc., as required by the Owner or authorities having jurisdiction.
- E. Damages: Promptly repair damages caused to adjacent facilities by demolition operations at no cost to Owner.
- F. Utility Services: Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations. Allow no interruption in service unless coordinated with Owner at least 24 hours in advance.
 1. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.
 2. Contractor will disconnect and seal utilities serving each structure to be demolished, or interior area to be demolished, prior to start of demolition work.
- G. If Contractor is required to disconnect utility services or other services to an occupied area, the Contractor shall provide temporary or alternative service to that area, as required by Owner.

PART 2 - PRODUCTS

(Not applicable)

PART 3 - EXECUTION

3.01 DEMOLITION

- A. Remove all equipment, piping, etc., as indicated on the drawings.
- B. All items shown to remain active shall be furnished with necessary devices or accessories.

3.02 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Remove from site debris, rubbish, and other materials resulting from demolition operations. Pay all fees related to removal and dumping.
 1. Burning of removed materials from demolished structures will not be permitted on site.
- B. Removal:
 1. Transport materials removed from demolished structures and dispose of off-site.

END OF SECTION 23 05 01

COMMON ELECTRICAL REQUIREMENTS FOR HVAC EQUIPMENT**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. This section specifies the basic requirements for electrical components which are an integral part of packaged HVAC equipment. These components include, but are not limited to factory installed motors furnished as an integral part of plumbing equipment.
- B. This section specifies the basic requirements for electrical components required to be furnished under Division 23, which are to be turned over to and installed by Division 26. These components include but are not limited to motors.
- C. Specific electrical requirements (i.e., horsepower and electrical characteristics) for plumbing equipment are scheduled on the drawings.

1.02 RELATED SECTIONS

- A. Section 23 34 23 – HVAC Power Ventilators.
- B. Section 23 74 13 – Packaged Air-Conditioning Units.
- C. Section 23 81 28 – Ductless Split Systems
- D. Section 23 82 00 – Radiant Ceiling Panels.

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 23 05 13

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Pipe and equipment hangers and supports.
- B. Equipment bases and supports.
- C. Sleeves and seals.
- D. Flashing and sealing equipment and pipe stacks.

1.02 RELATED SECTIONS

- A. Section 03 30 00 - Cast-In-Place Concrete: Equipment bases.
- B. Section 23 07 19 - Piping Insulation.

1.03 REFERENCES

- A. ASME B31.2 - Fuel Gas Piping
- B. ASTM F708 - Design and Installation of Rigid Pipe Hangers.

1.04 SUBMITTALS

- A. Submit under provisions of Section 23 05 00 and Section 01 33 00.
- B. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

PART 2 - PRODUCTS**2.01 PIPE HANGERS AND SUPPORTS**

- A. Plumbing Piping - Water:
 - 1. Conform to ASME B31.9 and ASTM F708.
 - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.
 - 3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 - 4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
 - 5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 6. Wall Support for Pipe: Welded steel bracket and wrought steel clamp.
 - 7. Vertical Support: Steel riser clamp.
 - 8. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 9. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 10. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- B. Hydronic Piping:

1. Conform to ASME B31.9 and ASTM F708.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
6. Vertical Support: Steel riser clamp.
7. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.02 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.03 FLASHING

- A. Metal Flashing: 28 gage 304 stainless steel.
- B. Copper Flashing: 16 oz./sq. ft.
- C. Lead Flashing:
 1. Waterproofing: 6 lb/sq ft.
- D. Caps: Steel, 22 gauge minimum; 16 gauge at fire resistant elements.

2.04 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe.
- C. Sleeves for Ductwork and Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
- D. Sleeves for Round Ductwork: Galvanized steel.
- E. Sleeves for Rectangular Ductwork: Galvanized steel.

PART 3 - EXECUTION

3.01 INSTALLATION

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

3.02 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as scheduled.
- B. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
- C. Place hangers within 12 inches of each horizontal elbow.

- D. Use hangers with 1-1/2-inch minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.03 EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, where indicated on Drawings, minimum 4 inches thick and extending 6 inches beyond supported equipment. Refer to Section 03 3000. Coordinate exact size requirement for pads.
- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.04 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 4 inches minimum above finished roof surface with lead worked one inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and calk, metal counter flash, and seal.
- C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36-inch sheet size. Fasten flashing to drain clamp device.
- D. Seal floor drains watertight to adjacent materials.
- E. Adjust storm collars tight to pipe with bolts; calk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.05 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

- B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- C. Extend sleeves through floors one inch above finished floor level. Caulk sleeves.
- D. Where piping or ductwork penetrates fire or smoke rated floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and calk. Provide close fitting metal collar or escutcheon covers at both sides of penetration. Secure collar or escutcheon to prevent blow-out. Fire stopping materials shall meet requirements of ASTM E119.
- E. Install chrome plated steel escutcheons at finished surfaces.

3.06 SCHEDULES

HANGER ROD

PIPE SIZE Inches	MAX. HANGER SPACING Feet	DIAMETER Inches
1/2 to 1-1/4	6.5	3/8
1-1/2 to 2	10	3/8
2-1/2 to 3	10	1/2
4 to 6	10	5/8

END OF SECTION 23 05 29

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:
- Ductwork larger than five (5) square feet in cross section
 - Packaged air-Conditioning Units
 - Fans

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Basic Requirements – Section 23 05 00.

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** 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 23 05 48

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 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.

1.03 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. Fans, blowers, primary balancing dampers and mixing boxes.
 - c. Central-station units.
 - d. Motor starters and other control equipment.
- F. 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.
- G. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, and warn of hazards and improper operations.
- H. 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 05 53

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Basic Requirements for Testing, Balancing and Adjusting Heating, Ventilating, and Air Conditioning Systems.

1.02 RELATED SECTIONS

- A. Section 23 05 00 – Common Work Results for Heating Ventilating and Air Conditioning.
- B. Section 23 05 48 – Vibration and Seismic controls for HVAC Piping and Equipment.
- C. Section 23 31 00 – HVAC Ducts and Casings.
- D. Section 23 09 33 – Electric and Electronic Control 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 01300 and Section 23 05 00.
- 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 (CONTRACTOR TO NOTIFY A/E AND OWNER OF TESTING DATES SO THAT TESTS CAN BE WITNESSED.)

- A. Sequence work under the provisions of Division 01.
- B. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.
- C. Schedule and provide assistance in final adjustment and test of life safety, smoke evacuation and/or smoke control system with Fire Authority.

PART 2 - PRODUCTS

2.01 EQUIPMENT

- A. All measurements during air balance operations shall be made by means of the "Velometer" or "Anemometer" method. Instruments used for check of air quantities shall have recent certification of calibration.
- B. The Air Balance Subcontractor shall furnish balance forms for all air systems. Forms shall list air distribution devices by location, system, size, pattern, CFM flow factor and required velocity.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Before commencing work, verify that systems are complete and operable. Ensure the following:
 - 1. Equipment is operable and in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Correct fan rotation.
 - 7. Fire and volume dampers are in place and open.
 - 8. Coil fins have been cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage has been minimized.
 - 12. Service and balance valves are open.
- B. Report any defects or deficiencies noted during performance of services to Architect/Engineer.
- C. Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.
- D. If, for design reasons, system cannot be properly balanced, report as soon as observed.

3.02 PREPARATION

- A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.
- B. Provide additional balancing devices as required.

3.03 INSTALLATION TOLERANCES

- A. Adjust air handling systems to plus or minus 5 percent for supply systems and plus or minus 10 percent for return and exhaust systems from figures indicated.
- B. Adjust hydronic systems to plus or minus 10 percent of design conditions indicated.

3.04 ADJUSTING

- A. Recorded data shall represent actually measured, or observed condition.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified

settings.

- E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

3.05 HYDROSTATIC TEST

- A. After completion of the installation, all piping shall be tested under 100 psi hydrostatic pressure, which shall be maintained for one hour without loss of pressure; after the system is proven tight and put in service, the contractor shall perform the equipment start-up and operating tests. All equipment shall be placed in complete operating condition subject to the approval of the Architect.

3.06 AIR BALANCE PROCEDURE

- A. All air quantities shall, after completion of the job, be adjusted to provide air quantities shown on plans. After complete adjustment, additional re-adjustment shall be performed if necessary to satisfy desired temperature.
- B. The balance procedure shall include the checking of each supply, return and exhaust fan. As a minimum, CFM, RPM and ampere readings shall be taken. Pulley adjustments, etc., shall be performed to obtain the required CFM readings.
- C. Air Balance Subcontractor shall also furnish all balancing instruments required. Air Balance Subcontractor shall provide one experienced technician to team with Contractor's technician to balance system. The Air Balance Subcontractor's Technician and the Contractor's Technician shall perform as a team during the entire field balancing operation.
- D. After all adjustments and corrections have been performed to balance system as designed and required, the Air Balance Subcontractor shall prepare and submit three (3) copies of completed balance form to Architect/Engineer for approval.
- E. At the time of balancing, the Air Balance Contractor's Technician shall verify that each device is the size and pattern submitted and includes accessories such as volume controls and 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 SYSTEM OPERATING TEST

- A. After the successful completion of all equipment start-up and individual item test requirements, formal tests shall be performed on the complete Mechanical systems, measurements shall be made and reports prepared as specified below. Provide all instruments, materials and labor to perform the tests and to obtain and record the measurements specified herein, including the furnishing of all required record forms. Submit for the Architect's approval the form on which the measurements specified herein have been recorded. Furnish all required record forms. Submit for the Architect's approval, complete shop drawings or catalog data for all instruments to be used for the final operating test, and obtain approval at least two weeks before the forms and instruments will be required. Sample forms can be provided by the Architect if the Contractor requests.
- B. First operating test by Contractor: Prove the operation of the Mechanical systems

and of each individual item in the systems. At least 10 days' notice shall be given the Architect of such tests. Should any item of the systems fail to perform in an approved manner, this test shall be repeated until the operating test is approved by the Architect. During this test, balance circulation of air and all other fluids conveyed to provide proper quantities to all items of equipment. Adjust and set all balancing cocks, valves, dampers and similar items to ensure that the systems perform as intended.

- C. Checking by Owner and Architect: Following the successful completion of first operating tests by the Contractor, the Owner and Architect shall have the privilege of making such tests as they may desire during a period of three weeks to ascertain if any corrections are to be made to the system. At the end of the testing by the Owner and Architect, the Architect shall direct the Contractor in writing to make such corrections to the systems as are within the Scope of the contract.
- D. Contractor's corrections to systems: Make all required corrections to the systems and notify the Architect in writing that the corrections outlined have been completed and give at least seven days' notice of a final operating test.
- E. Final operating test: An operating test shall then be performed by the Contractor to the satisfaction of the Architect. 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 final operating test.
 - 1. Electrical: Running ampere and voltage of each motor 3/4HP or larger.
 - 2. Air pressures at entrance and exit of each 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. Domestic hot water supply temperature at the fixtures closest to and farthest away from the domestic hot water heater on each system.
 - 6. Running ampere and voltage on recirculating pumps.
 - 7. Static pressure of cold-water line at building service connection.
- G. Report: Four copies of a written report of the final operating test, on the approved form of record, shall be submitted to the Architect for approval and subsequent transmittal to the Owner.

END OF SECTION 23 05 93

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Basic Requirements for Duct Insulation for HVAC Systems.

1.02 RELATED SECTIONS

- A. Section 23 31 00 – 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.

1.04 SUBMITTALS

- A. Submit under provisions of Division 01 and Section 23 05 00.
- B. Product Data: Provide product description, list of materials and thickness for each service, and locations.
- C. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

- A. Materials: Flame spread/smoke developed rating of 25/100 in accordance with NFPA 255.

1.06 QUALIFICATIONS

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

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 23 05 00.
- 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 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.

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.

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	THICKNESS
All supply, return, and ventilation air ducts, unless noted otherwise.	2 inches

3.05 RIGID GLASS FIBER DUCTWORK INSULATION SCHEDULE

DUCTWORK	THICKNESS
All ductwork in Mechanical Rooms Provide canvas jacket.	2 inches

3.06 FLEXIBLE GLASS FIBER DUCT LINER INSULATION SCHEDULE

DUCTWORK	THICKNESS

Supply and return ductwork as indicated
on the Drawings.

1 inch

END OF SECTION 23 07 13

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Basic Requirements for Piping Insulation for Heating, Ventilating, and Air Conditioning systems.

1.02 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.

1.03 SUBMITTALS

- A. Submit under provisions of Division 01 and Section 23 05 00.
- 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.

1.04 QUALITY ASSURANCE

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

1.05 QUALIFICATIONS

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

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 23 0500.

- B. Deliver materials to site in original factory packaging, labelled 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.

1.07 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 FOAM

- A. Insulation: SASTM C534; flexible, cellular elastomeric, tubing.
 - 1. "K" Value: ASTM C177 C518; 0.27 at 75 degrees F.
 - 2. Minimum Service Temperature: -40 degrees F.
 - 3. Maximum Service Temperature: 220 degrees F.
 - 4. Maximum Moisture Absorption: ASTM D1056; 1.0 percent pipe by volume, .0 percent sheet by volume.
 - 5. Moisture Vapor Transmission: ASTM E96, 0.20 perm inches.
 - 6. Maximum Flame Spread: ASTM E84; 25.
 - 7. Maximum Smoke Developed: ASTM E84; 25
 - 8. Connection: Waterproof vapor barrier adhesive.

2.03 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 Foam:
1. Armstrong Armaflex - FR.
 2. K-Flex USA.
 3. Architect Approved.

PART 3 - EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. On exposed piping, locate insulation and cover seams in least visible locations.
- C. Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:
 1. Provide vapor barrier jackets, factory applied or field applied.
 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe.
 3. Finish with glass cloth and vapor barrier adhesive.
 4. PVC fitting covers may be used.
 5. Continue insulation through walls, sleeves, pipe hangers, and other pipe 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.	Cooling Systems	
	Humidity Drain Piping	½ inch
B.	Refrigerant Piping	
	1. Liquid Pipe	½"
	2. Vapor Pipe (Indoor)	¾"
	3. Vapor Pipe (Outdoor)	1"

See Paragraph G above for exterior piping.

END OF SECTION 23 07 19

PART 1 GENERAL

1.0 SECTION INCLUDES

- 1.1 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION
- 1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION
- 1.3 PRODUCTS NOT FURNISHED OR INSTALLED UNDER BUT INTEGRATED WITH THE WORK OF THIS SECTION
- 1.4 BUILDING AUTOMATION SYSTEM - GENERAL DESCRIPTION
- 1.5 APPROVED CONTROL SYSTEM MANUFACTURES
- 1.6 QUALITY ASSURANCE
- 1.7 CODES AND STANDARDS
- 1.8 SYSTEM PERFORMANCE
- 1.9 SUBMITTAL REQUIREMENTS
- 1.10 WARRANTY REQUIREMENTS
- 1.11 OWNERSHIP OF PROPRIETARY MATERIAL
- 1.12 DEFINITIONS

1.1 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Section 23220 –Refrigeration Equipment
 - 1. Pressure Transmitters
 - 2. Temperature Transmitters
- B. Section 23240 –Air Handling Equipment
 - 1. Field Sensors
 - 2. Field mounted Operator Interface Devices

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Section 23500 – Refrigerant Piping
 - 1. Pressure and Temperature Sensor Wells and Sockets
- B. Section 23611 – Ductwork Accessories

1. Automatic Dampers
2. Airflow Stations
3. Terminal Unit Controls

1.3 BUILDING AUTOMATION SYSTEM - GENERAL DESCRIPTION

A. Provide a new Building Automation System (BAS) to integrate and control all mechanical equipment associated with this project.

1. The Building Automation System shall be as indicated on the drawings and described in these specifications. System must be fully integrated and coordinated with mechanical equipment DDC controllers furnished and installed in the equipment manufacturer's factory as specified in those sections. The intent of the BAS is to integrate all mechanical equipment into one system for global monitoring, control, and alarming associated with the building. It is the BAS manufacturer's responsibility to provide all the design, engineering, and field coordination required to ensure all equipment sequence of operations are met as specified and the designated BAS operators have the capability of managing the building mechanical system to ensure occupant comfort while maintaining energy efficiency.
2. The BAS shall meet open standard protocol communication standards (As defined in System Communications Section) to ensure the system maintains "interoperability" to avoid proprietary arrangements that will make it difficult for the Owner to consider other BAS manufacturers in future projects.
3. Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of mechanical systems and terminal devices on this project.
4. The BAS shall accommodate simultaneous multiple user operation. Access to the control system data should be limited only by the security permissions of the operator role. Multiple users shall have access to all valid system data. An operator shall be able to log onto any workstation on the control system and have access to all appropriate data.

1.4 APPROVED CONTROL SYSTEM MANUFACTURES

A. Approved BAS Manufacturers

1. Trane Tracer®— Basis of Design

1.5 QUALITY ASSURANCE

A. BAS Manufacturer Qualifications

1. The BAS manufacturer shall have an established business office within 50.00 miles of the project site and must provide 24 hours/day, 7 days/week response in the event of a customer warranty or service call.

2. The BAS Manufacturer shall have factory trained and certified personnel providing all engineering, service, startup, and commissioning field labor for the project from their local office location. BAS manufacturer shall be able to provide training certifications for all local office personnel upon request.

3. The BAS shall be provided by a single manufacturer and this manufacturer's equipment must consist of operator workstation software, Web-based hardware/software, Open Standard Protocol hardware/software, Custom application Programming Language, Graphical Programming Language, Building Controllers, Custom Application Controllers, and Application Specific Controllers. All other products specified herein (i.e., sensors, valves, dampers, actuators, etc.) need not be manufactured by the BAS manufacturer listed in this specification.

4. Independent representatives of BAS manufacturers are not acceptable. BAS vendor must be corporate owned entity of BAS manufacturer.

1.6 CODES AND STANDARDS

A. 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 shall be UL-916-PAZX listed.

2. National Electrical Code -- NFPA 70.

3. Federal Communications Commission -- Part J.

4. ASHRAE/ANSI 135-2012 (BACnet) - (System Level Devices) - Building Controllers shall conform to the listed version of the BACnet specification in order to improve interoperability with various building system manufacturers' control systems and devices.

5. ASHRAE/ANSI 135-2012 (BACnet) - (Unit Level Devices) - Unit Controllers shall conform to the listed version of the BACnet specification in order to improve interoperability with various building system manufacturers' control systems and devices.

1.7 SYSTEM PERFORMANCE

A. Performance Standards. The BAS system shall conform to the following:

1. Graphic Display. The system shall display a graphic with a minimum of 20 dynamic points. All current data shall be displayed within 10 seconds of the operator's request.

2. Graphic Refresh. The system shall update all dynamic points with current data within 10 seconds.

3. Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be 5 seconds. Analog objects shall start to adjust within 5 seconds.

4. Object Scan. All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or workstation will be current within the prior 10 seconds.
5. Alarm Response Time. The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed 10 seconds.
6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
7. Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every 5 seconds. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
8. Multiple Alarm Annunciations. All workstations on the network shall receive alarms within 5 seconds of each other.
9. Reporting Accuracy. Table 1 lists minimum acceptable reporting accuracies for all values reported by the specified system.

1.8 SUBMITTAL REQUIREMENTS

A. BAS manufacturer shall provide shop drawings and manufacturers' standard specification data sheets on all hardware and software being provided for this project. No work may begin on any segment of this project until the Engineer and Owner have reviewed submittals for conformity with the plan and specifications.

1. Provide electronic submittal package in PDF format for review and approval.

B. Quantities of items submitted shall be reviewed by the Engineer and Owner. Such review shall not relieve the BAS manufacturer of furnishing quantities required based upon contract documents.

C. Provide the Engineer and Owner, any additional information or data which is deemed necessary to determine compliance with the specifications or which is deemed valuable in documenting and understanding the system to be installed.

D. All shop drawings shall be provided to the Owner electronically as .dwg or .dxf file formats once they have been approved and as-built drawings have been completed.

E. Submit the following within 90 days of contract award:

1. A complete bill of materials of equipment to be used indicating quantities, manufacturers and model numbers.
2. A schedule of all control valves including the valve size, pressure drop, model number (including pattern and connections), flow, CV, body pressure rating, and location.

3. A schedule of all control dampers including damper size, pressure drop, manufacturer, and model number.

4. Provide all manufacturers' technical cut sheets for major system components. When technical cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Include:

- a. Building Controllers
- b. Custom Application Controllers
- c. Application Specific Controllers
- d. Operator Workstations
- e. Portable Operator Terminals
- f. Auxiliary Control Devices

5. Provide proposed Building Automation System architectural diagram depicting various controller types, workstations, device locations, addresses, and communication cable requirements

6. Provide detailed termination drawings showing all required field and factory terminations, as well as terminal tie-ins to DDC controls provided by mechanical equipment manufacturers. Terminal numbers shall be clearly labeled.

7. Provide a sequence of operation for each controlled mechanical system and terminal end devices.

8. Provide a BACnet Protocol Implementation Conformance Statement (PICS) for each BACnet system level device (i.e. Building Controller & Operator Workstations) type. This defines the points list for proper coordination of interoperability with other building systems if applicable for this project.

F. Project Record Documents: Upon completion of installation, submit three (3) copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and include:

- 1. Project Record Drawings - These shall be as-built versions of the submittal shop drawings. One set of electronic media including CAD .dwg and .pdf drawing files shall be provided.
- 2. Testing and Commissioning Reports and Checklists signed off by trained factory (equipment manufacturers) and field (BAS) commissioning personnel.

3. Operating and Maintenance (O & M) Manuals - These shall be as-built versions of the submittal product data. In addition to the information required for the submittals, Operating & Maintenance manual shall include:

- a. Procedures for operating the BAS including logging on/off, alarm management, generation of reports, trends, overrides of computer control, modification of setpoints, and other interactive system requirements.
- b. Explanation of how to design and install new points, new DDC controllers, and other BAS hardware.
- c. Documentation, installation, and maintenance information for all third party hardware/software products provided including personal computers, printers, hubs, sensors, valves, etc.
- d. Original issue media for all software provided, including operating systems, programming language, operator workstation software, and graphics software.
- e. Licenses, Guarantee, and Warranty documents for all equipment and systems.

G. Training Manuals: The BAS manufacturer shall provide a course outline and copies of training manuals at least two weeks prior to the start of any corporate training class to be attended by the Owner.

1.9 WARRANTY REQUIREMENTS

A. Warrant all work as follows:

- 1. BAS system labor and materials shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. BAS failures during the warranty period shall be adjusted, repaired, or replaced at no charge to the Owner. The BAS manufacturer shall respond to the Owner's request for warranty service within 24 hours of the initiated call and will occur during normal business hours (8AM-5PM).
- 2. At the end of the final start-up/testing, if equipment and systems are operating satisfactorily to the Owner and Engineer, the Owner shall sign certificates certifying that the BAS is operational, and has been tested and accepted in accordance with the terms of this specification. The date of Owner's acceptance shall be the start of the warranty period.
- 3. To ensure that the owner will have the most current operating system provided by the manufacturer, the BAS manufacturer shall include licensing and labor costs to facilitate software/firmware updates throughout the warranty period at no charge to the owner. These updates shall include upgrades for functional enhancements associated with the following: operator workstation software, project specific software, graphics, database, firmware updates, and all security related service packs. Written authorization by the Owner must be granted prior to the installation of these updates.

4. The BAS manufacturer shall provide a web-accessible Users Network for the proposed System and give the Owner free access to question/answer forum, user tips, upgrades, and training schedules for a one year period of time correlating with the warranty period.

1.10 OWNERSHIP OF PROPRIETARY MATERIAL

A. Project specific software and documentation shall become the owner's property upon project completion. This includes the following:

1. Operator Graphic files
2. As-built hardware design drawings
3. Operating & Maintenance Manuals
4. BAS System software database

1.11 DEFINITIONS

- A. DDC: Direct digital control
- B. I/O: Input/output.
- C. MS/TP: Manager Subordinate / Token Passing.
- D. POT: Portable Operator's Terminal.
- E. PID: Proportional plus integral plus derivative.
- F. RTD: Resistance temperature detector.
- G. BAS/ATC: Building Automation System/Automatic Temperature Controls.

PART 2 PRODUCTS

2.0 SECTION INCLUDES

- 2.1 MATERIALS:
- 2.2 SYSTEM COMMUNICATION
- 2.3 OPERATOR INTERFACE
- 2.4 BUILDING CONTROLLER SOFTWARE
- 2.5 VARIABLE AIR SYSTEM - BUILDING / SYSTEM CONTROLLERS
- 2.6 ADVANCED APPLICATION CONTROLLERS:
- 2.7 APPLICATION SPECIFIC CONTROLLERS:
- 2.8 APPLICATION CONTROLLER for Packaged Rooftop Units
- 2.9 VARIABLE AIR VOLUME TERMINAL UNIT CONTROLLERS

2.10 INPUT/OUTPUT INTERFACE:

2.11 POWER SUPPLIES:

2.12 AUXILLARY CONTROL DEVICES:

2.13 WIRING AND RACEWAYS:

2.1 MATERIALS:

A. Use new products that the manufacturer is currently manufacturing and that have been installed in a minimum of 25 installations. Do not use this installation as a product test site unless explicitly approved in writing by the owner or the owner's representative. Spare parts shall be available for at least five years after completion of this contract.

2.2 SYSTEM COMMUNICATION

A. Building Automation System (BAS) Communication

1. Each workstation, building controller, and equipment controller communication interface shall utilize the BACnet™ protocol with an Ethernet (IEEE 802.3), Wi-Fi (IEEE 802.11), RS485 (EIA-485), or Zigbee® (802.15.4) physical interface and an appropriate data link technology as defined in ANSI®/ASHRAE® Standard 135-2012. (e.g. BACnet over IP, BACnet over IPv6, BACnet SC, BACnet over MS/TP, BACnet Zigbee).
2. All system controllers shall be BTL listed as a BACnet Building Controller (B-BC) as defined in ANSI®/ASHRAE® Standard 135-2012.
3. Each System Controller shall communicate with a network of Custom Application and Application Specific Controllers utilizing one or more of the interfaces documented within Field Bus Communications below.
4. All system controllers shall be BTL listed as a BACnet Building Controller (B-BC) as defined in ANSI®/ASHRAE® Standard 135-2012.
5. All Operator Workstations (B-OWS, B-AWS) and Building Controllers (B-BC) shall support BACnet Secure Connect (BACnet SC), a secure and encrypted datalink layer specifically designed for those networks.

B. Field Bus Communications

1. BACnet™
 - a. All equipment and plant controllers shall be BTL listed as a BACnet Application Specific Controller (B-ASC) or a BACnet Advanced Application Controller (B-AAC) as defined in ANSI®/ASHRAE® Standard 135-2012.
 - b. All communication shall conform to ANSI®/ASHRAE® Standard 135-2012.

c. System Controller shall function as a BACnet router to each unit controller providing a globally unique BACnet Device ID for all BACnet controllers within the system.

d. BACnet Zigbee®

1) Communication between System Controller and equipment/plant controllers shall utilize BACnet Zigbee as defined in ANSI®/ASHRAE® Standard 135-2012.

2) Each equipment controller wireless communication interface shall self-heal to maintain operation in the event of network communication failure.

3) Each equipment controller wireless communication interface shall self-heal to maintain operation in the event of network communication failure.

e. BACnet MS/TP

1) Communication between System Controller and equipment/plant controllers shall utilize BACnet MS/TP as defined in ANSI®/ASHRAE® Standard 135-2012.

2.3 OPERATOR INTERFACE

A. Provide Building Operator Web Interface

1. Manufacturer shall provide a user interface with time-of-day schedules, data collection, dashboards, reports and building summary, system applications, and self-expiring timed overrides. Manufacturer shall provide a published user and applications guide(s) that detail the system application operation, configuration, setup and troubleshooting.

2. The building operator web interface shall be accessible via a web browser without requiring any “plug-ins” (i.e. JAVA Runtime Environment (JRE), Adobe Flash).

3. User Roles

a. The system shall include pre-defined “roles” that allow a system administrator to quickly assign permissions to a user.

b. User login/logoff attempts shall be recorded.

c. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.

4. On-Line Help and Training

a. Provide a context sensitive, on line help system to assist the operator in operation and configuration of the system.

b. On-line help shall be available for all system functions and shall provide the relevant data for each particular screen.

5. Equipment and Application Pages

a. The building operator web interface shall include standard pages for all equipment and applications. These pages shall allow an operator to obtain information relevant to the operation of the equipment and/or application, including:

- 1) Animated Equipment Graphics for each major piece of equipment and floor plan in the System. This includes:
 - a) Animated Equipment Graphics for each major piece of equipment and floor plan in the System. This includes:
 - b) Animation capabilities shall include the ability to show a sequence of images reflecting the position of analog outputs, such as valve or damper positions. Graphics shall be capable of launching other web pages.
- 2) Alarms relevant to the equipment or application without requiring a user to navigate to an alarm page and perform a filter.
- 3) Historical Data (As defined in Trend Logs section of CONTROLLER SOFTWARE) for the equipment or application without requiring a user to navigate to a Data Log page and perform a filter.

b. VAV Air System. An operator shall be able to view and control (where applicable) the following parameters via the building operator web interface:

- 1) System Mode
- 2) System Occupancy
- 3) System Occupancy
- 4) Ventilation (Outdoor air flow) status
- 5) Air Handler Static pressure setpoint
- 6) Air Handler Static pressure status
- 7) Air Handler occupancy status
- 8) Air Handler Supply air cooling and heating set points
- 9) Air Handler minimum, maximum and nominal static pressure setpoints
- 10) VAV box minimum and maximum flow
- 11) VAV box drive open and close overrides
- 12) VAV box occupancy status

- 13) VAV box Airflow to space
- 14) Average space temperature
- 15) Minimum space temperature
- 16) Maximum space temperature

c. System Graphics. Building operator web interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using colors to represent zone temperature relative to zone set point.

- 1) Graphic imagery – graphics shall use 3D images for all standard and custom graphics. The only allowable exceptions will be photo images, maps, schematic drawings, and selected floor plans.
- 2) Animation. Graphics shall be able to animate by displaying different Image lies for changed object status.
- 3) Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.

d. Graphics Library. Furnish a library of standard HVAC equipment such as chillers, air handlers, terminals, fan coils, unit ventilators, rooftop units, and VAV boxes, in 3-dimensional graphic depictions. The library shall be furnished in a file format compatible with the graphics generation package program.

e. Manual Control and Override

- 1) Point Control. Provide a method for a user to view, override, and edit if applicable, the status of any object and property in the system. The point status shall be available by menu, on graphics or through custom programs.
- 2) Temporary Overrides. The user shall be able to perform a temporary override wherever an override is allowed, automatically removing the override after a specified period of time.
- 3) Override Owners. The system shall convey to the user the owner of each override for all priorities that an override exists.
- 4) Provide a specific icon to show timed override or operator override, when a point, unit controller or application has been overridden manually.

f. Scheduling. - The scheduling application shall provide graphical representation of the day, week, month and exception events.

g. Alarm/Event Notification

- 1) Alarm/Event Log. The operator shall be able to view all logged system alarms/events from any building operator web interface.
 - a) The operator shall be able to sort and filter alarms from events. Alarms shall be sorted in a minimum of 4 categories based on severity.
 - b) The operator shall be able to acknowledge and add comments to alarms
 - c) Alarm/event messages shall use full language, easily recognized descriptors.
- 2) Alarm Suppression. Alarms shall be able to be suppressed based on load/source relationships to present the likely root cause to the building operator as described in ASHRAE Guideline 36. Load/Source relationships shall be configurable by the user through a web interface.

h. Reports and Logs.

- 1) The building operator web interface shall provide a reporting package that allows the operator to select reports.
- 2) The building operator web interface shall provide the ability to schedule reports to run at specified intervals of time.
- 3) The following standard reports shall be available without requiring a user to manually configure the report:
 - a) All Points in Alarm Report: Provide an on-demand report showing all current alarms.
 - b) All Points in Override Report: Provide an on-demand report showing all overrides in effect.
 - c) Commissioning Report: Provide a one-time report that lists all equipment with the unit configuration and present operation.
 - d) Points report: Provide a report that lists the current value of all points
- 4) The controls vendor shall provide a hardening report that summarizes the port configuration details to ensure sites have not been exposed to the Internet in alignment with Cyber Security best practices.

B. Provide Mobile App Interface

1. Provide mobile (smart phone or tablet) interfaces to the building automation system, compatible with iOS and Android™ operating systems.

2. Controls manufacturer shall provide a phone/tablet interface with the ability to view/override status and setpoints, view/change schedules, view/acknowledge/comment on alarms, and view graphics for all spaces and equipment.
3. This phone/tablet interface shall resize itself appropriately for the size of the interface (i.e. no "pinching and zooming" required).
4. This phone/tablet interface shall function remotely from the facility while following IT security best practices (e.g. no ports exposed to the internet).
5. The operator interface shall support system access on a mobile device via a mobile app to:
 - a. Alarm log
 - b. System Status
 - c. Equipment status
 - d. Space Status
 - e. Standard Equipment graphics
 - f. Override set points
 - g. Override occupancy
 - h. Acknowledge Alarms
 - i. Add Comment(s) to Alarms

2.4 BUILDING CONTROLLER SOFTWARE

A. Manufacturer shall provide standard applications to deliver HVAC system control. Standard applications include Time of Day Scheduling with Optimal Start/Stop, VAV Air Systems Control, Chiller Plant Control, Historical Trend Logs and Trim and Respond. Manufacturer shall provide system optimization strategies for functions such as fan pressure optimization and ventilation optimization.

B. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the building operator interface.

1. VAV Air Systems Applications

- a. The BAS shall provide air system applications that coordinate air handlers (AHU)/rooftop units (RTU) and Variable Air Volume Terminal equipment.
- b. The air system applications shall perform the following functions:

- 1) Startup and shutdown the air handler safely. Ensure the VAV boxes are open sufficiently when the air handler is running, to prevent damage to the ductwork and VAV boxes due to high air pressure.
 - 2) Fan Pressure Optimization - Minimize energy usage by controlling system static pressure to the lowest level while maintaining zone airflow requirements.
 - 3) During commissioning, and with the engineer/owner, the controls contractor shall confirm the performance of Fan Pressure Optimization by conducting a field functional test that demonstrates critical zone reset.
 - 4) Ventilation Optimization (ASHRAE 62) – properly ventilate all spaces while minimizing operating energy costs, using measured outdoor air flow. Dynamically calculate the system outdoor air requirement based on “real time” conditions in the spaces (i.e., number of occupants, CO2 levels, etc.) minimizing the amount of unconditioned outdoor air that must be brought into the building.
 - 5) Demand Controlled Ventilation – the active ventilation setpoint shall modulate between the occupied ventilation and occupied standby ventilation setpoint; Resetting the setpoint based on CO2 levels in the space.
 - 6) Discharge Air Temperature Reset (ASHRAE 90.1, Guideline 36) - Minimize energy usage by controlling discharge air temperature in response to building loads and outdoor air temperature.
- c. The Air Systems application shall provide a user interface that includes status of current system operation with real time data of key operating parameters. Key operating parameters:
- 1) Duct Static Pressure
 - 2) Duct Static Optimization Setpoint
 - 3) Outdoor Airflow
 - 4) Ventilation Optimization Setpoint
 - 5) Duct Static Optimization Maximum VAV Damper/Source VAV Box
 - 6) Ventilation Optimization Maximum VAV Vent Ratio/Source VAV box
- d. The air system application status screens shall explain what optimization calculations are occurring, critical parameters, and source equipment members. The optimization status, inputs, and results shall be displayed for VAV Ventilation Optimization (calculating proper outside air intake), VAV Discharge Air Temperature Optimization (calculating proper discharge air temperature) and VAV Duct Static Pressure Optimization (calculating proper fan static pressure).

e. The air systems applications shall provide a user interface that enables configuration changes made by swipe and type fields, selection list, and check box entry for feature definition:

- 1) VAV Auxiliary Night Heat
- 2) VAV Source Temperature Distribution
- 3) Changeover System control
- 4) Start/Stop Delay operation
- 5) Enable/Disable Optimization Strategies (Duct Static Optimization, Discharge Air Temperature Optimization and Ventilation Optimization)

f. The air system application vendor shall provide a published applications guide that details the air system application operation, configuration, setup, and troubleshooting. The applications guide documentation shall be maintained under version control and updated by the manufacture to reflect most recent feature updates as made available. Contents of the guide shall include:

- 1) Description of System Operation
- 2) Required Components
- 3) Sequences of Operation
- 4) Installation
- 5) Controller Setup
- 6) Required Programming
- 7) Commissioning
- 8) Optimization Strategies
- 9) Special Applications
- 10) Troubleshooting

g. The air system application shall present in plain user language the current operation with source zone information and reset events.

2. Trend Logs

a. The system shall harvest trend logs for defined key measurements for each controlled HVAC device and HVAC application. Trend logs shall be captured for a minimum of 5 key operating points for each piece of HVAC equipment and HVAC application and stored for no less than 1 year at 15-minute intervals. Data Logs shall be capable of being configured on an interval or change of value basis.

1) Fan Coil / Cabinet Unit Heater / Unit Ventilator / WSHP Unit

- a) Discharge Air Temperature
- b) Space Temperature Active
- c) Space Temperature Setpoint Active
- d) Air Flow Setpoint Active
- e) Discharge Air Flow

2) Air Handling Unit/Rooftop (VAV)

- a) Discharge Air Temperature
- b) Discharge Air Temperature Setpoint Active
- c) Space Temperature Active
- d) Cooling Capacity Status
- e) Discharge Air Flow

3) Air Handling Unit/Rooftop (CV)

- a) Discharge Air Temperature
- b) Space Temperature Active
- c) Space Temperature Setpoint Active
- d) Cooling Capacity Status
- e) Heating Capacity Primary Status
- f) Outdoor Air Damper Position

4) VAV Terminal Unit

- a) Discharge Air Temperature
- b) Space Temperature Active
- c) Space Temperature Setpoint Active
- d) Air Flow Setpoint Active
- e) Discharge Air Flow

5) Variable Air System (VAS)

- a) VAS Operating Mode
- b) Duct Static Optimization Duct Static Setpoint

- c) Duct Pressure Optimization Maximum
- d) Space Temperature Average
- e) Ventilation Optimization Air Setpoint

2.5 VARIABLE AIR SYSTEM - BUILDING / SYSTEM CONTROLLERS

A. There shall be one or more independent, standalone microprocessor based System Controllers to manage the global strategies described in CONTROLLER SOFTWARE section.

1. The controller shall provide a USB communications port for connection to a PC.
2. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
3. All System Controllers shall have a real time clock and shall be able to accept a BACnet time synchronization command for automatic time synchronization.
4. Data shall be shared between networked System Controllers.
5. Serviceability – The System Controller shall have a display on the main board that indicates the current operating mode of the controller.

B. Controls manufacturer shall provide secure remote access to the Building Automation System (BAS). Secure remote access shall not require IP ports to be "exposed" (i.e. port-forwarded or external public IP addresses) to the Internet. Controls manufacturer shall update secure remote access software as necessary to follow cyber security best practices and respond to cyber security events.

2.6 ADVANCED APPLICATION CONTROLLERS:

A. Advance Application Controllers shall be used to control all equipment or applications of medium and high complexity, including but not limited to Air Handlers, Boiler Plants and Chiller Plants.

B. The Advanced Application Controller shall be capable of operating as a stand-alone controller or as a member of a Building Automation System (BAS).

C. When the Advanced Application Controller is operating as a member of a Building Automation System (BAS), the application controller shall operate as follows:

1. Application Controller will receive operation mode commands from the BAS network controller. The BAS commands shall include but not be limited to the follow: Occupied Heat/Cool, Unoccupied Heat/Cool, Morning Warm-up, / Pre-cool, Occupied Bypass).
2. Application Controller will provide equipment status parameters to the BAS through BACnet communication.

3. Application Controller will operate as a stand-alone controller in the event of communication failure with the BAS.
4. In case of communications failure, stand-alone operation shall use default values or last known values for remote sensors read over the network such as outdoor air temperature.

D. For Stand-Alone Operation of Advanced Application Controllers:

1. Shall operate a schedule in a standalone application using a Real Time Clock with a 7 day power backup.
 - a. The Controller shall have a built in schedule (assessable with or without a display)
 - b. Support will be for at least 3 schedules with up to 10 events for each day of the week.
 - c. Each of the 3 schedules can be Analog, Binary or Multi-State
 - d. The controller shall support a minimum of 25 exceptions each with up to 10 events.

E. For ease of troubleshooting, the Controller shall support data trend logging.

1. With a minimum of 20,000 trending points total on a controller
2. Trends shall be capable of being collected at a minimum sample rate of once every second
3. Shall be capable of trending all BACnet points used by controller
4. Trends shall be capable of being scheduled or triggered.

F. To meet the sequence of operation for each application, the Controller shall use library programs provided by the controller manufacturer that are either factory loaded or downloaded with service tool to the controller.

G. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.

1. Operating conditions:
 - a. Temperature: -40°F to 158°F (-40°C to 70°C)
 - b. Relative Humidity: 5% to 100% RH (non-condensing)
2. Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum.
3. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40° F to 158° F [-40° C to 70° C].

H. Input/Output: The Controller shall have on board or through expansion module all I/O capable of performing all functionality needed for the application. Controls provided by the equipment manufacture must supply the required I/O for the equipment. In addition other controls must meet the following requirements:

1. Shall support flexibility in valve type, the controllers shall be capable of supporting the following valve control types: 0-10VDC, 0-5VDC, 4-20mA, 24VAC - 2 position.
2. Shall support flexibility in sensor type, the Controller shall be capable of reading sensor input ranges of 0 to10V, 0 to 20mA, 50ms or longer pulses, 200 to 20Kohm and RTD input.
3. Shall support flexibility in sensor type, all Analog Outputs shall have the additional capability of being programmed to operate as Universal Inputs or Pulse Width Modulation Outputs.
4. Shall support flexibility in sensor type, the Controller and/or expansion modules shall support dry and wetted (24VAC) binary inputs.
5. The controller shall support pulse accumulator for connecting devices like energy meters.
6. In order to support a wide range of devices, the Controller's binary output shall be able to drive at least 10VA each.
7. For future needs, any unused I/O that is not needed for the functionality of the equipment shall be available to be used by custom programs on the Controller and by any other controller on the network.
8. The Controller shall provide 24VAC and 24VDC power terminals sensors and other devices required.
9. The Controller shall provide a dedicated static pressure input.

I. Input/Output Expandability – The Controller shall provide the following functionality in order to meet current and future application needs:

1. For the application flexibility, the Controller shall be capable of expanding to a total of at least 100 hardware I/O terminations.
2. Expansion I/O can be mounted up to 650 ft. (200m) from control.
3. For optimized system operation, expansion I/O must communicate via an internal controller communication bus (point expansion via the BACnet MS/TP network is not allowed).

J. Serviceability – The Controller shall provide the following in order to improve serviceability of the Controller.

1. Diagnostic LEDs for power/normal operation/status, BACnet communications, sensor bus communications, and binary outputs. All wiring connections shall be clearly labeled and made to be field removable.
2. Binary and analog inputs and outputs shall use removable connectors or be connected to terminal strip external to the control box.
3. Software service tool connection through the following methods: direct cable connection to the Controller, connection through another controller on BACnet link
4. For safety purposes, the controller shall be capable of being powered by a portable computer's USB port for the purposes of configuration, programming and testing programs so that this work can be accomplished with the power off to the associated equipment.
5. The Controller software tool service port shall utilize standard off-the-shelf USB printer cable.
6. Capabilities to temporarily override the BACnet point values with built-in time expiration in the Controller.
7. To aid in service replacement, the Controller shall easily attached to standard DIN rail mounting.
8. For future expansion, the Controller shall be capable of adding sequence of operation programming utilizing service tools software with a graphical programming interface (editing or programming in line code is not permissible).
9. To aid in service replacement, the Controller shall allow for setting its BACnet address via controller mounted rotary switches that correspond to the numerical value of the address. (DIP switch methodologies are not allowed). Setting of the address shall be accomplished without the need of a service tool or power applied to the controller.
10. Controller data shall be maintained through a power failure.

K. Software Retention: All Controller operating parameters, setpoints, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.

L. Controller must meet the following Agency Compliance:

1. UL916 PAZX, Open Energy Management Equipment
2. UL94-5V, Flammability
3. FCC Part 15, Subpart B, Class B Limit
4. BACnet Testing Laboratory (BTL) listed as BACnet Advanced Application Controller (B-AAC)

2.7 APPLICATION SPECIFIC CONTROLLERS:

A. General Description

1. Application Specific Controllers (ASC) shall be microprocessor-based DDC controllers which, through hardware or firmware design, control specified equipment. They are not user programmable, but are customized for operation within the confines of the equipment they are designed to serve.

2. Zone Controllers are controllers that operate equipment that control the space temperature of single zone. Examples are controllers for VAV, Fan coil, Blower Coils, Unit Ventilators, Heat Pumps, and Water Source Heat Pumps.

B. The Application Specific Controller shall be capable of operating as a stand-alone controller or as a member of a Building Automation System (BAS).

C. When the Application Specific Controller is operating as a member of a Building Automation System (BAS), the application controller shall operate as follows:

1. Application Controller will receive operation mode commands from the BAS network controller. The BAS commands shall include but not be limited to the follow: Occupied Heat/Cool, Unoccupied Heat/Cool, Morning Warm-up, / Pre-cool, Occupied Bypass).

2. Application Controller will provide equipment status parameters to the BAS through BACnet communication.

3. Application Controller will operate as a stand-alone controller in the event of communication failure with the BAS.

4. In case of communications failure stand-alone operation shall use default values or last known values for remote sensors read over the network such as outdoor air temperature.

D. Stand-Alone Operation: Each piece of equipment specified in section “A” shall be controlled by a single controller and provide stand-alone control in the event that a BAS is not present.

E. Software

1. To meet the sequence of operation for each zone control, the controller shall use programs developed and tested by the controller manufacturer that are either factory loaded or downloaded with service tool to the controller.

2. For controlling ancillary devices and for flexibility to change the sequence of operation in the future, the controller shall be capable running custom programs written in a graphical programming language.

F. Environment: Controller hardware shall be suitable for the anticipated ambient conditions.

1. Storage: -55° to 203° F (-48° to 95° C) and 5 to 95% Rh, non-condensing.
2. Operating: -40° to 158° F (-40 to 70° C) and 5 to 95% Rh, non-condensing.
3. Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum.
4. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40° to 158° F [-40° to 70° C].

G. Input/Output:

1. For flexibility in selection and replacement of valves, the controllers shall be capable of supporting all of the following valve control types 0-10VDC, 0-5VDC, 4-20mA, 24VAC floating point, 24VAC - 2 position (Normally Open or Normally Closed).
2. For flexibility in selection and replacement of sensors, the controllers shall be capable of reading sensor input ranges of 0 to 10V, 0 to 20mA, pulse counts, and 200 to 20Kohm.
3. For flexibility in selection and replacement of binary devices, the controller shall support dry and wetted (24VAC) binary inputs.
4. For flexibility in selection and replacement devices, the controller's shall have binary output which are able to drive at least 12VA each.
5. For flexibility in selection and replacement of motors, the controller shall be capable of outputting 24VAC (binary output), DC voltage (0 to 10VDC minimum range) and PWM (in the 80 to 100 Hz range).
6. For future needs, any I/O that is unused by functionality of equipment control shall be available to be used by custom program on the controller and by another controller on the network.
7. For future expansion and flexibility, the controller shall have either on board or through expansion, 20 hardware input/output points. Expansion points must communicate with the controller via an internal communications bus. Expansion points must be capable of being mounted up to 650ft. (200 m) from the controller. Expansion points that require the BACnet network for communication with the controller are not allowed.

H. Serviceability – The controller shall provide the following in order to improve serviceability of the controller.

1. Diagnostic LEDs shall indicate correct operation or failures/faults for all of the following: power, sensors, BACnet communications, and I/O communications bus.
2. All binary output shall have LED's indicating the output state.
3. All wiring connectors shall be removable without the use of a tool.

4. Software service tool connection through all of the following methods: direct cable connection to the controller, connection through another controller on BACnet link
5. For safety purposes, the controller shall be capable of being powered by a portable computer for the purposes of configuration, programming, and testing programs so that this work can be accomplished with the power off to the equipment.
6. Capabilities to temporarily override of BACnet point values with built-in time expiration in the controller.
7. BACnet MAC Address shall be set using decimal (0-9) based rotary switches.
 - a. Configuration change shall not be made in a programming environment, but rather by a configuration page utilizing dropdown list, check boxes, and numeric boxes.
8. For ease of troubleshooting, the Controller shall support BACnet data trend logging.
 - a. With a minimum of 20,000 trending points total on controller
 - b. Trends shall be capable of being collected at a minimum sample rate of once every second.
 - c. Shall be capable of trending all BACnet points used by controller
 - d. Trends shall be capable of being scheduled or triggered
- I. Software Retention: All Zone Controller operating parameters, setpoints, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.
- J. Application controller shall meet the following Agency Compliance:
 1. UL916 PAZX, Open Energy Management Equipment
 2. UL94-5V, Flammability
 3. FCC Part 15, Subpart B, Class B Limit
 4. BACnet Testing Laboratory (BTL) listed as BACnet Application Specific Controller (B-ASC)

2.8 APPLICATION CONTROLLER for Packaged Rooftop Units

- A. The Rooftop Unit (RTU) Application Controller shall be a microprocessor-based DDC controller which, through hardware or firmware design, controls specified equipment. The controller is not user programmable, but is customized for operation within the confines of the equipment it is designed to serve.
- B. The Application Controller shall be capable of operating as a stand-alone controller or as a member of a Building Automation System (BAS).

C. When the Application Controller is operating as a member of a Building Automation System (BAS), the application controller shall operate as follows:

1. Application Controller will receive operation mode commands from the BAS network controller. The BAS commands shall include but not be limited to the follow: Occupied Heat/Cool, Unoccupied Heat/Cool, Morning Warm-up, / Pre-cool, Occupied Bypass).
2. Application Controller will provide equipment status parameters to the BAS through BACnet communication.
3. Application Controller will operate as a stand-alone controller in the event of communication failure with the BAS.
4. In case of communications failure stand-alone operation shall use default values or last known values for remote sensors read over the network such as outdoor air temperature.

D. Software

1. To meet the sequence of operation for each zone control, the controller shall use programs developed and tested by the controller manufacturer that are either factory loaded or customized with use of service tool native to the controller.

E. Environment: Controller hardware shall be suitable for the anticipated ambient conditions.

1. Storage: -55° to 203° F (-48° to 95° C) and 5 to 95% Rh, non-condensing.
2. Operating: -40° to 158° F (-40 to 70° C) and 5 to 95% Rh, non-condensing.
3. Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum.
4. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40° to 158° F [-40° to 70° C].

F. Controller Input/Output: The controller shall have on board capable of performing all functionality needed for the application. Controls provided by the equipment manufacture must supply the required I/O for the equipment.

1. For flexibility in selection and replacement of valves, the controllers shall be capable of supporting all of the following output types; 0-10VDC, 0-5VDC, 4-20mA, Binary.
2. For flexibility in selection and replacement of sensors, the controllers shall be capable of reading sensor input ranges of 0 to 10V, 0 to 20mA, Pulse counts, and 200 to 20Kohm.

G. Serviceability – The controller shall provide the following in order to improve serviceability of the controller.

1. Diagnostic LEDs shall indicate correct operation or failures/faults for all of the following: power, sensors, BACnet communications, and I/O communications bus.

2. All binary output shall have LED's indicating the output state.
3. All wiring connectors shall removable without the use of a tool.
4. Software service tool connection through the following methods: direct cable connection to the controller, connection through another controller on BACnet link.

H. Software Retention: All Zone Controller operating parameters, setpoints, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.

I. Controller shall meet the following Agency Compliance:

1. UL916 PAZX, Open Energy Management Equipment
2. UL94-5V, Flammability
3. FCC Part 15, Subpart B, Class B Limit
4. BACnet Testing Laboratory (BTL) listed

2.9 VARIABLE AIR VOLUME TERMINAL UNIT CONTROLLERS

A. General Description

1. Variable Air Volume (VAV) controllers shall be microprocessor-based DDC controllers which, through hardware or firmware design, control specified equipment. They are typically not user programmable, but are configurable for operation of VAV terminal units.
2. Variable Air Volume (VAV) controllers are controllers that operate equipment that control the space temperature of single zone.

B. The VAV controller shall be capable of operating as a stand-alone controller or as a member of a Building Automation System (BAS).

C. When the VAV controller is operating as a member of a Building Automation System (BAS), the application controller shall operate as follows:

1. The VAV controller will receive operation mode commands from the BAS network controller. The BAS commands shall include but not be limited to the following: Occupied Heat/Cool, Unoccupied Heat/Cool, Morning Warm-up, / Pre-cool, Occupied Bypass).
2. The VAV controller will provide equipment status parameters to the BAS through BACnet communication.
3. The VAV controller will operate as a stand-alone controller in the event of communication failure with the BAS.

4. In case of communications failure stand-alone operation shall use default values or last known values for remote sensors read over the network such as outdoor air temperature.

D. Stand-Alone Operation: Each VAV Terminal Unit shall be controlled by a single controller and provide stand-alone control in the event that a BAS is not present.

E. The VAV controller shall communicate to the building automation system via one of the following protocols: BACnet™ MS/TP or BACnet™ Zigbee defined in ANSI®/ASHRAE® Standard 135-2020

1. BACnet™ MS/TP

a. To allow maximum communications speed and co-existence with other controllers, the controller shall support at a minimum the following BACnet MS/TP manager baud rates: 9600, 19200, 38400, 76800.

2. BACnet™ Zigbee

a. VAV controller wireless communication interface shall self-form and self-heal to maintain operation in the event of network communication failure.

b. IEEE 802.15.4 radios to minimize risk of interference, reliability, and range.

c. Operating range shall be a minimum of 200 feet; open range shall be 2,500 ft. (762 m) with less than 2% packet error rate.

d. To protect against harmful interference, certifications shall include Energy Management Equipment FCC CFR47, Section 15.247 & subpart E, Digital Modulation Transmission with no SAR (FCC ID: TPF-251701)

F. Each VAV terminal unit shall use a space zone sensor(s) to measure the space condition it is serving.

1. The VAV controller shall use a wired or wireless communication interface to connect to its space zone sensor.

2. Each zone sensor communication interface shall be capable of many-to-one sensors per controller to support averaging, monitoring, and multiple zone applications. Sensing options shall include temperature, relative humidity, CO2, and occupancy.

3. Wireless zone sensors

a. To check for proper operation, wireless zone temperature sensors shall include a signal strength and battery condition indicators on the zone sensor.

b. The wireless zone sensor battery life shall provide at least 15 years life under normal operating conditions and must be readily available Lithium size AA, 1.5V.

- c. The wireless zone sensor and receiver addresses shall be held in non-volatile memory to ensure operation through system voltage disturbances and to minimize the risk of incorrect association.
- d. To ensure proper system performance, the wireless zone sensor shall automatically determine when the space temperature is rapidly changing. When the space temperature is readily changing, the space temperature shall be transmitted at least once each 30 seconds. The maximum time between transmissions shall be 15 minutes.
- e. Zone temperature sensing accuracy shall be +/- 0.5F (+/- 0.28C).

G. Software

- 1. To meet the sequence of operation for each zone control, the controller shall use programs developed and tested by the controller manufacturer that are either factory loaded or downloaded with service tool to the controller.
- 2. For controlling ancillary devices and for flexibility to change the sequence of operation in the future, the controller shall be capable running custom programs written in a graphical programming language.

H. Environment: Controller hardware shall be suitable for the anticipated ambient conditions.

- 1. Storage: -55° to 203° F (-48° to 95° C) and 5 to 95% Rh, non-condensing.
- 2. Operating: -40° to 158° F (-40 to 70° C) and 5 to 95% Rh, non-condensing.
- 3. Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum.
- 4. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40° to 158° F [-40° to 70° C].

I. Input/Output:

- 1. For flexibility in selection and replacement of valves, the controllers shall be capable of supporting all of the following valve control types 0-10VDC, 0-5VDC, 4-20mA, 24VAC floating point, 24VAC - 2 position (Normally Open or Normally Closed).
- 2. For flexibility in selection and replacement of sensors, the controllers shall be capable of reading sensor input ranges of 0 to 10V, 0 to 20mA, and 200 to 20Kohm.
- 3. For flexibility in selection and replacement of binary devices, the controller shall support dry and wetted (24VAC) binary inputs.
- 4. For flexibility in selection and replacement devices, the controller shall have binary output which are able to drive at least 12VA each.

5. For flexibility in selection and replacement of motors, the controller shall be capable of outputting 24VAC (binary output), DC voltage (0 to 10VDC minimum range) and PWM (in the 80 to 100 Hz range).

J. Serviceability – The controller shall provide the following in order to improve serviceability of the controller.

1. Diagnostic LEDs shall indicate correct operation or failures/faults for all of the following: power, sensors, BACnet communications, and I/O communications bus.
2. All binary output shall have LED's indicating the output state.
3. All wiring connectors shall removable without the use of a tool.
4. Software service tool connection through all of the following methods: direct cable connection to the controller, connection through another controller on BACnet link and through the controller's zone sensor.
5. For safety purposes, the controller shall be capable of being powered by a portable computer for the purposes of configuration, programming, and testing programs so that this work can be accomplished with the power off to the equipment.
6. Capabilities to temporarily override of BACnet point values with built-in time expiration in the controller.
7. BACnet MAC Address shall be set using decimal (0-9) based rotary switches.
 - a. Configuration change shall not be made in a programming environment, but rather by a configuration page utilizing dropdown list, check boxes, and numeric boxes.
8. For ease of troubleshooting, the Controller shall support BACnet data trend logging.
 - a. Trends shall be capable of being collected at a minimum sample rate of once every second.
 - b. Shall be capable of trending all BACnet points used by controller
 - c. Trends shall be capable of being scheduled or triggered

K. Software Retention: All Zone Controller operating parameters, setpoints, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.

L. Controller shall meet the following Agency Compliance:

1. UL916 PAZX, Open Energy Management Equipment
2. UL94-5V, Flammability
3. FCC Part 15, Subpart B, Class B Limit

4. AS/NZS CISPR 32:2016

5. VCCI-CSPR 32:2016

6. CAN ICES-003(B)/NMB-003(B)

7. To ensure integration to the building automation system the controller must be BTL (BACnet Testing Lab) listed. The following BACnet profiles are in order of most functionality (B-BC) to least functionality (B-ASC).

a. BACnet Building Controller (B-BC)

b. BACnet Advance Applications Controller (B-AAC)

c. BACnet Application Specific Controller (B-ASC)

2.10 INPUT/OUTPUT INTERFACE:

A. Hardwired inputs and outputs may tie into the system through building, custom application, or ASCs.

B. All input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.

C. Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against the effects of contact bounce and noise. Binary inputs shall sense “dry contact” closure without external power (other than that provided by the controller) being applied.

D. Pulse accumulation input objects. This type of object shall conform to all the requirements of binary input objects and also accept up to 10 pulses per second for pulse accumulation.

E. Analog inputs shall allow the monitoring of low voltage (0 to 10 VDC), current (4 to 20 mA), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with and field configurable to commonly available sensing devices.

F. Binary outputs shall provide for on/off operation or a pulsed low-voltage signal for pulse width modulation control. Binary outputs on building and custom application controllers shall have status lights. Outputs shall be selectable for either normally open or normally closed operation.

G. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10VDC or a 4 to 20 mA signal as required to provide proper control of the output device. Analog outputs shall not exhibit a drift of greater than 0.4% of range per year.

H. Tri-State Outputs. Provide tri-state outputs (two coordinated binary outputs) for control of three-point floating type electronic actuators without feedback. Use of three-point floating devices shall be limited to zone control and terminal unit control applications (VAV terminal units, duct-mounted heating coils, zone dampers, radiation, etc.). Control algorithms shall run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.

I. System Object Capacity. The system size shall be expandable to at least twice the number of input/ output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The operator interfaces installed for this project shall not require any hardware additions or software revisions in order to expand the system.

2.11 POWER SUPPLIES:

A. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish overcurrent protection in both primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.

1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in overvoltage and overcurrent protection and shall be able to withstand a 150% current overload for at least three seconds without trip-out or failure.

a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MIL-STD 810C for shock and vibration.

b. Line voltage units shall be UL recognized and CSA approved.

2.12 AUXILIARY CONTROL DEVICES:

A. Motorized dampers, unless otherwise specified elsewhere, shall be as follows:

1. Damper frames shall be 16 gauge galvanized sheet metal or 1/8" extruded aluminum with reinforced corner bracing.

2. Damper blades shall not exceed 8" in width or 48" in length. Blades are to be suitable for medium velocity performance (2,000 fpm). Blades shall be not less than 16 gauge.

3. Damper shaft bearings shall be as recommended by manufacturer for application.

4. All blade edges and top and bottom of the frame shall be provided with compressible seals. Side seals shall be compressible stainless steel. The blade seals shall 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 shall not be larger than 48" x 60". Provide a minimum of one damper actuator per section.

B. Control dampers shall be parallel or opposed blade types as scheduled on drawings.

C. Electric damper/valve actuators

1. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.

2. Where shown, for power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.

3. All rotary spring return actuators shall be capable of both clockwise or counter clockwise spring return operation. Linear actuators shall spring return to the retracted position.

4. Proportional actuators shall 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 non-spring return actuators shall 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 shall have a manual crank for this purpose.

6. Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.

7. Actuators shall be Underwriters Laboratories Standard 873 listed.

8. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque.

D. Binary Temperature Devices

1. Low-voltage space thermostat shall be 24 V, bimetal-operated, mercury-switch type, with either adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C to 30°C (55°F to 85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.

2. Line-voltage space thermostat shall be bimetal-actuated, open contact type, or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listed for electrical rating, concealed setpoint adjustment, 13°C to 30°C (55°F to 85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.

3. Low-limit thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type, with an element of 6 m (20 ft) minimum length. Element shall respond to

the lowest temperature sensed by any 30 cm (1 ft) section. The low-limit thermostat shall be manual reset only.

E. Wired Temperature Sensors

1. Temperature sensors shall be RTD or thermistor.
2. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 1.5 m (5 ft) in length per 1 m² (10 ft²) of duct cross section.
3. Immersion sensors shall 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. The well must withstand the flow velocities in the pipe.
4. Space sensors shall be equipped with setpoint adjustment, override switch, display, and/or communication port as shown on plans.
5. Provide matched temperature sensors for differential temperature measurement.

F. Wired Humidity Sensors

1. Duct and room sensors shall have a sensing range of 20% to 80%.
2. Duct sensors shall be provided with a sampling chamber.

G. Static Pressure Sensors

1. Sensor shall have linear output signal. Zero and span shall be field-adjustable.
2. Sensor sensing elements shall withstand continuous operating conditions plus or minus 50% greater than calibrated span without damage.
3. Water pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Sensor shall be complete with 4-20 ma output, required mounting brackets, and block and bleed valves. Mount in location accessible for service.
4. Water differential pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (DP) and maximum static pressure shall be 3,000 psi. Transmitter shall be complete with 4-20 ma output, required mounting brackets, and five-valve manifold. Mount in a location accessible for service.

H. Low Limit Thermostats

1. Safety low limit thermostats shall be vapor pressure type with an element 6m [20 ft] minimum length. Element shall respond to the lowest temperature sensed by any one foot section.
2. Low limit shall be manual reset only.

I. Wireless Communication Sensors

1. HVAC terminal unit controllers used for zone space control shall use a wired or wireless communication interface to connect to its space zone sensor.
2. Each zone sensor communication interface shall be capable of many-to-one sensors per controller to support averaging, monitoring, and multiple zone applications. Sensing options shall include temperature, relative humidity, CO₂, and occupancy.
3. Wireless zone sensors
 - a. To check for proper operation, wireless zone temperature sensors shall include a signal strength and battery condition indicators on the zone sensor.
 - b. The wireless zone sensor battery life shall provide at least 15 years life under normal operating conditions and must be readily available Lithium size AA, 1.5V.
 - c. The wireless zone sensor and receiver addresses shall be held in non-volatile memory to ensure operation through system voltage disturbances and to minimize the risk of incorrect association.
 - d. To ensure proper system performance, the wireless zone sensor shall automatically determine when the space temperature is rapidly changing. When the space temperature is readily changing, the space temperature shall be transmitted at least once each 30 seconds. The maximum time between transmissions shall be 15 minutes.

2.13 WIRING AND RACEWAYS:

- A. General: Provide copper wiring, plenum cable, and raceways as specified in the applicable sections of this specification.
- B. All insulated wire to be copper conductors, UL labeled for 90°C (194°F) minimum service.
- C. Fiber Optic Cable. Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. The sheath shall be UL Listed OFNP in accordance with NEC Article 770. The optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125 µm.

PART 3 EXECUTION

3.0 SECTION INCLUDES

- 3.1 EXAMINATION:
- 3.2 PROTECTION:
- 3.3 COORDINATION:
- 3.4 GENERAL WORKMANSHIP:

3.5 FIELD QUALITY CONTROL:

3.6 COMMUNICATION WIRING:

3.7 FIBER OPTIC CABLE:

3.8 INSTALLATION OF SENSORS:

3.9 FLOW SWITCH INSTALLATION:

3.10 WARNING LABELS:

3.11 IDENTIFICATION OF HARDWARE AND WIRING:

3.12 CONTROLLERS:

3.13 PROGRAMMING:

3.14 CONTROL SYSTEM CHECKOUT AND TESTING:

3.15 CLEANING:

3.16 TRAINING:

3.1 EXAMINATION:

A. The Contract Documents shall be thoroughly examined for coordination of control devices, their installation, wiring, and commissioning. Coordinate and review mechanical equipment specifications, locations, and identify any discrepancies, conflicts, or omissions that shall be reported to the Architect/Engineer for resolution before rough-in work is started.

B. The BAS manufacturer shall inspect the jobsite in order to verify that control equipment can be installed as required, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

3.2 PROTECTION:

A. The BAS installation contractor shall protect all work and material from damage by their work or personnel, and shall be liable for all damage thus caused.

B. The BAS manufacturer shall be responsible for their work and equipment until final inspection, testing, and acceptance. The BAS installing contractor shall protect their work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 COORDINATION:

A. Site

1. Where the mechanical work will be installed in close proximity to, or will interfere with, work of other trades, the contractor shall assist in working out space conditions to

make a satisfactory adjustment. If the contractor installs his/her work before coordinating with other trades, so as to cause any interference with work of other trades, the contractor shall make the necessary changes in his/her work to correct the condition without extra charge.

2. Coordinate and schedule work with all other work in the same area, or with work that is dependent upon other work, to facilitate mutual progress.

B. Submittals. Refer to the “Submittals,” section of this specification for requirements.

C. Test and Balance

1. The contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.

2. The contractor shall provide training in the use of these tools. This training will be planned for a duration of 4 hours.

3. In addition, the contractor shall provide a qualified technician to assist in the test and balance process, until the first 20 terminal units are balanced.

4. The tools used during the test and balance process shall be returned to the contractor at the completion of the testing and balancing.

D. Life Safety

1. Duct smoke detectors required for air handler shutdown shall be supplied under Section 26100 of this specification. The contractor shall interlock smoke detectors to air handlers for shutdown as described in the Sequences of Operation for this project.

2. Smoke dampers and actuators required for duct smoke isolation are provided under Section 26100. The contractor shall interlock these dampers to the air handlers as described in the Sequences of Operation for this project as applicable.

3. Fire/smoke dampers and actuators required for fire rated walls are provided under another Section 26100. Control of these dampers shall be by 26100

E. Coordination with Controls Specified in Other Sections or Divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the contractor as follows:

1. All communication media and equipment shall be provided as specified in the “Communication” section of this specification.

2. Each supplier of a controls product is responsible for the configuration, programming, start-up, and testing of that product to meet the sequences of operation described in this section.

3. The Contractor shall coordinate and resolve any incompatibility issues that arise between the control products provided under this section and those provided under other sections or divisions of this specification.

3.4 GENERAL WORKMANSHIP:

- A. Install equipment, piping, wiring/conduit, parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.
- B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- C. Install all equipment in readily accessible locations as defined by National Electric Code (NEC). Control panels shall be attached to structural walls or properly supported in a free-standing configuration, unless mounted in equipment enclosure specifically designed for that purpose. Panels shall be mounted to allow for unobstructed access for service.
- D. Verify integrity of all control wiring to ensure continuity and freedom from shorts and grounds prior to commencing the startup and commissioning procedures.
- E. All control device installation and wiring shall comply with Contract Documents, acceptable industry specifications, and industry standards for performance, reliability, and compatibility. Installation and wiring shall be executed in strict adherence to local codes and standard practices referenced in Contract Documents.

3.5 FIELD QUALITY CONTROL:

- A. All work, materials, and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Contract Documents.
- B. BAS manufacturer shall continually monitor the field installation for building code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to building lines and properly supported.
- C. BAS installing Contractor(s) shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

3.6 COMMUNICATION WIRING:

- A. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.
- B. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.
- C. Maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer shall not be exceeded during installation.

D. Contractor shall verify the integrity of the entire network following cable installation. Use appropriate test measures for each particular cable.

E. When a cable enters or exits a building, a lightning arrestor must be installed between the line and ground.

F. All runs of communication wiring shall be unspliced length when the length is commercially available.

G. All communication wiring shall be labeled to indicate origin and destination.

3.7 FIBER OPTIC CABLE:

A. All cabling shall be installed in a neat and workmanlike manner. Minimum cable and unjacketed fiber bend radii as specified by cable manufacturer shall be maintained.

B. Maximum pulling tensions as specified by the cable manufacturer shall not be exceeded during installation. Post installation residual cable tension shall be within cable manufacturer's specifications.

C. Fiber optic cabinets, hardware, and cable entering the cabinet shall be installed in accordance with manufacturers' instructions. Minimum cable and unjacketed fiber bend radii as specified by cable manufacturer shall be maintained.

3.8 INSTALLATION OF SENSORS:

A. Sensors required for mechanical equipment operation shall be factory installed and wired as specified in mechanical equipment specifications. BAS manufacturer shall be responsible for coordinating these control devices and ensuring the sequence of operations will be met. Installation and wiring shall be in accordance with the BAS manufacturer's recommendations.

B. Sensors that require field mounting shall meet the BAS manufacturer's recommendations and be coordinated with the mechanical equipment they will be associated.

C. Mount sensors rigidly and adequately for the environment the sensor will operate.

D. Room temperature sensors shall be installed on concealed junction boxes properly supported by the block wall framing. For installation in dry wall ceilings, the low voltage sensor wiring can be installed exposed and must meet applicable National and Local Electrical Codes.

E. All wires attached to wall mounted sensors shall be sealed off to prevent air from transmitting in the associated conduit and affecting the room sensor readings.

F. Install duct static pressure tap with tube end facing directly down-stream of air flow.

G. Install space static pressure sensor with static sensing probe applicable for space installation where applicable.

H. Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.

I. All pipe mounted temperature sensors shall be installed in matched thermowells. Install all liquid temperature sensors with heat conducting fluid in thermal wells for adequate thermal conductance.

J. Wiring for space sensors shall be concealed in building drywall. EMT conduit is acceptable within mechanical equipment and service rooms.

K. Install outdoor air temperature sensors on north wall complete with sun shield at manufacturer's recommended location and coordinated with Engineer.

3.9 FLOW SWITCH INSTALLATION:

A. Coordinate installation of flow switch with Mechanical Contractor who will be responsible for installing a thread o let in steel piping applications. Copper pipe applications will require the use CxCxF Tee, and no pipe extensions or substitutions will be allowed.

B. Mount a minimum of 5 pipe diameters upstream and 5 pipe diameters downstream, or two feet, whichever is greater, from pipe fittings and other inline potential obstructions.

C. Install in accordance with manufacturers' instructions, which will require proper flow direction, horizontal alignment with flow switch mounting on the top of pipe.

3.10 WARNING LABELS:

A. Permanent warning labels shall be affixed to all equipment that can be automatically started by the BAS system.

B. Permanent warning labels shall be affixed to all motor starters and all control panels that are connected to multiple power sources utilizing separate disconnects.

3.11 IDENTIFICATION OF HARDWARE AND WIRING:

A. All field wiring and cabling, including that within factory mounted, and wired control panels and devices for mechanical equipment, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information for troubleshooting, maintenance, and service purposes. BAS manufacturer to coordinate this labeling requirement with mechanical equipment manufacturer as it relates to controls.

B. Permanently label or code each point of field terminal strips to show the instrument or item served and correlate them to the BAS design drawings.

C. Identify control panels with minimum 1-cm letters on laminated plastic nameplates.

D. Identifiers shall match record documents. All plug-in components shall be labeled such that removal of the component does not remove the label.

3.12 CONTROLLERS:

A. Provide a separate DDC Controller for individual HVAC mechanical equipment. BAS manufacturer shall furnish and coordinate DDC controllers and control devices and ensure that installation and wiring adhere to BAS manufacturer's design recommendations. For those mechanical equipment units that do not have factory installed controls specified, the BAS manufacturer shall field mount controls and coordinate all installation and termination information to ensure the specified sequence of operations are met.

B. Building Controllers and Custom Application Controllers shall be selected to provide a minimum of 15% spare I/O point capacity for each point type (analog or digital) found at each location. If input points are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point used in each controller.

1. Future use of spare I/O point capacity shall require providing the field instrument and control device, field wiring, engineering, programming, and commissioning. No additional Controller boards or point modules shall be required to implement use of these spare points.

3.13 PROGRAMMING:

A. Provide sufficient internal memory for all controllers to ensure specified sequence of operations, alarming, trending, and reporting requirements are achieved. BAS manufacturer shall provide a minimum of 25% spare memory capacity for future use.

B. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index.

C. Software Programming

1. Provide programming for individual mechanical systems to achieve all aspects of the sequence of operation specified. It is the BAS manufacturer's responsibility to ensure all mechanical equipment functions and operates as specified in sequence of operations. Provide sufficient programming comments in controller application software to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.

D. BAS Operator's Interface

1. When Operator Workstation is specified, provide color graphics for each piece of mechanical equipment depicting sufficient I/O to monitor and troubleshoot operation. Operator color graphics shall include Chiller Plant, Cooling Tower System, Boiler Plant, Air Handling Units, Rooftop Units, VAV Terminal Boxes, Fan Coil Units, Unit Ventilators, Heat Exchangers, Exhaust Fans, etc. These standard graphics shall depict all points dynamically as specified in the points list and/or indicated in sequence of operation.

2. The BAS manufacturer shall provide all the labor necessary to install, initialize, start up, and trouble-shoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface data base, and any third party software installation and integration required for successful operation of the operator interface.

3. As part of this execution phase, the BAS manufacturer shall perform a complete test of the operator interface.

3.14 CONTROL SYSTEM CHECKOUT AND TESTING:

A. Start-up testing. All testing in this section shall be performed by the contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the owner's representative is notified of the system demonstration.

1. The contractor shall furnish all labor and test apparatus required to calibrate and prepare for service all of the instruments, controls, and accessory equipment furnished under this specification.

2. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.

3. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures according to manufacturer's recommendations.

4. Verify all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starter, etc.) operate properly and normal positions are correct.

5. Verify all analog output devices (I/Ps, actuators, etc) are functional, that start and span are correct, and that direction and normal positions are correct. The contractor shall check all control valves and automatic dampers to ensure proper action and closure. The contractor shall make any necessary adjustments to valve stem and damper blade travel.

6. Verify the system operation adheres to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimal start/stop routines.

7. Alarms and Interlocks

a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.

b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.

c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

3.15 CLEANING:

A. The BAS manufacturer's installing contractor(s) shall clean up all debris resulting from their installation activities on a daily basis. The installation contractors shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the Owner, Construction Manager, General Contractor, and/or Mechanical Contractor.

B. At the completion of work in any area, the installation contractor shall clean all of their work, equipment, etc., making it free from dust, dirt and debris.

C. At the completion of work, all equipment furnished under this Section shall be checked for paint damage. Any factory finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.16 TRAINING:

A. Provide minimum of (8) hours of operator training throughout the contract period. Training shall consist of a minimum of (2) classroom training sessions of (4) hours for each session. The training will be provided for personnel designated by the Owner.

B. These objectives will be divided into logical groupings; participants may attend one or more of these, depending on level of knowledge required:

1. Day-to-day BAS Operators

2. BAS Troubleshooting & Maintenance

C. Provide course outline and materials prior to schedule training session. The instructor(s) shall provide one copy of training material per student.

D. The instructor(s) shall be factory-trained and experienced in teaching this technical material.

END OF SECTION 23 09 00

REFRIGERANT AND HUMIDITY DRAIN PIPING**PART 1 - GENERAL****1.01 SCOPE**

- A. Interconnecting piping between evaporator coil and condensing unit on split system packaged units and ventilation air units.
- B. Condensate (Humidity) drain piping.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Common Work Results for HVAC - Section 23 05 00.
- B. HVAC Piping Insulation - Section 23 07 19.

PART 2 - PRODUCTS**2.01 PIPING:**

- A. Type "L", hard drawn copper (degreased) - Refrigerant.
- B. Type "M", hard drawn copper – Condensate Drain.

2.02 FITTINGS

- A. Wrought copper.

2.03 SOLDER

- A. Brazing alloy with 1000 degrees F melting point and suitable flux.

2.04 VALVES

- A. Packless bellows or diaphragm type for use with Freon type refrigerant.

2.05 APPROVED MANUFACTURERS

- A. Valves:
 - 1. Mueller Brass Company.
 - 2. Kertest Mfg. Co.
 - 3. Engineer Approved.
- B. Solder:
 - 1. Phoson Fifteen.
 - 2. Sil-Fos.
 - 3. Engineer Approved.

PART 3 – EXECUTION**3.01 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. Provide clearance for installation of insulation, and access to valves and fittings.
- E. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors.
- F. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- G. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- H. Install refrigerant accessories as shown on the drawings and as may be recommended by the unit manufacturer.
- I. Provide double suction risers and pitch lines as required to insure positive oil return to compressor.
- J. Testing shall be done during progress of work or at completion to insure tight system. Charge the system with dry nitrogen and soap test hot gas lines at 300 psi and liquid and suction lines at 245 psi. Allow system to stand for 24 hours under pressure and if no change in pressure, system may be considered tight.
- K. Before charging, evacuate the system to 0.15 inches of mercury absolute pressure. All pumps to operate at least four (4) hours at this reading.
- L. Install condensate drain piping with traps per details on the drawings. Supports on roof shall be portable pipe hanger Model PP10 with roller

3.02 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.

3.03 REFRIGERANT CONTAINMENT

- A. Contractor shall take all necessary precautions to prevent the accidental or intentional release of refrigerant to the atmosphere.
- B. When a sealed system must be broken, provide all necessary equipment and containers as required to pump down the entire system volume, or that volume not contained in isolated receivers on the equipment.
- C. Contractor shall clean and re-use refrigerant to the greatest extent possible. Un-used refrigerant shall be properly disposed of or recycled at the contractor's expense.

END OF SECTION 23 23 00

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes refrigerant piping used for Variable Refrigeration Flow (VRF) air-conditioning applications.

1.02 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction (low pressure gas) Lines: 550 psig, or per equipment manufacturers recommendation.
 - 2. Hot-Gas (high pressure gas) and Liquid Lines: 550 psig, or per equipment manufacturers recommendation.

1.03 SUBMITTALS

- A. Product Data: Provide for each type of valve and refrigerant piping specialty indicated.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, valve arrangements and locations, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 - 1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.04 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

- C. Installer Qualification: Only trained installers skilled in refrigeration pipe installation and assembly of Refrigerant Coupling Systems, Inc. mechanically attached fittings.

1.05 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.01 COPPER TUBE AND FITTINGS

- A. Copper Tube:
 - 1. Straight Lengths: ASTM B 75, UNS C12200, Type "L" hard drawn copper (degreased). Quality; Cleaned, Eddy Current Tested, and Plugged per ASTM B 280.
 - 2. Coiled: ASTM B 280, UNS C12200, O60 Temper (Soft Annealed), ACR, cleaned and capped
- B. Fittings:
 - 1. Brazed wrought copper
- C. Field Bends (all angles): ASME B31.5

2.02 VALVES AND SPECIALTIES

- A. Service Valves:
 - 1. Body: Forged brass with brass cap.
 - 2. Core: Removable ball-type check valve with stainless-steel spring.
 - 3. Seat: Polytetrafluoroethylene.
 - 4. End Connections: Straight ends.
 - 5. Working Pressure Rating: 700 psig.
 - 6. Maximum Operating Temperature 250 deg. F
 - 7. Valves must be specifically rated for R-410A.

2.03 REFRIGERANTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Fittings shall be suitable for use with CFC, HCFC, HFC, HFO and R744 (CO2) refrigerants within the design pressure rating. Fittings shall be suitable for use with Refrigerant class A2L (mildly flammable).

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS

- A. Suction (low pressure gas), Hot Gas (high pressure gas) and Liquid Lines OD 5/8" and Smaller for Conventional Air-Conditioning, Heat Pump, and Heat Recovery Applications (only between heat recovery distribution box and indoor evaporator units): Copper, Type ACR, O60 (soft annealed)-temper tubing and field bent fittings with wrought copper fittings and soldered joints.
- B. Suction (low pressure gas), Hot Gas (high pressure gas), and Liquid Lines OD 1-5/8" and smaller for Conventional Air-Conditioning, Heat Pump, and Heat Recovery Applications: Straight Lengths, Copper, Type "L" hard drawn copper tubing and wrought copper fittings with soldered joints.

3.02 VALVE AND SPECIALTY APPLICATIONS

- A. Install service valves in refrigerant piping before and after heat recovery distribution boxes.

3.03 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls.
- E. Install piping above accessible ceilings to allow enough space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Field Bend changes in direction.
- I. Select system components with pressure rating equal to or greater than maximum

allowable working pressure.

- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. Provide Jacketed insulation in locations where exposed to mechanical injury.
- M. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- N. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."
- O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."
- R. Provide proper compensation for pipe/tube expansion and contraction per equipment manufacturers recommendations.

3.04 PIPE JOINT CONSTRUCTION

- A. Use wrought iron copper fittings.
- B. Field Bends: Fabricate field bends with a center-line bend radius greater than or equal to 4 times the nominal OD of the pipe or tube. Tube shall be bent with a tubing bender sized for ACR OD tube sizes and shall not cause cracks or wrinkles in the tube or pipe. Do NOT use a conduit bender for bending ACR copper. The difference between maximum and minimum diameters for pipe bends should not exceed 8% of the nominal outside diameter of the pipe. Only O60 soft annealed-temper shall be field bent.

C. JOINING PROCEDURE

1. Tube ends shall be cut with a clean sharp tubing cutter.
2. Deburr the I.D. of the cut tube end with a clean, sharp deburring tool.
3. Visually inspect the interior of each tube for obstructions and debris before assembly. Protect the joint from contamination before assembly.
4. Visually inspect the exterior of each tube end receiving a fitting. This tube end must be clean, free of burrs, scratches, pits, or deformation. End of fitting must be round.
5. Install fittings.

D. THERMAL INSULATION AND VAPOR BARRIER

1. Insulate piping as required by equipment manufacturer, local codes and authority having jurisdiction.
2. Strictly comply with insulation manufacturers installation instructions to provide a vapor proof insulation system.
3. If properly sealed vapor proof insulation system is not possible, mechanically attached fittings installed outdoors or in extremely humid environments should be protected with cold shrink sleeves, or heat shrink sleeves.

3.05 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs.
2. Rigid high compressive strength foam insulating pipe support at all support points. Comply with Section 230719 "DX Piping System Insulation".
3. Do NOT attach hangers directly to pipe or tube.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. Up to 3/4" OD: Maximum span, 60 inches; minimum rod size, 3/8 inch.
2. Greater than 3/4" thru 1" OD: Maximum span, 72 inches; minimum rod size, 3/8 inch.
3. Greater than 1" thru 2-1/8" OD: Maximum span, 96 inches; minimum rod size, 3/8 inch.

D. Support multi-floor vertical runs every 10 feet and at least at each floor.

3.06 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

- B. Tests and Inspections:
1. Comply with ASME B31.5, Chapter VI.
 2. Test as recommended by equipment manufacturers instructions.
 3. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 - a. Fill system with 95/5 nitrogen/hydrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gauge throughout duration of test.
 - c. Test all joints and fittings with hydrogen leak detector, at test pressure.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.07 SYSTEM CHARGING

- A. Charge system using the following procedures and per equipment manufacturers instructions.
1. Evacuate (triple evacuation procedure) entire refrigerant system with a vacuum pump to obtain a steady state vacuum of less than 500 micrometers. If vacuum holds for 12 hours, system is ready for charging. Do NOT evacuate the system through a charging manifold. Use only suction rated hoses and core removal tools.
 2. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
 3. Charge system as recommended by equipment manufacturer.

END OF SECTION 23 23 01

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Basic Requirements for HVAC Ducts and Casings.

1.02 RELATED SECTIONS

- A. Section 23 05 00 – Common Work Results for Heating, Ventilating, and Air Conditioning System.
- B. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.
- C. Section 23 07 13 – Duct Insulation.
- D. Section 23 05 93 – Testing, Adjusting and Balancing.

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.

1.06 DEFINITIONS

- A. Duct Sizes: Required free area dimensions.
- B. Low Pressure: All ductwork shall be fabricated for 2 inch WG positive or negative static pressure and velocities less than 2,500 fpm.

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 ceiling diffusers. 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 degree 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.

2.03 DUAL WALL DUCT AND FITTINGS

- A. Dual wall duct shall be comprised of an airtight outer pressure shell, a 1 inch insulation layer, and perforated metal inner liner. Liner shall be supported from the steel by welded spacers.
- 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.

C. TESTING FOR LEAKAGE

1. General: After each duct system is completed, test low pressure ductwork for duct leakage using same test method described in SMACNA "High Pressure Duct Standards - 3rd Edition, Chapter 10 - Testing and Leakage". Repair leaks and repeat tests until total leakage is less than 1% of system design air flow. Provide documentation to show ducts have been tested.

D. BALANCING

1. Seal any leaks in ductwork that become apparent in balancing process.

END OF SECTION 23 31 00

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Basic Requirements for Air Duct Accessories for complete Heating, Ventilating, and Air Conditioning Systems.

1.02 RELATED SECTIONS

- A. Section 23 05 00 – Common Work Results for Heating, Ventilating, and Air Conditioning Controls.
- B. Section 23 05 48 – Vibration and Seismic controls for HVAC Piping and Equipment.
- C. Section 23 31 00 – HVAC Ducts and Casings.
- D. Section 23 05 93 – Testing, Adjusting and Balancing.

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 "Temperature Control Systems" for control dampers; not work of this section.
- C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering dampers which may be incorporated in the work include, but are not limited to, the following:
 - Air Balance, Inc.
 - Airguide Corp.
 - Airstream Products Div., Penn Ventilator Co., Inc.
 - American Warming & Ventilating, Inc.
 - Arrow Louver and Damper Corp.
 - Elgo Shutter and Mfg. Co.
 - Imperial Damper and Louver Co., Inc.
 - Louvers & Dampers.
 - Ruskin Mfg. Co.

2.02 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.

2.03 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:

2.04 DUCT ACCESS DOORS

- A. General: Provide, where indicated and at all fire and smoke dampers, duct access doors of size indicated.
- B. Construction: Construct of same or greater gage as ductwork served, provide double panel insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one side hinged, other side with 1 handle-type latch for doors 12 inches high and smaller, 2 handle-type latches for larger doors.
- C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering duct access doors which may be incorporated in the work include, but are not limited to, the following:
Air Balance Inc.
Duro Dyne Corp.
Register & Grille Mfg. Co., Inc.
Ruskin Mfg. Co.
Semco
Ventfabrics, Inc.

2.05 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.

2.06 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 23 33 00

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Basic Requirements for HVAC Power Ventilators.

1.02 RELATED SECTIONS

- A. Section 23 05 00 – Common Work Results for Heating, Ventilating, and Air Conditioning Systems.
- B. Section 23 05 48 – Vibration and Seismic controls for HVAC Piping and Equipment.
- C. Section 23 31 00 – HVAC Ducts and Casings.

1.03 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacturer of power ventilators and exhaust fans, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. AMCA Compliance: Provide power roof ventilators and exhaust fans bearing the Air Movement and Control Association, Inc. (AMCA) Certified Ratings Seal.
- C. UL Compliance: Provide power roof ventilator and exhaust fans electrical components which have been listed and labeled by Underwriters Laboratories (UL).

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's data for power ventilators and exhaust fans, including specifications, capacity ratings, dimensions, weights, materials, accessories furnished, and installation instructions.
- B. Maintenance Data: Submit maintenance instructions, including lubrication instructions, motor and drive replacement, and spare parts lists. Include this data in maintenance manuals.

PART 2 - PRODUCTS

2.01 DIRECT DRIVE ROOF DOWNBLAST CENTRIFUGAL EXHAUST FANS

- A. General Description:
 - 1. Downblast fan shall be for roof mounted applications
 - 2. Performance capabilities up to 4,300 cubic feet per minute (cfm) and static pressure to 1 inches of water gauge
 - 3. Fans are available in sixteen sizes with nominal wheel diameters ranging from 8 inches through 18 inches (071 – 180 unit sizes)

4. Maximum continuous operating temperature is 180 Fahrenheit (82.2 Celsius)
 5. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number.
- B. Wheel:
1. Constructed of aluminum
 2. Non-overloading, backward inclined centrifugal
 3. Statically and dynamically balanced in accordance to AMCA Standard 204-05
 4. The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency.
- C. Motors:
1. Electronically Commutated Motor
 - a. Motor enclosure: ODP
 - b. Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable. Examples of unacceptable motors are: Shaded Pole, Permanent Split Capacitor (PSC), Split Phase, Capacitor Start and 3 phase induction type motors.
 - c. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.
 - d. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor.
 - e. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.
 - f. Motor shall be a minimum of 85% efficient at all speeds.
- D. Housing:
1. Motor cover, shroud, curb cap, and lower windband shall be constructed of heavy gauge aluminum
 2. Shroud shall have an integral rolled bead for extra strength
 3. Shroud shall be drawn from a disc and direct air downward
 4. Lower windband shall have a formed edge for added strength
 5. Motor cover shall be drawn from a disc
 6. All housing components shall have final thicknesses equal to or greater than preformed thickness.
 7. Curb cap shall have pre-punched mounting holes to ensure correct attachment
 8. Rigid internal support structure
 9. Leak proof
- E. Housing Supports and Drive Frame:
1. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators.
- F. Vibration Isolation:
1. Rubber isolators.
 2. Sized to match the weight of each fan.
- G. Disconnect Switches:
1. NEMA rated: 3R
 2. Positive electrical shut-off
 3. Wired from fan motor to junction box installed within motor compartment

- H. Options/Accessories:
 - 1. Birdscreen:
 - a. Material Type: Galvanized
 - b. Protects fan discharge
 - 2. Roof Curbs:
 - a. Types: Standing Seam Metal Roof Curb
 - b. Mounted onto roof with fan
 - c. Material: Galvanized
 - d. Insulation thickness: 1 inch
 - e. Coating Type: None
 - 3. Curb Seal:
 - a. Rubber seal between the fan and the roof curb
 - b. Type: Gravity
 - c. Prevents outside air from entering back into the building when fan is off
 - d. Balanced for minimal resistance to flow
 - e. Galvanized frames with prepunched mounting holes
 - 4. Finishes:
 - Types: None

2.03 APPROVED MANUFACTURERS

- A. Roof Mounted Exhaust Fans
 - 1. Greenheck.
 - 2. ACME.
 - 3. Cook.
 - 4. Architect Approved.

PART 3 - EXECUTION

3.01 GENERAL

- A. Examine areas and conditions under which power ventilators and exhaust fans are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF POWER VENTILATORS

- A. General: Except as otherwise indicated or specified, install ventilators and exhaust fans in accordance with manufacturer's installation instructions and recognized industry practices to ensure that ventilators serve their intended function.
- B. Coordinate ventilator and exhaust fan work with work of roofing, walls, and ceilings, as necessary for proper interfacing.
- C. Ensure that power ventilators and exhaust fans are wired properly, with correct motor rotation, and positive electrical motor grounding.
- D. Remove shipping bolts and temporary supports within ventilators and exhaust fans. Adjust dampers for free operation.

3.03 TESTING

- A. General: After installation of ventilators and exhaust fans has been completed, test each to demonstrate proper operation of units at performance requirements specified. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.

3.04 SPARE PARTS

- A. General: Furnish to Owner, with receipt, 1 spare set of belts for each belt drive power ventilator and exhaust fans.

END OF SECTION 23 34 23

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Basic Requirements for Air Inlets and Outlets.

1.02 RELATED SECTIONS

- A. Section 23 05 00 – Common Work Results for Heating, Ventilating, and Air Conditioning System.
- B. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.
- C. Section 23 31 00 – HVAC Ducts and Casings.
- D. Section 23 05 93 – Testing, Adjusting and Balancing.

1.03 REFERENCES

- A. ADC 1062 - Certification, Rating and Test Manual.
- B. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- C. ARI 650 - Air Outlets and Inlets.
- D. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
- E. SMACNA - Low Pressure Duct Construction Standard.

1.04 QUALITY ASSURANCE

- A. Test and rate performance of air outlets and inlets in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.
- B. Air distribution devices have been specifically selected based on the specified manufacturer's performance data. If the Contractor submits on devices other than those specified, the submittal must include an item-by-item selection of substitutions listed by space location.
- C. Where compliance with performance requires different dimensions, such as neck or face size, than the specified item, the submittal must note where these dimension changes occur listing both the original and the new dimensions.
- D. Any additional costs by any trade resultant from air device substitution shall be borne by the Contractor.

1.05 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 90A.

1.06 SUBMITTALS

- A. Submit product data under provisions of Division 01 and Section 23 0500.
- 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-T5 extruded aluminum alloy.
- B. Blades shall be constructed of .081-inch-thick aluminum. Blades shall be adjustable and drainable.
- C. Insect screen shall be aluminum mesh, removable type. Screen shall be mounted on exterior of louver.
- D. Finish shall be as selected by Architect.

2.02 APPROVED MANUFACTURERS

- A. Air Devices
 - 1. Titus.
 - 2. Price.
 - 3. Architect Approved.
- B. Louvers
 - 1. Greenheck.
 - 2. Ruskin.
 - 3. Architect Approved.

PART 3 - EXECUTION

3.01 INSTALLATION (AIR DEVICES)

- A. Install air devices in accordance with manufacturers' instructions.
- B. Check location of air devices and make necessary adjustments in position to conform with architectural reflected ceiling plan, symmetry, and lighting arrangement.
- C. Install diffusers to ductwork with air tight 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 weather-tight.
- G. Field verify exact opening dimensions and coordinate mounting requirements with General Contractor.

END OF SECTION 23 37 00

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Variable Volume Packaged Air Handling Units.

1.02 RELATED WORK

- A. Section 23 05 00 - Common Work Results for HVAC.
- B. Section 23 07 13 - Duct Insulation for HVAC.
- C. Section 23 31 00 - HVAC Ducts and Casings.
- D. Section 23 09 23 – Automatic Temperature Control.
- E. Division 23 – All sections.

1.03 REFERENCES

- A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- C. AMCA 99 - Standards Handbook.
- D. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
- E. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
- F. NFPA 70 - National Electrical Code.

1.04 QUALITY ASSURANCE

- A. Unit performance shall be certified in accordance with ARI 430 for Central Station air handling units.

1.05 SUBMITTALS

- A. Submit under provisions of Section 23 05 00.
- B. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- C. Product Data:
 - 1. Provide literature, which indicates dimensions, weights, capacities, ratings, fan performance, gages and finishes of materials, and electrical characteristics and connection requirements.
 - 2. Provide fan curves with specified operating point clearly plotted.
 - 3. Submit sound power level data for both fan outlet and casing radiation at rated capacity.
 - 4. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed

and field-installed wiring.

- D. Manufacturer's Installation Instructions.

1.06 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 23 05 00.
- B. Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 23 05 00.
- B. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.
- C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.09 EXTRA MATERIALS

- A. Provide one set of fan belts for each unit.
- B. Provide one set of spare filters for each unit.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Daikin
- B. AAON
- C. Greenheck
- D. Architect Approved.

2.02 GENERAL DESCRIPTION

- A. Furnish as shown on plans. Unit performance and electrical characteristics shall be per the job schedule.
- B. Configuration: Fabricate as detailed on prints and drawings.
- C. The complete unit shall be ETL/UL listed.
- D. The unit shall be ASHRAE 90.1-2016 compliant and labeled.

- E. Each unit shall be specifically designed for outdoor application and include a weatherproof cabinet. Units shall be of a modular design with factory installed access sections available to provide maximum design flexibility.
- F. Units shall be shipped fully charged with R410A.
- G. Factory test shall include test and adjustment of the gas furnace.
- H. All units shall have decals and tags to indicate caution areas and aid unit service. Unit nameplates shall be fixed to the main control panel door. Electrical wiring diagrams shall be attached to the control panels. Installation, operating and maintenance bulletins and start-up forms shall be supplied with each unit.
- I. Performance: All scheduled capacities and face areas are the minimum accepted value. All scheduled amps, KW, and HP are maximum accepted values that allow scheduled capacity to be met.

2.03 MANUFACTURED UNITS

- A. Unit shall be fully assembled at the factory and consist of an insulated metal cabinet, downturn outdoor air intake with 2" aluminum mesh filter assembly, evaporator coil, hot gas reheat coil, indirect gas-fired furnace, packaged DX system, phase and brownout protection, motorized dampers, filter assembly intake air, supply air blower assembly, and an electrical control center. All specified components and internal accessories factory installed are tested and prepared for single-point high voltage connection except with electric post heat and exhaust fan only power which have dual point power.

2.04 CABINET

- A. Materials: Formed, double wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.
 - 1. Unit's exterior shall be supplied from the manufacturer using G60 galvanneal steel with proprietary pre-painted material in the following finish color; Concrete Gray-RAL 7023. This has been subjected to a salt spray test per ASTM-B117 and evaluated using ASTM-D714 and ASTM-D610 showing no observable signs of rust or blistering until reaching 2,500 hours. Uncoated galvanized steel exterior is not acceptable.
 - 2. Internal assemblies: 22-gauge, galvanized (G90) steel except for motor supports which shall be minimum 14 gauge galvanized (G90) steel.
- B. Cabinet Insulation: Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.
 - 1. Materials: Rigid urethane injected foam. Foam board not acceptable.
 - a. Thickness: 2 inch (50.8 mm)
 - b. Thermal Resistance R13
 - c. Thermally broken
 - d. Meets UL94HF-1 flame requirements.
 - e. Location and application: Full coverage of entire cabinet exterior to include walls, roof of unit, unit base, and doors.
 - 2. Materials: Fiberglass insulation. If insulation other than fiberglass is used, it must also meet the Fire Hazard Classification shown below.
 - a. Thickness: 2 inch (50.8 mm)
 - b. Thermal Resistance R8
 - c. Fire Hazard Classification: Maximum flame spread of 25 and smoke developed of 50, when tested in accordance with ASTM C 411.
 - d. Location and application: Divider panels between outdoor air and

return air/exhaust air streams.

- C. Roof Insulation: 2-inch (50.8 mm) fiberglass located above the 1-inch (25.4 mm) foam panel.
- D. Access panels / doors: Unit shall be equipped with insulated, hinged doors or removable access panels to provide easy access to all major components. Doors and access panels shall be fabricated of 18-gauge galvanized G90 steel or painted galvanized steel.
- E. Supply Air blower assemblies: Blower assembly shall consist of an electric motor and direct-drive fans. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125-inch-thick neoprene vibration isolators. Blower motors shall be capable of continuous speed modulation and controlled by a VFD.
- F. Evaporator Coil: Evaporator coil shall be (silver) soldered or brazed into the compressed refrigerant system. Coil shall be constructed of copper tubing, permanently bonded to aluminum fins and enclosed in a galvanized steel frame. If two compressors are used as components of the unit, then the evaporator coil shall be of "interlaced" configuration, permitting independent operation of either compressor without conflict with the other compressor.
- G. Control panel / connections: Units shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections. Unit shall be equipped with a Unit Disconnect Switch.
- H. Condensate drain pan: Drain Pan shall be an integral part of the unit whenever a cooling option is included. Pan shall be formed of welded austenitic stainless steel sheet material and provided with a welded stainless steel drain connection at the front for connection to a P trap. Drain pan shall be sloped in two directions to provide positive draining and drain connector shall be sealed at penetration through cabinet wall.
- I. P trap: If the unit is equipped with a condensate drain pan, contractor shall provide, or fabricate, and install an appropriate P trap, in accordance with all local and area codes and Best Practices.
- J. Reheat coil with factory installed modulating hot gas reheat valve.
- K. Indirect gas furnace
 1. Shall be ETL Certified as a component of the unit.
 2. Shall have an integral combustion gas blower.
 3. Shall be ETL Certified for installation downstream of a cooling coil.
 4. Shall have fault sensors to provide fault conditions to optional digital controller or building controls.
 5. Shall have 4-pass tubular heat exchangers, constructed of type 409 stainless steel. Heat exchanger tubes shall be installed on the vest plate by means of swaged assembly, welded connections are not acceptable. Heat exchanger tubes shall be supported by a minimum of two fabricated assemblies that support the tubes and also permit expansion and contraction of the tubes.
 6. Heat exchanger shall have a 25-year extended warranty.
 7. Furnace control shall be HighTurndown 15:1 Modulating.
 8. Shall be encased in a weather-tight metal housing with intake air vents. Large, metal lift-off door shall provide easy access to the enclosed vest plate, control circuitry, gas train, burner assembly and exhaust blower.
 9. Shall have solid state controls permitting stand-alone operation or control by

building controllers.

- L. Packaged DX System: Unit shall have an integral compressor(s) and evaporator coil located within the weather-tight unit housing. Condenser coils and appurtenant condenser fan assemblies shall be factory installed as integral subassemblies of the unit and mounted on the exterior of the unit. Lead condenser fan shall have EC motor to maintain condenser pressure at part load conditions. Motors shall be UL Recognized and CSA Certified. The lead refrigerant compressor(s) shall be inverter hermetic scroll-type and shall be equipped with liquid line filter drier, thermostatic expansion valves (TXV)(s), manual reset high pressure and low-pressure cutouts and all appurtenant sensors, service ports and safety devices. Compressed refrigerant system shall be fully charged with R-410A refrigerant. Compressors shall be mounted within an insulated access compartment and on a raised cabinet shelf to reduce sound and vibration. Each compressor shall be factory-equipped with an electric crankcase heater to boil off liquid refrigerant from the oil.
- M. Condenser Fans: Fan blades must be constructed of aluminum or a composite material and have a geometry designed and documented to reduce sound and energy when compared to a traditional rectangular blade fan. Traditional rectangular blade fans are not allowed due to increased noise generated and increase power utilized. Condenser fan motors shall be three phase, external rotor, type 56 frame, open air over and shaft up. Each condenser fan motor shall have a vented frame, rated for continuous duty and be equipped with an automatic reset thermal protector. Lead condenser fan(s) will have an electronically commutated (EC) motor that will modulate to maintain a head pressure set point.] Motors shall be UL Recognized and CSA Certified. Single condenser fan running at max RPM and design static pressure shall not exceed an A-weighted sound power level of 75 db at free inlet/outlet test conditions.
- N. Packaged DX Control and Diagnostics: The Packaged DX system shall be controlled by an onboard digital controller (DDC) that indicates both owner-supplied settings and fault conditions that may occur. The DDC shall be programmed to indicate the following faults:
 - 1. Global alarm condition (active when there is at least one alarm)
 - 2. Supply Air Proving alarm
 - 3. Compressor Trip alarm
 - 4. Compressor Locked Out alarm
 - 5. Supply Air Temperature Low Limit alarm
 - a. Sensor #1 Out of Range (outside air temperature)
 - b. Sensor #2 Out of Range (supply air temperature)
 - c. Sensor #3 Out of Range (cold coil leaving air temperature)
- O. Phase and brownout protection: Unit shall have a factory-installed phase monitor to detect electric supply phase loss and voltage brown-out conditions. Upon detection of a fault, the monitor shall disconnect supply voltage to all motors.
- P. Motorized dampers / Intake Air, Motorized dampers of low leakage type shall be factory installed.
- Q. Hail Guards: Protects the condensing unit from damage due to extreme weather conditions such as hail and flying debris.
- R. Provide unit with horizontal supply air ductwork connection.

2.05 BLOWER

- A. Blower section construction, Supply Air: direct drive motor and blower shall be

assembled on a 14-gauge galvanized steel platform and shall be equipped with 1.125-inch-thick neoprene vibration isolation devices.

- B. Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.
- C. Fan: Direct drive, airfoil plenum fan with aluminum wheel statically and dynamically balanced. Prop or belt-drive fan not acceptable due to low static capabilities.
- D. Blades: Welded aluminum blades only.
- E. Blower section motor source quality control: Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating".

2.06 MOTORS

- A. General: Blower motors greater than 1/2 horsepower shall be "NEMA Premium" unless otherwise indicated. Compliance with EPA's minimum energy-efficiency standards for single speed ODP and TE enclosures is not acceptable. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure.
- B. Motors shall be 60 cycle, 3 phase 208 volts.

2.07 UNIT CONTROLS

- A. The unit shall be constructed so that it can function as a stand-alone heating and cooling system controlled by factory-supplied controllers, thermostats and sensors or it can be operated as a heating and cooling system controlled by a Building Management System (BMS). This unit shall be controlled by a factory-installed microprocessor programmable controller (DDC) that is connected to various optional sensors.
- B. Unit shall incorporate a DDC controller with integral LCD screen that provides text readouts of status. DDC controller shall have a built-in keypad to permit operator to access read-out screens without the use of ancillary equipment, devices or software. DDC controllers that require the use of equipment or software that is not factory-installed in the unit are not acceptable. Alarm readouts consisting of flashing light codes are not acceptable. Owner-specified ventilating conditions can be input by means of pushbuttons.
- C. Unit supply fan shall be configured for duct pressure by factory.
- D. Outside Air damper control shall be two-position.
- E. Variable Frequency Drive (VFD): unit shall have factory installed variable frequency drive for modulation of the exhaust air blower assembly. The VFD shall be factory-programmed for unit-specific requirements and shall not require additional field programming to operate.

2.08 FILTERS

- A. Unit shall have permanent 2-inch (50.8 mm) aluminum filters located in the outdoor air intake and shall be accessible from the exterior of the unit. MERV 8 disposable pleated filters shall be provided in the supply air stream. MERV 13 disposable

pleated filters shall be provided in the supply final air stream.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Prior to start of installation, examine area and conditions to verify correct location for compliance with installation tolerances and other conditions affecting unit performance. See unit IOM.
- B. Examine roughing-in of plumbing, electrical and HVAC services to verify actual location and compliance with unit requirements. See unit IOM.
- C. Proceed with installation only after all unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Installation shall be accomplished in accordance with these written specifications, project drawings, manufacturer's installation instructions as documented in manufacturer's IOM, Best Practices and all applicable building codes.

3.03 CONNECTIONS

- A. In all cases, industry Best Practices shall be incorporated. Connections are to be made subject to the installation requirements shown above.
- B. Piping installation requirements are specified in Division 22 (Plumbing). Drawings indicate general arrangement of piping, fittings and specialties.
- C. Duct installation and connection requirements are specified in Division 23 of this document.
- E. Electrical installation requirements are specified in Division 26 of this document.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory authorized service representative to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to A / E in writing. Inspection must include a complete startup checklist to include (as a minimum) the following: Completed Start-Up Checklists as found in manufacturer's IOM.

3.05 START-UP SERVICE

- A. Engage a factory authorized service representative to perform startup service. Clean entire unit, comb coil fins as necessary, install clean filters. Measure and record electrical values for voltage and amperage. Refer to Division 23 "Testing, Adjusting and Balancing" and comply with provisions therein.

3.06 DEMONSTRATION AND TRAINING

- A. Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain the entire unit. Refer to Division 01 Section Closeout Procedures and Demonstration and Training.

3.07 WARRANTY

- A. Provide unit with minimum one (1) year factory parts and labor warranty from date of equipment start-up.
- B. Provide refrigerant compressors with minimum five (5) year factory warranty.

END OF SECTION 23 74 13

VARIABLE REFRIGERANT FLOW (VRF) – HVAC SYSTEMS (6 – 42 TONS)

PART 1 - GENERAL**1.01 SECTION INCLUDES:**

- A. Outdoor Heat Recovery (VRF) Units
- B. Indoor Evaporators – Ducted-Vertical/Horizontal Units

1.02 SYSTEM PERFORMANCE DOCUMENTATION

- A. The manufacturer shall provide published outdoor unit performance data in table format which states the product heating and cooling capacities expressed in British thermal units per hour (BtuH) and power consumption expressed in kilowatts (kW) at a minimum of 8 possible combinations of allowed conditions between 50% and 130% connection ratio (VRF systems). Possible combinations of allowed condition variables include Combination Ratios expressed as a percentage value, Outdoor Ambient Temperature expressed in degrees Fahrenheit (°F), and indoor unit Entering Air wet and dry bulb temperature expressed in degrees Fahrenheit (°F). Any product whose system design and engineering manuals or guides where published data tables are expressed in units other than these specified will not be accepted.
- B. Any product whose published documentation requires the design engineer to apply a correction factor derived from a published curve or tabular data for combination ratio, outdoor ambient temperature, and/or entering air temperature against rated conditions to obtain performance at any possible combination of allowed conditions will not be accepted.

1.03 SUBMITTALS:

- A. A complete submittal package shall be compiled and 10 copies shall be forwarded to the general contractor who shall supply the architect with the submittals for dissemination to all parties. The submittal shall be a collection of documents that represent the technical aspects of each product or collection of products to be used on the project. All performance submissions shall be calculated at the design temperatures; Nominal performance data shall not be accepted. The submission and approval of said submittals does not relieve the contractor of supplying all requirements set forth in the specification and drawings. Any substitutions offered by the contractor shall include, as a separate document, any and all differences between the submitted products and the specified products including but not limited to, all dimensions, electrical, control, weights, warranties, country of origin.
- B. If submittals contain any proposed alternate equipment specifications, calculations, dimensions, electrical specifications, sound specifications or any other mandated submission which are not accepted, are noted or rejected for any

reason the contractor shall be allowed to correct any deficiency and re-submit a second time. Should there be any irregularities found on second submission, the contractor will be directed to and agrees to submit on the original specified products, including any changes or revisions, and provide those specified products without any additional compensation.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Provide a dry and clean place for the products. Comply with manufacturer's instructions on handling to prevent products from damaging. If product is damaged upon arrival, reject the shipment. If hidden damage is found after removing the product from the container, retain container and all packing material. Contractor is responsible for filing a claim with the freight carrier.

1.05 UPON JOB COMPLETION

- A. Provide the owner with a tablet containing a copy of approved submittal, VRF system service diagnostics software, project mechanical and control drawings, all as-built piping drawings, seismic data certificates, installation, operation and maintenance manuals, troubleshooting guides, service manuals and engineering manuals in PDF format.
- B. Provide the owner with a tablet containing a copy of the approved submittal package, a full set of drawings and specifications, on boarding software, custom documents, such as control drawings, shop drawings, wiring diagrams, BMS software, GUI image files, commissioning reports, refrigerant charge calculations, refrigerant piping design and as-built reports, O&M's, troubleshooting guides, service manuals, and equipment engineering manuals in .pdf format. Tablet shall also include a licensed copy of deluxe version of the VRF equipment manufacturer's service diagnostics.

PART 2 - STANDARD/CERTIFICATIONS

2.01 APPROVED MANUFACTURERS

- A. Daikin
- B. LG
- C. Architect Approved

2.02 CERTIFIED PRODUCT PERFORMANCE RATINGS

- A. All VRF (Variable Refrigerant Flow) and VSMS (Variable Speed Multi-Split and Mini-Split) products shall have published performance ratings certified by AHRI (Air-Conditioning, Heating, and Refrigeration Institute) and listed in the AHRI certified product directories available at www.ahridirectory.org.

2.03 PRODUCTION FACILITY CERTIFICATIONS

- A. All system components shall be manufactured in production facilities maintaining the following ISO certifications:
- B. ISO 9001 Quality Management System
- C. ISO 14001 Environmental Management System

2.04 UL COMPLIANCE

- A. All system shall comply with Underwriters Laboratories (UL) 1995 5th edition of the Standard for Safety for Heating and Cooling Equipment Standard for Safety and bear the Electrical Testing Laboratories (ETL) and/or Canadian Standards Association (CSA) mark on the product name plate.

2.05 ELECTRICAL STANDARD

- A. All system electrical power wiring shall be installed in accordance with the NFPA 70 National Electrical Code (NEC) or applicable state and local building codes.

2.06 CORROSION QUALITY CONTROL

- A. Outdoor unit painted surfaces shall be factory tested for a minimum of 1000 hours using the accelerated salt spray test procedure as documented in ASTM Standard B-117 using the Surface Scratch Test Procedure. Photographic evidence shall be available upon request by the Engineer of Record.
- B. Photographic evidence shall include images of the test sample showing the surface scratch area at zero (0) hours, 400 hours, and 1000 hours. Post-test images of the sample must show no significant deterioration of the coating material, blistering, flaking, peeling, or rust formation along the test scratch.

2.07 HEAT RECOVERY SYSTEM(S) – (6 TO 42 TONS NOMINAL)

- A. Product Design
 - 1. LG Multi V 5 heating and cooling system shall be an air-cooled system allowing user to configure in the field a heat pump or a heat recovery system consisting of one to three outdoor unit modules, conjoined to make a 6–42-ton single refrigerant circuit.
 - a) Heat recovery systems, employing three pipes, shall be connected to Heat recovery (heat recovery) unit(s) and indoor unit(s). Multi-port heat recovery units shall allow simultaneous heating and cooling of individual zone(s) at various capacities as required to satisfy their zone requirements.
 - 2. All three-phase VRF heat recovery outdoor units shall be from the same product development generation. Mixing of outdoor units from different development generations is not acceptable.

- B. Operating Conditions
1. Outdoor Unit shall be capable of continuous compressor operation between the following operating ambient air conditions, operation outside of these conditions are possible and may involve non-continuous operations.
 2. Operating Ambient Air Conditions:
 - a) Cooling: 5°F DB to 122°F DB
 - b) Heating: -22°F WB to 61°F WB
 - c) Cooling Based (ODU reversing valve in cooling position)
Synchronous: 14°F DB to 81°F DB (Heat Recovery Operation Only)
 - d) Heating Based (ODU reversing valve in heating position)
Synchronous: 14°F WB to 61°F WB (Heat Recovery Operation Only)
- C. Electrical
1. All air source heat recovery frame(s) shall be designed and electrically protected to maintain stable continuous compressor operation when provided with 208-230/60/3 power with the following specifications:
 - a. <208-230/60/3>
 - 1) Voltage fluctuation of $\pm 10\%$
 - b. Voltage imbalance of up to two percent;
 - c. Power surge of up to 5kA RMS Symmetrical.
- D. General Features
1. The air-conditioning system shall use R410A refrigerant.
 2. Each system shall consist of one, two or three air source outdoor unit modules conjoined together in the field to result in the capacity specified elsewhere in these documents.
 3. Dual and triple frame configurations shall be field piped together using manufacturer's designed and supplied Y-branch kits and field provided interconnecting pipe to form a common refrigerant circuit.
 4. System shall have following frame configurations vs. capacity.
 - a) 6-to-20-ton units shall be a single frame only.
 - b) 22-to-34-ton units shall be dual frame only.
 - c) 36-to-42-ton heat recovery units shall be triple frame only
 5. System shall employ self-diagnostics function to identify any malfunctions and provide type and location of malfunctions via fault alarms.
 6. Field Provided Refrigerant Piping
 - a) The refrigerant piping system shall be constructed using field provided ACR copper rated for the use with refrigerant R410A, dehydrated pipe field engineered and assembled with manufacturer supplied Heat recovery unit(s) and Y- branches, as may be required, connected to multiple (ducted, non-ducted or mixed combination) indoor units to effectively and efficiently control the heat pump operation or simultaneous heating and cooling operation

of the heat recovery VRF system. Other pipe materials, if used, shall perform, at a minimum, as well as that specified above, shall not have any adverse reactions, for example galvanic corrosion or branch to branch differential pressure drop, with any other components or materials also in use in the system and shall be installed per manufacturer's instructions.

- b) The unit shall be shipped from the factory fully assembled including internal refrigerant piping, inverter driven compressor(s), controls, temperature sensor, humidity sensor, contacts, relay(s), fans, power and communications wiring as necessary to perform both Heat Pump and Heat Recovery operations.
- c) Each outdoor unit refrigeration circuit shall include, but not limited to, the following components:
 - 1) Refrigerant strainer(s)
 - 2) Check valve(s)
 - 3) Inverter driven, medium pressure vapor injection, high pressure shell compressors
 - 4) Liquid refrigerant cooled inverter PCB
 - 5) Oil separator(s)
 - 6) Accumulator /controlled volume receiver(s)
 - 7) 4-way reversing valve(s)
 - i. Vapor injection valve(s)
 - 8) Variable path heat exchanger control valve(s)
 - 9) Oil balancing control
 - 10) Oil Level sensor(s)
 - 11) Electronic expansion valve(s)
 - i. Sub-cooler (s)
 - ii. Vapor Injection Valve(s)
 - 12) High and low side Schrader valve service ports with caps
 - i. Service valves

7. Field Insulation:

- a) All refrigerant pipe, y-branches, elbows and valves shall be individually insulated with no air gaps. Insulation heat transfer resistance shall not be less than the minimum called for by the local building code, local energy code or as a minimum per manufacture installation requirements. In no case shall the insulation be installed in a compressed state at any point in the system.
 - 1) All joints shall be glued and sealed per insulation manufactures instructions to make a vapor tight assembly.

8. Microprocessor:

- a) Factory installed microprocessor controls in the outdoor unit(s), heat recovery unit(s), and indoor unit(s) shall perform functions to optimize the operation of the VRF system and communicate in a daisy chain configuration between outdoor unit and heat recovery unit(s) and indoor unit(s) via RS485 (shielded twisted wire pair)

network. Control devices shall also be available to control other building systems as required from the VRF control system. DIO/AIO capabilities shall be available as well as a central controller to perform operation changes, schedules and other duties as required by this specification. Addition of separate building control system shall not be required. Other control devices and sequences shall be as specified in other sections of this project specification.

9. Inverter PCB Cooling:
 - a) Cooling of the inverter PCB shall be conducted by way of high pressure, sub-cooled liquid refrigerant via heat exchanger attached to the inverter PCB. The full capacity flow of refrigerant shall pass through the heat exchangers to maximize the cooling effect of the PCBs and to aid in the evaporation process and capacity of the outdoor coil during the heating mode. The recovered heat of the PCBs must be used to enhance the overall heating process, other uses or dissipation of heat to ambient shall not be permitted.
10. Compressor Control:
 - a) Fuzzy control logic shall establish and maintain target evaporating temperature (T_e) in cooling mode and condensing temperature (T_c) in heating mode by Fuzzy control logic to ensure the stable system performance.
11. Initial Test Run (ITR) (Heating or Cooling) / Fault Detection Diagnosis (FDD) Code:
 - a) This control mode shall monitor and display positive or negative results of system initial startup and commissioning. Heating or Cooling ITR mode will be automatically selected. It shall monitor and provide performance metrics for the following, but not be limited to, refrigerant charge validation, auto-charge operation verification, refrigerant cycle stability, connection ratios, indoor unit status, error status, and number of indoor units connected. This commissioning specific control mode shall not replace the system error monitoring control system during normal operation.
12. BMS Integration:
 - a) The VRF system shall be able to integrate with Building Management Systems via BACnet™ IP gateway. This gateway converts between BACnet™ IP or Modbus TCP protocol, and RS-485 LGAP (LG Aircon protocol) allowing third party control and monitoring of the LG A/C system, or LonWorks™ gateways. See controls specification for points list.
13. Wi-Fi Communication:
 - a) The outdoor unit microprocessor shall be capable of being monitored via an optional Wi Fi wireless communications dongle or embedded Wi Fi transmitter. Wi-Fi shall allow service or maintenance personal access to the complete operating system, via LGMV mobile, without need of tools other than smart phone or tablet. Active live system review, collection of all system data for a

- field determined duration presented in a .csv file format or collection of all operating conditions, including all indoor units, valves, sensors, compressor speeds, refrigerant pressures, etc., by snapshot of conditions and placing that snapshot into a power point slide to be reviewed at another time. Systems that require computers, hard wire only connection or other devices to collect, review or record operating conditions shall not be allowed.
14. Indoor Unit Connectivity:
 - a) The system shall be designed to accept connection up to <64> indoor units of various configuration and capacity, depending on the capacity of the system.
 15. Power and Communication Interruption:
 - a) The system shall be capable of performing continuous operation when an individual or several indoor units are being serviced; communication wire cut or power to indoor unit is disconnected from power for a minimum of a 24-hour period. Systems that alarm and/or shut down because of a lack of power to any number of indoor units shall not be acceptable.
 16. Connection Ratios:
 - a) The maximum allowable system combination ratio for all VRF systems shall be 130% and the minimum combination ratio shall be 50%.
 17. Comfort Cooling Mode:
 - a) Comfort cooling shall be initiated via a field setting at the outdoor unit during commissioning or anytime thereafter. Comfort cooling shall allow user to select all or some of the indoor units of a system to automatically modify each of the indoor unit's superheat target set point based on the impending total cooling load of on the indoor unit, the rate of change of the zone temperature relative to set point and optionally, if specified, the rate of change of the zone humidity level.
 18. The outdoor unit shall be provided with a factory installed fusible plug or rupture disc. The fusible plug connection shall be threaded for easy connection with a field provided vent pipe to safely discharge the system's refrigerant charge away from the outdoor unit if a building fire causes an extreme pressure condition in the outdoor unit refrigerant circuit employ for safety a threaded fusible plug.
 19. Refrigerant Flow Control
 - a) An active refrigerant -in-circulation control system consisting of a refrigerant storage container, interconnecting refrigerant piping control valves, pressure transducers, microprocessor control, and software to continuously monitor necessary refrigeration cycle operating parameters to maintain stable cycle operation between minus (-)22°F and 122°F ambient conditions. The refrigerant system operating conditions shall be checked by the algorithm at three-minute intervals and if needed automatically and

dynamically remove and store refrigerant to the storage tank or inject refrigerant from the tank into the refrigerant circuit.

- 1) The algorithm shall adjust refrigerant charge automatically:
 - i. As the outdoor air temperature changes;
 - ii. System mode of operation changes;
 - iii. The path of refrigerant flow through the outdoor coil is modified;
 - iv. The system's target suction and head pressure control values are adjusted.
 - b) Sub-cooler: The VRF outdoor unit shall include a factory provided and mounted sub-cooler assembly consisting of a shell and tube-type sub-cooling heat exchanger and EEV providing refrigerant sub-cooling modulation control by fuzzy logic of EEV and by mode of operation to provide capacity and efficiency as required. Brazed plate heat exchangers shall not be allowed for this function.
 - c) Advanced Smart Load Control: The air source unit shall be provided with Smart Load Control (SLC) enhanced energy saving algorithm that reduces compressor lift during off-peak operation to further reduce system energy consumption when weather and load conditions permit.
 - 1) The SLC algorithm shall be monitoring in real time, the rate of change of the outdoor ambient air temperature, either the outdoor ambient air relative humidity or the indoor air relative humidity [field selectable], and the rate of change of the building load.
 - 2) The SLC algorithm shall foresee pending changes in the building load, outdoor temperature and humidity (or indoor humidity) and proactively reset head and/or suction pressure targets in anticipation of the reduction/increase in building load.
 - 3) The SLC algorithm shall provide no fewer than three (3) field selection options to maximize the control of the VRF system operation during morning warm-up or cool-down following night-setback reset. The selection shall be set by the commissioning agent (or at any other time thereafter). Selectable algorithm choices include:
 - i. Maximize energy savings
 - ii. Balance the rate of temperature change with energy consumed.
 - iii. Quickly cool/heat the building.
20. Refrigerant Volume Management
- a) Active Refrigerant Charge
 - 1) The VRF system shall be able to operate at any and all published conditions year-round in cooling or heating mode without the need of adding or removing refrigerant from the system.

- 2) The air source unit shall be provided with an isolated vessel, interconnecting piping, valves and sensors to store refrigerant and actively pass refrigerant to (or from) the refrigerant circuit in real time as necessary to maintain stable refrigeration cycle operation.
 - 3) The air source unit microprocessor shall be provided with an algorithm that monitors the VRF system head pressure, suction pressure, subcooling, superheat, compressor speed, high and low side temperatures and the load on the system at three-minute intervals and if needed, automatically and dynamically remove and store refrigerant to the storage tank or inject refrigerant from the tank into the refrigerant circuit.
- b) Manual Seasonal Refrigerant Charge Adjustments
(Applicable for VRF systems without Active Refrigerant Charge)
- 1) Alternates: Systems that CANNOT passively and automatically modify the active refrigerant charge using the method(s) stated in the section Active Refrigerant Charge shall clearly state so in bold capital letters in the proposal that this feature is not included.
 - i. VRF systems that cannot perform active refrigerant control may submit their proposal as an Alternate. However, all Alternate proposals must BUT include as part of the equipment price the cost of to provide bi-annual refrigerant charging services for 15 years. Service shall be performed by the factory authorized agent only. Service shall include refrigerant, parts, labor, truck and/or trip charges, and any miscellaneous fees necessary to analyze the current state of the system and perform the refrigerant charge adjustment. Service must occur one month before the winter season and one month before the summer season.
 - 2) If the VRF system requires a charge adjustment more frequently to maintain stable operation, the VRF manufacturer shall provide additional services at no additional charge.
 - 3) The 15-year period shall begin on the date the equipment is commissioned or the date the building occupancy permit was issued for the area(s) served by the system – whichever date is later.
 - 4) This service shall be underwritten, warranted, and administered by the VRF equipment manufacturer – not the local distributor or applied representative.

- 5) The selected service provider shall be mutually agreeable between the building owner (or owners agent) and must be licensed, insured, and trained to work on the VRF system. No third-party service (subcontracted service) providers will be acceptable.
 - 6) If the service provider is not an employee of the VRF manufacturer, the service provider shall be reimbursed for services rendered directly from the manufacturer. Labor rate for services shall be paid at the prevailing union wage rate in place at the time of service.
21. VRF Systems with Onboard Alternate Operating Mode Selection Capability
- a) All VRF systems equipped with field selectable Alternate Operating Modes via DIP Switch or other means, for example but not limited to, High Heat, High Ambient Cooling, High Sensible, or Enhanced Efficiency selections. Performance using the proposed field selected Alternate Operating Mode shall be tested using AHRI Standard 1230 and published in the AHRI Directory.
 - b) Acceptable Alternate Operating Modes must ship with all models of the VRF product offering and must be factory embedded. Custom factory or field modifications to factory provided algorithms created to meet scheduled requirements are not acceptable.
 - c) Provide a copy of instructions required to set the Alternate Operation Mode with the initial submittal.
 - d) For systems that provide field selectable Alternate Operating Modes, ALL technical data provided in the submittal data sheets showing product rated condition performance data, must also provide separate data sheets that show product performance data at each of the field selectable Alternate Operating Modes available. Capacity, power input, and acoustic performance data for each mode offered shall be reported separately. Mixing of ODU, IDU, or VRF system performance capability operating in one mode with for example the power consumption, sound power rating, or electrical requirements of the same system operating in another mode is not acceptable.

E. Field Supplied Refrigerant Piping Design Parameters

1. The outdoor unit shall be capable of operating at an elevation difference of up to 360 feet above or below the lowest or highest indoor unit respectively without the requirement of field installed sub-cooler or other forms of performance enhancing booster devices.
2. The outdoor unit shall be capable of operating with up to 3280 equivalent length feet of interconnecting liquid line refrigerant pipe in the network.

3. The outdoor unit shall be capable of operating with up to 656 actual feet or 738 equivalent length feet of liquid line refrigerant pipe spanning between outdoor unit and farthest indoor unit.
4. The piping system shall be designed with pipe expansion and contraction possibilities in mind. Required expansion devices shall be field designed, supplied and installed based on proper evaluation of the proposed piping design. In addition to these requirements, the piping system installation must conform to the VRF equipment manufacturer's published guidelines.
5. The installation of pipe hangers, supports, insulation, and in general the methods chosen to attach the pipe system to the structure must allow for expansion and contraction of the piping system and shall not interfere with that movement.
6. The elevation difference between indoor units on <heat pump systems> shall be 131 feet.
7. The elevation differences for <heat recovery systems> shall be:
 - a) Heat recovery unit to connected indoor unit shall be 49 feet
 - b) Heat recovery unit to heat recovery unit shall be 98 feet
 - c) Indoor unit to indoor unit connected to same heat recovery unit shall be 49 feet
 - d) Indoor unit to indoor unit connected to separate parallel piped heat recovery units shall be 131 feet.
8. The acceptable elevation difference between two series connected heat recovery units shall be 16 feet.

F. Defrost Operations

1. The outdoor unit(s) shall be provided with a minimum of 4 independent field adjustable defrost cycle algorithms to maximize the effectiveness of the defrost cycle to the local weather conditions. Intelligent Defrost shall melt accumulated frost, snow and ice from the outdoor unit heat exchanger. The defrost cycle length and sequence shall be based on outdoor ambient temperatures, outdoor unit heat exchanger temperature, and various differential pressure variables. Intelligent Heating Mode, when outdoor unit humidistat is engaged, shall extend the normal heating sequences by adjusting the outdoor unit coil target temperature to be above the ambient dew point temperature delaying the need for defrost operations, so long as heating demand is being met.
2. Smart Heating: This feature shall be capable of eliminating several defrost actions per day based on outdoor air temperature and humidity conditions. Smart heating shall extend the heating operation cycle by delaying the frost formation on the outdoor coil by adjusting the surface temperature to keep it above the current outdoor ambient dew point. The algorithm shall delay while maintaining indoor space temperature.
3. Defrost Mode Selection: The outdoor unit shall be provided with a minimum of three field selectable defrost operation modes: Normal, Fast, or Forced.

- a) Normal Defrost: Operation intended for use in areas of the country that experience adverse winter weather with periods of heavy winter precipitation and extremely low temperatures. This strategy shall maximize the systems heating performance and maintain operational efficiency. When the ambient temperature is either: a) above 32°F or b) below 32°F with the humidity level below 60% RH, Intelligent Defrost shall continue heating regardless of ice build-up on the coil until the quality of the heated air (i.e. discharge air temperature) decreases. At temperatures below 4°F, a defrost cycle shall occur every two hours to optimize system heating efficiency.
 - b) Fast Defrost: Operation intended for use in areas of the country with mild winter temperatures and light to moderate humidity levels. The strategy minimizes defrost cycle frequency allowing frozen precipitation to build longer in between cycles. Minimum time between defrost cycles shall be 20 minutes. Intelligent Defrost shall choose between split coil/frame and full system methods based on current weather conditions to minimize energy consumption and maximize heating cycle time.
 - c) Forced Defrost: Operation shall be available for the service provider to test defrost operations at any weather condition and to manually clear frozen water from the outdoor coil surfaces.
4. Defrost Method Selection: The outdoor unit shall be provided with two field selectable defrost operation methods: Split Coil/Frame and Full System. Split Coil/Frame option provides continuous heating of the occupied space during defrost operation.
- a) Split Coil/Frame method shall be available when Normal Defrost mode is selected. Split Coil method shall be available on all Heat Pump and Heat recovery single-frame VRF systems. Split Frame defrost shall be available on all Heat Pump and Heat recovery multi-frame outdoor units.
 - b) Split Coil method shall remove ice from the bottom half of the outdoor unit coil first for a maximum time of six minutes, then the top half for a maximum of six minutes. Next the bottom coil shall be heated again for an additional three minutes to remove any frozen water that may have dripped onto the lower coil during the top coil defrost operation.
 - c) When Split Coil/Frame method is selected, a Full System defrost shall occur every 1-9 (field selectable) defrost cycles to assure 100% of the frozen precipitation has been removed to maintain efficient performance.
 - d) Full System method shall be available as a field selectable option. All outdoor units located in areas of the country where large volumes of frozen precipitation are common, the commissioning agent shall be able to select the Full System only defrost method.

5. Indoor Unit Fan Operation During Defrost
 - a) During partial defrost operation indoor units operating in cooling or dry mode shall continue normal operation.
 - b) During partial defrost operation, indoor units that are commissioned with fans set for continuous operation shall maintain normal fan speed unless the leaving air temperature drops, then the fan speed will be reduced to low speed for the remainder of the defrost cycle.
 - c) During full system defrost operation indoor unit fans will cycle off and remain off during the remainder of the defrost cycle.

G. Oil Management

1. The system shall utilize a high-pressure oil return system to ensure a consistent film of oil on all moving compressor parts at all points of operation. Oil is returned to compressor through a separate high pressure oil injection pipe directly into the oil sump. Oil returned to the compressor via the suction port of the compressor shall not be allowed.
2. Each compressor shall be provided with a high efficiency independent centrifugal cyclone type oil separator, designed to extract oil from the oil/refrigerant gas stream leaving the compressor.
3. The system shall have an oil level sensor in the compressor to provide direct oil level sensing data to the main controller. The sensor shall provide data to main outdoor unit PCB to start oil return mode and balance oil levels between multiple compressors.
4. The system shall only initiate an oil return cycle if the sensed oil level is below oil level target values as determined by the microprocessor. The system shall display an error if the oil sensor signals low oil level for a period of 130 minutes or longer.
5. A default oil return algorithm shall automatically initiate the oil return mode if the system detects a failure of the oil sump sensor. A fault code shall be reported by the system.
6. Timed oil return operations or systems that do not directly monitor compressor oil level shall not be permitted.
7. Indoor Unit Fan Operation during Oil Return Cycle
 - a) During oil return cycle indoor units operating in cooling or dry mode shall continue normal operation.
 - b) During oil return, indoor units that are commissioned with fans set for continuous operation shall maintain normal fan speed unless the leaving air temperature drops, then the fan speed will be reduced to low speed for the remainder of the oil return cycle.
 - c) During oil return cycle indoor unit fans will cycle off and remain off during oil return cycle while operating in all modes.

H. Fan and Motor Assembly

1. 6-ton frames shall be equipped with one direct drive variable speed propeller fan with Brushless Digitally Controlled (BLDC) motor with a vertical air discharge.
2. 8-to-20-ton frames shall be equipped with two direct drive variable speed propeller fan(s) with BLDC motor(s) with a vertical air discharge.
3. The fan(s) blades shall be made of Acrylonitrile Butadiene Styrene (ABS) material and incorporate biomimetic technology to enhance fan performance and reduce fan generated noise.
4. The fan(s) motor shall be equipped with permanently lubricated bearings.
5. The fan motor shall be variable speed with an operating speed range of 0-1150 RPM cooling mode and 0-1150 RPM heating mode.
6. The fan shall have a guard to help prevent contact with moving parts.
7. The cabinet shall have option to redirect the discharge air direction from vertical to horizontal with the addition of optional factory provided air guides.
8. The fan controller shall have a DIP switch setting to raise external static pressure of the fan up to 0.32 inch of W.C. to accommodate ducted installations.
9. The fan control shall have a function setting to remove excess snow automatically.
10. The fan control shall have a function setting to remove access dust and light debris from the outdoor unit and coil.

I. Cabinet

1. Outdoor unit cabinet shall be made of 20-gauge galvanized steel with a weather and corrosion resistant enamel finish. Outdoor unit cabinet finish shall be tested in accordance with ASTM B-117 salt spray surface scratch test (SST) procedure for a minimum of 1000 hours.
2. Cabinet weights and foot prints shall vary between 430 lbs., 7.61 sq. ft. (1.27 sq. ft. per ton), for 6-ton cabinet to 666 lbs., 10.14 sq. ft. (.51 sq. ft. per ton), for 20-ton cabinet for single cabinet configurations. The front panels of the outdoor units shall be removable type for access to internal components.
3. A smaller service access panel, not larger than 7" x 7" and secured by a maximum of (2) screws, shall be provided to access the following:
 - a) Service tool connection
 - b) DIP switches
 - c) Auto addressing
 - d) Error codes
 - e) Main microprocessor
 - f) Inverter PCB
4. The cabinet shall have piping knockouts to allow refrigerant piping to be connected at the front, right side, or through the bottom of the unit.
5. The cabinet shall have a factory installed coil guard.

J. Outdoor Unit Coil

1. Outdoor unit coil shall be designed, built and provided by the VRF outdoor unit manufacturer.
2. The outdoor unit coil for each cabinet shall have lanced aluminum fins with a maximum fin spacing of no more than 17 Fins per Inch (FPI). All the outdoor unit coils shall be 2 or 3 rows consisting of staggered tubes for efficient air flow across the heat exchanger
3. Outdoor unit coil shall be comprised of aluminum fins mechanically bonded to copper tubing with inner surfaces having a riffling treatment to expand the total surface of the tube interior
4. The aluminum fin heat transfer surfaces shall have factory applied corrosion resistant Black Fin coating. The copper tubes shall have inner riffling to expand the total surface of the tube interior.
 - a) ISO 21207 Salt Spray Test Method B – 1500 hours
 - b) ASTM B-117 Acid Salt Test – 900 hours
 - c) The Black Fin coating shall be certified by Underwriters Laboratories and per ISO 21207. The above conditions shall establish the minimum allowable performance which all alternates must comply.
5. Variable Path Heat Exchanger: System shall have a variable flow and path outdoor heat exchanger function to vary the refrigerant flow and volume and path. Control of the variable path circuits shall be based on system operating mode and operating conditions as targeted to manage the coil heat transfer capacity and efficiency. The variable path heat exchanger technology shall be provided to maintain stable refrigeration cycle operation during mild weather conditions and maintain a robust hot vapor temperature system head pressure that delivers “gas-furnace leaving air temperature” from the indoor unit at sub-zero outdoor air temperature down to minus (-) 22°F. The outdoor unit coil, all indoor units and pipe network shall be field tested to a minimum pressure of 550 psig.

K. Compressor(s)

1. Compressor shall be designed and assembled by the VRF manufacturer specifically for use in the air source VRF product line. Third party manufactured, branded, or designed to the VRF system’s OEM specifications by a third-party manufacturer shall not be acceptable.
2. Compressor shall be a hermetic, high-side shell (HSS), commercial grade, compliant scroll direct-drive design.
 - a) Compressor Design: The compressor design shall be of the high-pressure shell scroll type where the internal pressure below the suction valves of the compressor shall be at the same high pressure and high temperature. The motor shall be cooled by high pressure gas at temperatures above saturation conditions and minimize the mixing of refrigerant liquid with oil in the sump. The system shall employ a high-pressure oil return method returning recovered oil from the oil separator directly into the oil sump of the compressor;

oil shall not be allowed to return via the suction line. Bearing surfaces are continually coated with oil. The compressor shall employ an Aero-bearing constructed with high lubricity materials increasing operation time in case of low sump oil level.

Compressor shall have a nominal operating range from 12Hz to 150 Hz.

3. The fixed and oscillating compressor scroll components shall be made of high grade (GC25) or denser steel material. All scrolls shall be heat treated and tempered.
4. The oscillating scroll shall be finely machined and polished. PVE refrigerant oil shall be used as the sole liquid used to maintain a seal between the high and low sides of the compression chamber. Compressors that requires the use of any type of mechanical or wearable sealant material between the moving surfaces of the compression chamber is NOT ACCEPTABLE.
5. Vapor Injection: System shall have a medium pressure gas vapor injection function employed in the heating and cooling modes to increase system capacity when the outdoor ambient temperatures are low and lower compressor lift when temperatures are high. The compressor vapor injection flow amount shall be controlled by the vapor injection sub-cooling algorithm reset by discharge gas temperatures of the compressor.
6. Bearing surfaces shall be coated with Teflon® equal. Bearings shall be lubricated using a constant flow of PVE refrigerant oil to the bearing surfaces. The film of oil separating the crankshaft journals and bearing surfaces shall be consistent at all times the crankshaft is in motion and shall be maintained irrelevant of crankshaft rotational speed.
7. An internal, integrated, mechanically driven gear pump shall draw oil from the compressor sump reservoir, pressurize the oil and inject the oil directly to the crankshaft journals maintaining a consistent film of oil between all moving parts. Auxiliary, indirect, or electronically driven pumps are not acceptable.
8. The viscosity property of the PVE oil in the compressor sump shall be maintained irrelevant or compressor operation and the surrounding ambient temperature.
 - a) The compressor shall be equipped with an external thermally protected electric crankcase heater that is automatically activated only when the ambient temperature is below freezing and the compressor is not running to maintain the temperature of the oil in the sump above the refrigerant boiling point.
 - b) During stable operation, irrelevant of ambient air temperature outside the water source unit, the temperature of refrigerant vapor in contact with the surface of the oil in the compressor sump shall be maintained above 140°F to prevent foaming and to eliminate refrigerant from mixing with the oil degrading the viscosity of the oil in the sump.

9. The compressor motor shall be designed to operate at high temperatures.
 - a) The motor winding insulation shall be designed to operate continuously at a minimum temperature of 180°F without deterioration.
 - b) The motor cooling system shall be designed to maintain acceptable operational temperature at all times and in all conditions using high pressure, hot refrigerant vapor as motor coolant.
10. Inverter Compressor Controller(s)
 - a) Each compressor shall be equipped with a dedicated inverter compressor drive. The control of multiple compressors using a single drive is not acceptable.
 - b) The inverter drive shall vary the speed of the compressor crankshaft between zero (0) Hz and 140 Hz.
 - c) The inverter driver controller shall be matched with the physical properties of the compressor. The drive shall be manufactured by the VRF air source unit manufacturer. The inverter drive and matching compressor shall have been thoroughly tested as a matched pair. The inverter drive shall be programmed to avoid operating the compressor at any speed that results in harmonic vibration, nuisance noise, or mechanical damage to either the driver or the compressor with power provided that is within the tolerance specification.
 - d) The compressor inverter drive assembly and software must be designed, manufactured, and supplied by the VRF product manufacturer. Third party branded inverter driver hardware and/or driver software or inverter driver hardware and/or software provided by a third-party manufacturer to meet OEM specifications of the VRF water source manufacturer will not be acceptable.
 - e) All inverter drive hardware or software manufactured in, is a product of, or sourced from China, or using a broker or third-party provider as an intermediary that obtains the product from CHINA shall not be acceptable.
11. Compressor(s)
 - a) Each 6, 8, 10-ton frames shall be equipped with a single hermetically sealed, inverter driven, High Side Shell (HSS) scroll compressor.
 - b) 12-, 14-, 16-, 18-and 20-ton frames shall be equipped with dual hermetically sealed, inverter driven, High Side Shell (HSS) scroll compressors.
 - c) Each inverter driven, HSS scroll compressor shall be capable of operating from 12 Hz up to 150 Hz in any and all modes (cooling, heating or simultaneous modes).
 - d) The compressor shall be designed for a separate port for oil to be directly returned to the compressor oil sump.

- e) The compressor bearing(s) shall have Teflon™ coating and shall be an aero type design using High lubricity materials.
- f) The compressor(s) shall be protected with:
 - 1) High Pressure switch
 - 2) Over-current /under current protection
 - 3) Oil sump sensor
 - 4) Phase failure
 - 5) Phase reversal
 - 6) Compressor shall be capable of receiving injection of medium pressure gas at a point in the compression cycle where such injection shall allow a greater mass flow of refrigerant at lower outdoor ambient and achieving a higher heating capability. The VRF outdoor unit shall have published performance data for heating mode operation down to -22°F on both heat pump and heat recovery systems.
- g) Standard, non-inverter driven compressors shall not be permitted nor shall a compressor without vapor injection or direct sump oil return capabilities.

L. Operational Sound Levels

- 1. The compressor(s) shall be mounted on rubber isolation grommets. Compressor shall ship with removable clamps that secure the compressor in place while transported. The installing contractor shall remove and discard (or optionally adjust the clamps to allow the isolator to properly function) the clamps prior to commissioning the water source unit.
- 2. Each single frame outdoor unit shall be rated with an operational sound pressure level not to exceed as listed on below chart when tested in an anechoic chamber under ISO 3745 standard at the highest field selectable heating operating modes available. Such documentation shall be presented in all submittals, manufactures who elect to rate their equipment at other than tested in an anechoic chamber under ISO 3745 standard at the highest field selectable heating operating modes available and the highest field selectable conditions shall not be allowed.
- 3. A field setting shall be available to program the outdoor unit to reduce sound levels at night, when desired, to a selectable level while still able to meet building load requirement. This mode is available in both cooling and heating modes.

M. Sensors

1. Each outdoor unit module shall have:
 - a) Suction temperature sensor
 - b) Discharge temperature sensor
 - c) Oil level sensor
 - d) High Pressure sensor
 - e) Low Pressure sensor
 - f) Outdoor temperature sensor
 - g) Outdoor humidity sensor
 - h) Outdoor unit heat exchanger temperature sensors

N. Wind Load Installations for Outdoor Units

1. Provide Florida wind Load Installation Drawings that meet the requirements of the 2017 Florida Building Code, 6th Edition and ASCE Standard 7-2010 with submittal.

O. Seismic Installations

1. Provide with submittal: 1) OSHPD Special Seismic Certification Preapproval (OSP) documents for certified product list of VRF equipment to be installed in high seismic risk areas. 2) Equipment installation documents in conformance with CBC 2013, 2016 and 2019 California Building Code and IBC 2012, 2015 and 2018 International Building Code.

P. Warranty

1. Limited Warranty Period
 - a) STANDARD ONE-YEAR PARTS WARRANTY FOR A QUALIFIED SYSTEM - The Part(s) of a qualified System, including the compressor, are warranted for a period (the “Standard Parts Warranty Period”) ending on the earlier to occur of one (1) year after the date of original installation, or eighteen (18) months from the date of manufacture.
 - b) ADDITIONAL SIX (6) YEAR COMPRESSOR PART WARRANTY - The Compressor is warranted for an additional six (6) year period after the end of the applicable Standard Part Warranty Period (the “Compressor Warranty Period”).
2. Extended Warranty
 - a) The Standard Warranty Period and the Compressor Warranty Period are extended to a total of ten (10) years (the “Extended Warranty Period”) for qualified Systems that have been (a) commissioned by a party that has completed the current Training Requirements, (b) such commissioning is pursuant to LG’s current published instructions, and (c) the System commissioning results and supporting documents are entered correctly into LG’s online commissioning system. Commissioning of a System requires one (1) hour of LG Monitoring View (LGMV) data. Commissioning

results must be entered into LG's online commissioning system within sixty (60) days of System startup.

2.08 INDOOR EVAPORATORS – HORIZONTAL DUCTED

A. General

1. Unit shall be factory assembled, wired, piped and run tested.
2. Unit shall be designed to be installed for indoor application.
3. Unit shall be designed to mount fully concealed behind the wall, in a closet or above the finished ceiling.
4. The unit case shall be designed to accept an internal, optional LG electric strip heater mounted in the reheat position, available in 5, 10, 15, and 20 KW capacities for field installation per installation instructions.
5. The supply air shall be flanged for field installed ductwork that shall not exceed the external static pressure limitation of the unit.

B. Casing/Panel

1. Unit case shall be manufactured using 22-gauge Pre Coated Metal (PCM).
2. The external surface shall be finished with a high gloss baked enamel finish.
3. The finish color shall be morning fog.
4. The cold surfaces of the unit shall be internally insulated with 1/2-inch foil faced polystyrene fiber insulation.
5. The inside surface of fan assembly door access panel shall be treated with 1/2-inch polystyrene fiber insulation, encapsulated on both sides.
6. The access panel shall be sealed along the edges with reinforced foil faced covering to prevent deterioration caused by panel removal.
7. All the access panels shall be provided with gasket seals to minimize air leakage.
8. The external insulation shall be plenum rated and conform to ASTM Standard D-1418.

C. Cabinet Assembly

1. The unit shall be designed to operate in the vertical (up flow) configuration or horizontal (left) end discharge.
2. Unit shall, in the vertical position, have opening for supply air from top with a dedicated bottom vertical return and in the horizontal position supply air shall be from the left end with the return air from the right end.
3. Unit shall be equipped with factory installed temperature thermistors for:
 - a) Return air
 - b) Refrigerant entering coil
 - c) Refrigerant leaving coil
4. Unit shall have a factory assembled, piped and wired electronic expansion valve (EEV) for refrigerant control.
5. Unit shall have a built-in control panel to communicate with other indoor units and to the outdoor unit.
6. Unit shall have the following functions as standard:

- a) Self-diagnostic function
- b) Auto addressing
- c) Auto restart function
- d) Auto changeover function (Heat Recovery system only)
- e) Auto operation function
- f) Auto clean function
- g) Child lock function
- h) Forced operation
- i) Dual thermistor control
- j) Sleep mode
- k) External static pressure (ESP) control
- l) Dual set point control
- m) Aux heater applications
- n) Filter life timer
- o) External on/off control input
- p) Wi-Fi compatible
- q) Auto fan operation
- r) Refrigerant Leak detection logic

D. Fan Assembly

- 1. The unit shall have an integral fan assembly consisting of galvanized steel housing and forward curve fan wheel.
- 2. The fan motor is Brushless Digitally commutated (BLDC) with permanently lubricated and sealed ball bearings.
- 3. The fan motor shall include thermal, overcurrent and low RPM protection.
- 4. The fan/motor assembly shall be mounted on vibration attenuating rubber grommets.
- 5. The fan speed shall be controlled using microprocessor based direct digitally controlled algorithm that provides a minimum of three pre-programmed fan speeds. Each setting is also adjustable by field setting to compensate for a limited amount of additional resistance to airflow by adjusting the RPM of the fan motor.
- 6. In cooling mode, the indoor fan shall have the following settings: Low, Med, High, and Auto.
- 7. In heating mode, the indoor fan shall have the following settings: Low, Med, High, and Auto.
- 8. Each of the settings can be field adjusted from the factory setting (RPM/ESP).
- 9. Unit shall be designed for high-speed air volume against an external static pressure of up to 1.0" water gauge model dependent.

E. Filter Assembly

- 1. The unit comes with a filter rack capable of accepting a field supplied 16" x 20" x 1" filter cartridge
- 2. The filter rack shall be equipped with guides to keep filter centered in the rack.

3. The filter access shall be from the front of the unit without removing coil or fan area access panel.
 4. The filter access door shall be fitted with thumb screws that can be removed without the use of any tool.
- F. Coil Assembly
1. Unit shall have a factory-built coil comprised of aluminum fins mechanically bonded on copper tubing.
 2. The copper tubing shall have inner grooves to expand the refrigerant contact surface for high efficiency heat exchanger operation.
 3. Unit shall have minimum two to three row coil, 18 fins per inch.
 4. Unit shall have a factory supplied condensate drain pan below the coil constructed of HIPS (high impact polystyrene resin).
 5. Unit shall be designed for gravity drain.
 6. The unit shall have a secondary drain port plug for overflow.
 7. Unit shall have provision of 45° flare refrigerant pipe connections.
 8. The coil shall be factory pressure tested at a minimum of 550 psig.
 9. All refrigerant piping from outdoor unit to indoor unit shall be field insulated. Each pipe should be insulated separately. Thickness and heat transfer characteristics shall be determined by the design engineer and shall meet all code requirements.
- G. Microprocessor Control
1. The unit shall have a factory installed microprocessor controller capable of performing functions necessary to operate the system with or without the use of a wall mounted controller. The unit shall have a factory mounted return air thermistor for use as a space temperature control device. All operating parameters except scheduling shall be stored in non-volatile memory resident on the microprocessor. The microprocessor shall provide the following functions, self-diagnostics, auto re-start after a power failure and a test run mode
 2. The unit shall be able to communicate with other indoor units and the outdoor unit using a field supplied minimum of 18 AWG, two core, stranded, twisted, and shielded communication cable.
 3. The unit controls shall operate the indoor unit using one of the five operating modes:
 - a) Auto changeover (Heat Recovery System only)
 - b) Heating
 - c) Cooling
 - d) Dry
 - e) Fan only
 4. The unit shall be able to operate in either cooling or heating mode for testing and/or commissioning.
 5. The unit shall be able to operate with the fan turned off during system cooling thermal off.
 6. The unit shall be able to operate with a continuous fan setting.

7. The unit shall have adjustable, multi-step cooling and heating mode thermal on/off temperature range settings.
 8. The system shall include a product check function to access and display indoor unit type and capacity from a wired programmable zone controller.
- H. Electrical
1. The unit electrical power shall be 208-230/1/60 (V/Ph/Hz).
 2. The unit shall be capable of operating within voltage limits of +/- 10% of the rated voltage.
- I. Controls
1. Unit shall use controls provided by the manufacturer to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over an RS-485 daisy chain.
- J. Seismic Installations
1. Provide with submittal: 1) OSHPD Special Seismic Certification Preapproval (OSP) documents for certified product list of VRF equipment to be installed in high seismic risk areas. 2) Equipment installation documents in conformance with CBC 2013, 2016 and 2019 California Building Code and IBC 2012, 2015 and 2018 International Building Code.
- K. Warranty
1. Please refer to the respective outdoor unit for applicable warranty.

PART 3 - EXECUTION

- 3.01** Orient unit to obtain maximum air flow to condenser coil and adequate clearance for service (refer to manufacturer's installation instructions).
- 3.02** Install unit level and attach to supports.
- 3.03** Install interconnecting refrigerant piping between outdoor unit and indoor air handler. Arrange piping provide access for service panel removal and to avoid restricting service walk area. Insulate all refrigerant piping.
- 3.04** Coordinate location of electrical connections with electrical contractor.
- 3.05** Install condensate drain piping and insulate.
- 3.06** Install condensate overflow cut-off devices.
- 3.07** Install filters.
- 3.08** Ensure all condensing unit coil fins are straight and coil covers installed.
- 3.09** Provide unit identification on all units.

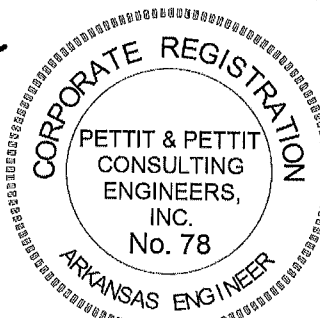
- 3.10** Installation of all units shall be coordinated with manufacturer's installation instructions.
- 3.11** Install all control wiring in conduit.

END OF SECTION 23 81 30

The Engineer of Record for Divisions 26, 27, and 28 of the Specifications for the Byrne Hall Renovation Project, St. Johns Center, Little Rock, Arkansas, Job No. 25-058 (P&P Job No. 25-112) is:

6-9-2026

Date



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PETTIT & PETTIT
CONSULTING ENGINEERS, INC.

PART 1 - GENERAL**1.01 SECTION INCLUDES**

- A. Basic Electrical Requirements specifically applicable to Divisions 26, 27, 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, 2021 Edition.
 - 9. Local, City and State Codes and Ordinances.
 - 10. National Electrical Code, 2023 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" reproducibles, legibly and accurately marked to indicate all changes, additions, deletions, etc., from the contract drawings.

1.08 GUARANTEE

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

replaced or repaired free of charge.

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

1.09 OPERATING AND MAINTENANCE MANUALS

- A. After approval of materials and equipment for use in this project, 3 copies of an Operation and Maintenance Manual shall be submitted for approval.
- B. The basic information for each item of equipment to be included is as follows:
 - 1. Index
 - 2. Maintenance and operating instructions
 - a. Manufacturer's descriptive literature and maintenance manuals
 - b. An Approved Set of Shop drawings
 - c. Applicable control diagrams
 - d. Composite wiring diagrams as applicable showing all motor controllers, relays, etc., with interlocking provisions as built in the job, along with a written description of the control sequence if applicable.
 - e. Spare parts list (when parts are provided)
 - f. Listing of part suppliers and their addresses
 - g. Single line diagram of the "as built" building electrical distribution system.
- C. Upon final approval, submit one (1) bound copy of the approved Operation and Maintenance Manual to the Engineer and hold two (2) copies for instruction of Owner as hereinafter specified.

1.10 CONFLICTS BETWEEN DRAWINGS AND SPECIFICATIONS

- A. If a conflict between the drawings and the specifications occurs, the most stringent requirement shall apply.

PART 2 - PRODUCTS

2.01 UL LISTING

- A. Where the Underwriter's Laboratories have an applicable standard, the product shall be listed with UL and shall be so marked.

2.02 SUBSTITUTIONS

- A. Each Section of the Project Manual, when applicable has a paragraph entitled "Manufacturers". If "Engineer Approved Equal" is not in the list of manufacturers, no substitutions will be accepted. Submit one of the manufacturers listed.
- B. The Engineer does not give any prior approvals on submittals. Do not call the Engineer for prior approval.

PART 3 - EXECUTION

3.01 600 VOLT INSULATION TEST

- A. Prior to energizing the electrical system, the contractor shall provide insulation resistance tests for all distribution and utilization equipment. The Contractor shall provide a suitable and stable source of test power. The insulation test shall be a "megger" test at 500 volts D.C. for one-half minute. A test report shall be submitted to the Engineer. The minimum

insulation resistance for No. 12 AWG conductors shall be 1,000,000 ohms and for larger conductors shall be 250,000 ohms. Conductors testing below the minimum insulation resistance shall be replaced and tested again.

3.02 CONTINUITY TEST

- A. The Contractor shall perform a continuity test on the entire electrical system prior to energizing the system to 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 23 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 26 05 00

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 05 33 – Raceway and Boxes for Electrical Systems.
- B. Section 26 05 19 – Low-Voltage Electrical Power Connectors and Cable.
- C. Section 26 05 29 – Hangers and Supports for Electrical Systems.
- D. Section 26 28 16 - Enclosed Switches and Circuit Breakers.
- E. Section 28 31 00 – Fire Detection and Alarm.

1.03 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.
- B. NEMA WD 1 - General Purpose Wiring Devices.
- C. NEMA WD 6 - Wiring Device Configurations.
- D. NFPA 72 - National Fire Alarm Code.
- E. UL 498 - Attachment Plugs and Receptacles.
- F. UL 1010 - Receptacle Plug Combinations for Use in Hazardous (Classified) Locations.

1.04 SUBMITTALS

- A. Submit under provisions of Division 1 and Section 26 05 00.
- B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.05 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.
- C. Conform to requirements of the Arkansas State Fire Protection Code.

1.06 COORDINATION

- A. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections. Verify voltage, ampere, and phase ratings before beginning any of the work. Notify Engineer immediately of any discrepancies found. Any work installed that has to be replaced because of the contractor's failure to verify these ratings will not be reimbursed. Verify that equipment furnished under other sections has disconnects and starters, if so specified in other sections.
- B. Determine connection locations and requirements.
- C. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
- D. Sequence electrical connections to coordinate with start-up schedule for equipment.

PART 2 - PRODUCTS

2.01 CORDS AND CAPS

- A. Manufacturers:
 - 1. Hubbell.
 - 2. Pass & Seymour.
 - 3. Arrow-Hart.
- B. Attachment Plug Construction: Conform to NEMA WD 1.
- C. Configuration: NEMA WD-6; match receptacle configuration at outlet provided for equipment.
- D. Cord Construction: ANSI/NFPA 70, Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
- E. Size: Suitable for connected load of equipment, length of cord, and rating at branch circuit overcurrent protection.

2.02 BOILER SAFETY SHUTDOWN EQUIPMENT FOR BOILERS RATED 400,000 BTUH AND

HIGHER

- A. Normally closed pushbutton(s) shall be equal to Square D #SK9RD5H13 with additional KA1 contacts for additional boilers.
- B. Power Relay shall be equal to Square D Class 8501 Type CO-7 in a NEMA 1 enclosure.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using liquidtight flexible conduit with watertight connectors.
- C. Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.
- D. Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated.
- E. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- F. Install disconnect switches, controllers, control stations, and control devices as indicated and as required by applicable codes.
- G. Provide interconnecting conduit and wiring between devices and equipment where indicated.
- H. All flexible conduit to pumps, chillers, air handling units, outdoor equipment, and water heaters shall be liquidtight.
- I. Ground all metal equipment. Ensure that bonding breaks through paint to bare metallic surface of all painted metallic equipment.
- J. The contractor shall check overload settings, wire sizes, fuse/circuit breaker sizes & disconnect sizes of equipment provided by others for compliance with the National Electrical Code and shall:
 - 1. Adjust settings where possible.
 - 2. Advise the Engineer of non-compliance where remedy will require more than just adjustments.

END OF SECTION 26 05 02

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLE**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Building wire and cable.
- B. Wiring connectors and connections.

1.02 RELATED SECTIONS

- A. Section 26 05 29 – Hangers and Supports for Electrical Systems.
- B. Section 26 05 33 – Raceway and Boxes for Electrical Systems.
- C. Section 26 05 53 – Identification for Electrical Systems.

1.03 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.
- B. NETA – National Electrical Testing Association.
- C. UL 83 - Thermoplastic Insulated Wires and Cables.
- D. UL 486 A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- E. UL 486 C - Splicing Wire Connectors.
- F. UL 1581 - Reference Standard for Electrical Wires, Cables and Flexible Cords.

1.04 SUBMITTALS

- A. Submit under provisions of Division 1 and Section 26 05 00.
- 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.

1.06 REGULATORY REQUIREMENTS

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

1.07 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Conductors shall be copper.
- C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.
- D. Where wire and cable routing are not shown, and destination only is indicated, determine exact routing and lengths required.

1.08 COORDINATION

- A. Determine required separation between cable and other work.
- B. Determine cable routing to avoid interference with other work.

PART 2 - PRODUCTS

2.01 MANUFACTURERS - BUILDING WIRE AND CABLE

- A. Southwire.
- 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:

208Y120 Volts			Switchlegs	
Phase A	Black		Violet	
Phase B	Red		Pink	
Phase C	Blue			
Ground	Green			
Neutral	White			
480Y277 Volts			240/120 Volts	
Phase A	Brown		Black	
Phase B	Orange		Red	
Phase C	Yellow			

	Ground Neutral	Green Gray	Green White
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 05 53 – 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 26 06 19

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Rigid steel conduit.
- B. Flexible metal conduit.
- C. Liquidtight flexible metal conduit.
- D. Electrical metallic tubing.
- E. Surface mounted raceway.
- F. PVC conduit.
- G. Fittings and conduit bodies.

1.02 RELATED SECTIONS

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.

Electrical

1.04 DESIGN REQUIREMENTS

- A. Conduit Size: ANSI/NFPA 70.

1.05 SUBMITTALS

- A. Submit under provisions of Division 1 and Section 260511.
- B. Product Data: Provide for metallic conduit, flexible metal conduit, liquidtight flexible metal conduit, metallic tubing, fittings and conduit bodies.

1.06 PROJECT RECORD DOCUMENTS

- A. Accurately record actual routing of conduits larger than 2 inches.

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 prior to rough-in.
- C. Route conduit as shown on Drawings in approximate locations unless specifically dimensioned. Route as required to complete wiring system.

PART 2 - PRODUCTS

2.01 CONDUIT REQUIREMENTS

- A. Minimum Size: 3/4 inch unless otherwise specified.
- B. Underground Installations:
 - 1. Below Grade: Conduit installed below grade shall be Schedule 40 PVC.
- C. Fittings Boxes and Conduit Bodies: As manufactured by surface metal raceway manufacturer.

2.07 NONMETALLIC CONDUIT

- A. Manufacturers:
 - 1. Carlon.
 - 2. Engineer Approved.
- B. Description: NEMA TC 3; Schedule 80 PVC.
- C. Fittings and Conduit Bodies: NEMA TC 3.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install conduit in accordance with NECA "Standard of Installation."
 - 1. Arrange conduit to maintain headroom and present neat appearance.
 - 2. Exterior: All branch circuit conduit serving exterior, building mounted light fixtures, receptacles, and other devices/equipment on finished-out exterior building walls shall be concealed unless specifically noted otherwise or unless construction prohibits.
- B. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- C. Install no more than equivalent of four 90-degree bends between boxes. Use factory elbows for all 90 degree bends.
- D. Use suitable caps to protect installed conduit against entrance of dirt and moisture during construction.
- E. Ground and bond conduit under provisions of Section 16170.
- F. Identify conduit under provisions of Section 16195.
- G. Provide suitable pullboxes in all conduit runs as required by the National Electrical Code and as required to facilitate wire installation.
- H. Make sure conduits are properly terminated, reamed and brushed before installation of wire or cable.
- I. Underground duct installation requirements:
 - 1. Ducts shall be in accordance with the NEC, as shown on the drawings, and as specified.
 - 2. Underground conduit stub-ups and sweeps to equipment inside of buildings shall be galvanized rigid steel, and shall extend a minimum of 5 feet outside of building foundation or as directed on plans..
 - 3. Stub-ups, sweeps, and risers to equipment mounted on outdoor concrete slabs shall be galvanized rigid steel, and shall extend a minimum of 5 feet away from edge of slab.
 - 4. Install insulated grounding bushings on the terminations.
 - 5. Rigid steel conduit turns of direction for all duct lines shall have minimum 4 feet radius in the horizontal and vertical directions. Sweeps for all duct lines shall have a minimum 40 feet radius in the horizontal and 4 feet in the vertical directions. Where a 40 feet radius is not possible, horizontal turns of direction shall be rigid steel.
 - 6. All multiple conduit runs shall have conduit spacers. Spacers shall securely support and maintain uniform spacing of the duct assembly a minimum of 3 inches above bottom of trench during the concrete pour. Spacer spacing shall not exceed 5 feet.

7. Duct lines shall be installed no less than 12 inches from other utility systems, such as water, sewer, and chilled water.
8. Clearances between individual ducts:
 - a. For like services, not less than 3 inches.
 - b. For power and signal services, not less than 6 inches.
 - c. Provide plastic spacers to maintain clearances.
 - d. Provide nonferrous tie wires to prevent displacement of the ducts during pouring of concrete or backfill. Tie wires shall not act as substitute for spacers.
9. Couple the ducts with proper couplings. Stagger couplings in rows and layers to insure maximum strength and rigidity of the duct bank.
10. Keep ducts clean of earth, sand, or gravel during construction, and seal with tapered plugs upon completion of each portion of the work.

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.

3.03 USE OF THE FOLLOWING IS PROHIBITED

- A. Installation of conduit or tubing which has been crushed or deformed.
- B. LB Fittings. All bends shall be factory made 90 degree elbows.

END OF SECTION 26 05 25

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Grounding electrodes and conductors.
- B. Equipment grounding conductors.
- C. Bonding.
- D. Chemicals.
- E. Conduit.

1.02 RELATED SECTIONS

- A. Section 26 05 33 – Raceway and Boxes for Electrical Systems.
- B. Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables.

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 05 00.
- 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.

1.09 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc.

PART 2 - PRODUCTS

2.01 ROD ELECTRODE

- A. Material: Copper clad steel.
- B. Diameter: 3/4 inch.
- C. Length: 10 feet.

2.02 WIRE

- A. Material: Stranded or solid copper.
- B. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.
- C. Wire shall conform to Section 26 05 19.

2.03 EXOTHERMIC CONNECTIONS

- A. Cadweld.
- B. Approved Equal.

2.04 CHEMICALS

- A. Ground enhancement materials (50 lbs. minimum per rod).
- B. Cadweld "GEM" system, or approved equal.

2.05 CONDUIT

- A. Conduit shall conform to Section 26 05 33.

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 26 05 26

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Conduit, cable and equipment supports.
- B. Anchors and fasteners.

1.02 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.
- B. NECA - National Electrical Contractors Association.
- C. UL 514B - Fittings for Conduit and Outlet Boxes.

1.03 SUBMITTALS

- A. Submit under provisions of Division 1 and Section 26 05 00.
- 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 26 05 29

PART 1 - GENERAL**1.01 SECTION INCLUDES**

- A. Rigid steel conduit.
- B. Flexible metal conduit.
- C. Liquidtight flexible metal conduit.
- D. Electrical metallic tubing.
- E. Surface mounted raceway.
- F. PVC conduit.
- G. Fittings and conduit bodies.
- H. Wall and ceiling outlet boxes.
- I. Floor boxes.
- J. Pull and junction boxes.

1.02 RELATED SECTIONS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 – Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems.
- D. Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems.
- E. Section 26 27 26 - Wiring Devices.
- F. Section 26 05 02 - Equipment Wiring Systems.

1.03 REFERENCES

- A. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
- B. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- C. ANSI/NFPA 70 - National Electrical Code.
- D. NECA "Standard of Installation".
- E. NEMA TC 3 - PVC Fittings to Use with Rigid PVC Conduit and Tubing.
- F. UL 1 - Flexible Metal Conduit.

- G. UL 5 - Surface Metal Raceways and Fittings
- H. UL 6 - Rigid Metal Conduit.
- I. UL 360 - Liquid-tight Flexible Steel Conduit.
- J. UL 652 - Schedule 40 and 80 Rigid PVC Conduit.
- K. ANSI/NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- L. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- M. UL 38 - Boxes for Use with Fire-Protection Signaling Systems, Manually Actuated Signaling.
- N. UL 50 - Cabinets and Boxes.
- O. UL 514A - Metallic Outlet Boxes.
- P. UL 514B - Fittings for Conduit and Outlet Boxes.
- Q. UL 996 - Electrical Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.
- R. UL 1241 - Junctions Boxes for Swimming Pool Lighting Fixtures.
- S. UL 1773 - Termination Boxes.
- T. UL 65 - Wired Cabinets.

1.04 DESIGN REQUIREMENTS

- A. Conduit Size: ANSI/NFPA 70.

1.05 SUBMITTALS

- A. Submit under provisions of Division 1 and Section 26 05 00.
- 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 40 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. *As an owner approved VE item, in wall rough-in from device to device with MC cable is accepted. The MC cable is to be through studs from device to device and not installed up the walls into ceiling cavity.*
 - 2. Exposed:
 - a. Use galvanized rigid steel conduit or electric metallic tubing in unfinished areas only (Electric Room, Mechanical Room) unless noted otherwise.
- 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.

2.02 RIGID STEEL CONDUIT

- A. Manufacturers:
1. Allied.
 2. Triangle.
 3. Engineer Approved.
- B. Rigid Steel Conduit: ANSI 80.1
- C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; material to match conduit.

2.03 FLEXIBLE METAL CONDUIT

- A. Manufacturers:
1. Allied.
 2. Triangle.
 3. Engineer Approved.
- B. Description: Interlocked steel construction.
- C. Fittings: ANSI/NEMA FB 1.
- D. Maximum Length: 6'-0".

2.04 LIQUIDTIGHT METAL CONDUIT

- A. Manufacturers:
1. Allied.
 2. Triangle.
 3. Engineer Approved.
- B. Description: Interlocked steel construction with PVC jacket.
- C. Fittings: ANSI/NEMA FB 1.
- D. Maximum Length: 6'-0".

2.05 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
1. Allied.
 2. Triangle.
 3. Engineer Approved.

- B. Description: ANSI C80.3; galvanized tubing.
- C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; die-cast compression type.

2.06 NONMETALLIC CONDUIT

- A. Manufacturers:
 - 1. Carlon.
 - 2. Engineer Approved.
- B. Description: NEMA TC 3; Schedule 40 PVC.
- C. Fittings and Conduit Bodies: NEMA TC 3.

2.07 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

2.08 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Surface-Mounted Cast Metal Box: NEMA 250, Type as required; flat-flanged,

surface-mounted junction box.

1. Material: Galvanized steel.

C. Cover: Furnish with ground flange, neoprene gasket, and stainless-steel cover screws.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install conduit in accordance with NECA "Standard of Installation".
- B. Install surface metal raceway in accordance with manufacturer's directions.
- C. Arrange supports to prevent misalignment during wiring installation.
- D. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers. Supports shall be installed within 3 feet of every outlet box, junction box, panel, or other conduit terminations. Fastening of unbroken lengths shall be permitted to be increased to a distance of 5 feet where structural members do not readily permit fastening within 3 feet. Do not space supports further than 10 feet apart.
- E. Group related conduits; support using conduit rack. Construct rack using steel channel.
- F. Fasten conduit supports to building structure and surfaces under provisions of Section 26 0529.
- G. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
- H. Do not attach conduit to ceiling support wires.
- I. Arrange conduit to maintain headroom and present neat appearance.
- J. Route all conduit parallel and perpendicular to walls. This includes conduit installed above ceilings, in attics, on roofs, and in crawl spaces.
- K. Install insulated bushings or approved equivalent on each end of all conduit.
- L. Maintain 12-inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.
- M. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- N. Bring conduit to shoulder of fittings; fasten securely.
- O. Install no more than equivalent of four 90-degree bends between boxes. Use factory elbows for all 90-degree bends in conduits 1" and larger.
- P. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- Q. Provide suitable fittings to accommodate expansion and deflection where conduit crosses expansion joints.
- R. Use suitable caps to protect installed conduit against entrance of dirt and moisture during construction.

- S. Ground and bond conduit under provisions of Section 26 0526.
- T. Identify conduit under provisions of Section 26 0553.
- U. Provide suitable pullboxes in all conduit runs as required by the National Electrical Code and as required to facilitate wire installation.
- V. Holes for passage of conduits through all one-hour and two-hour drywall partitions shall be neatly cut to the required size. If holes are cut larger than necessary, they shall be covered with two (2) additional pieces of 5/8 inch type X gypsum wallboard, each 8 inches by 16 inches with a half circular cutout of the proper size, one (1) layer on one-hour partitions, and two (2) layers on two-hour partitions.
- W. Holes for passage of conduits through one-hour, two-hour, and four-hour masonry walls shall be fireproofed. Fireproofing materials shall be as follows:
 - 1. Cellular Glass Insulation: Pittsburgh Corning Corp. Foamglas "Regular" or UL rated or UNI-JAC UL rated pipe insulation, or approved equal.
 - 2. Fire Retardant Putty: IPC Flamesafe Type FAS500 or FST600 Series, or improved equal, for one-hour and two-hour walls.
 - 3. IPC/KB5 Mortar Seal, or approved equal (full depth of wall) for four-hour walls.
- X. Holes for passage of conduits through masonry floors shall be fireproofed. Fireproofing material shall be Firestop Compound - IPC Flamesafe Type 500/FST 600, or approved equal, filled to full depth of slab. Minimum annular space around conduit shall be 3/16 inch.
- Y. Refer to Architectural drawings for locations of fire-rated walls, ceilings, and floors.
- Z. Support 2-1/2 inch and larger conduit in accordance with Section 26 0548.
- AA. All flexible conduit in Mechanical Rooms and outside shall be liquidtight flexible conduit.
- BB. 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.
- CC. Make sure conduits are properly terminated, reamed, and brushed before installation of wire or cable.
- DD. Install bushings on all conduits.
- EE. Structural Engineer shall approve placement of conduits in all concrete slabs, beams, and columns. See Structural Drawings for structural engineer's name and address.
- FF. Conduits which pass from an air conditioned space to a non-air conditioned space shall have sealoffs installed on non-air conditioned side near wall.
- GG. Ground metallic conduits.
- HH. Install gasketed conduit hubs on all conduits exiting the top or sides of NEMA 3R enclosures.
- II. Install electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements.
- JJ. Install electrical boxes to maintain headroom and to present neat mechanical appearance.

- KK. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- LL. Install boxes to preserve fire resistance rating of partitions and other elements.
- MM. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices with each other.
- NN. Use flush mounting outlet boxes in finished areas, unless noted otherwise on the Drawings.
- OO. 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.
- PP. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- QQ. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- RR. Install flush mounting box without damaging wall insulation or reducing the effectiveness.
- SS. Use adjustable steel channel fasteners for hung ceiling outlet box.
- TT. Do not fasten boxes to ceiling support wires.
- UU. Support boxes independently of conduit.
- VV. Use gang box where more than one device is mounted together. Do not use sectional box.
- WW. In other than masonry, use 4-inch square by 1-1/2-inch minimum box with plaster ring for single devices.
- XX. Use cast outlet box in exterior locations exposed to the weather and wet locations.
- YY. Use cast floor boxes for installations in slab on grade. See plans for specialty A/V floorboxes equal to FSR. Coordinate cover trim with floor covering thickness and type.
- ZZ. Set floor boxes level.
- AAA. 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.
- BBB. Locate boxes so outlets are not obstructed by pipes, ducts, or other items.
- CCC. Boxes for light switches shall generally be located within 6 inches of door jamb.
- DDD. 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.
- EEE. 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.

- FFF. 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.
- GGG. Fireproof all poke-through devices in accordance with manufacturer's directions.
- HHH. Ground all boxes. Ensure that bonding breaks through paint to bare metallic surface.

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 coverclips on surface metal raceway.
- U. All steel EMT fittings.
- V. Flexible conduit connectors on which the flexible conduit is threaded.
- W. Plastic boxes.
- X. Fiberglass boxes.

END OF SECTION 26 05 33

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 D 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 05 00.

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.

<u>Maximum Equipment 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. 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 26 05 48

PART 1 - GENERAL**1.01 SECTION INCLUDES**

- A. Nameplates and labels.
- B. Wire and cable markers.
- C. Trench tape.

1.02 REFERENCES

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

1.03 RELATED SECTIONS

- A. Section 09 91 00 - Painting: Boxes.

1.04 SUBMITTALS

- A. Submit under provisions of Division 1 and Section 26 05 00.
- 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>
Cable TV	Orange	“Caution – Cable TV Line Buried Below”
Electrical	Red	“Caution – Electric Line Buried Below”
Telephone	Orange	“Caution – Telephone Line Buried Below:
Fiber Optic	Orange	“Caution – Buried Fiber Optic Cable”

- C. Tape shall be equal to Panduit Type HTDU with width to match trench width.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive nameplates and labels.

3.02 APPLICATION

- A. Install nameplate and label parallel to equipment lines.
- B. Secure nameplate to equipment front using No. 4 round heat cadmium plated, steel self-tapping screws or nickel-plated brass plates.
- C. Identify underground conduits using underground warning tape. Install one tape per trench at 6 inches below finished grade.
- D. All fire alarm junction boxes and pullboxes shall be painted red where concealed or exposed in mechanical or electrical rooms.
- E. Both ends of pullwires shall be identified by means of labels or tags, reading "PULLWIRE" and shall be numbered to refer to same pullwire.

- F. Install nameplates at each circuit breaker on all switchboards and large panelboards.
- G. Install wire markers on wires in each junction box, panelboard, switchboard, control panel, etc.
- H. Install nameplates at each device within motor control centers.
- I. Install directory of addresses and corresponding devices and locations in each addressable fire alarm and security control panels.
- J. All security junction boxes and pullboxes shall be painted yellow where concealed or exposed in mechanical or electrical rooms.
- K. Install labels on all telephone and computer cables.
- L. All telephone junction boxes and pullboxes shall be painted white where concealed or exposed in mechanical or electrical rooms.
- M. Paint all data junction boxes and pullboxes blue where concealed or exposed in mechanical or electrical rooms.
- N. Paint all public address junction boxes and pullboxes dark gray where concealed or exposed in mechanical or electrical rooms.
- O. Paint all television cable junction boxes or pullboxes black where concealed or exposed in mechanical or electrical rooms.

END OF SECTION 26 05 53

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.

Label Installation

- E. 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 26 05 73

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Branch circuit panelboards.
- B. Distribution panelboards.

1.02 RELATED SECTIONS

- A. Section 09 91 00 - Painting: Touchup.
- B. Section 26 05 29 – Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Engraved nameplates.
- D. Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems.

1.03 REFERENCES

- A. NECA (National Electrical Contractors Association) "Standard of Installation."
- B. NEMA AB 1 - Molded Case Circuit Breakers.
- C. NEMA PB 1 - Panelboards.
- D. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or less.
- E. NFPA 70 - National Electrical Code.
- F. UL 67 - Panelboards.

1.04 SUBMITTALS

- A. Submit under provisions of Division 1 and Section 26 05 00.
- B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker arrangement and sizes.
- C. 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 Product.

1.05 RECORD DOCUMENTS

- A. Record actual locations of Products; indicate actual branch circuit arrangement.

1.06 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.

1.07 QUALITY ASSURANCE

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

1.08 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section.

1.09 REGULATORY REQUIREMENTS

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

1.10 FIELD MEASUREMENTS

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

1.11 MAINTENANCE MATERIALS

- A. Provide two of each panelboard key.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Square D.
- B. Siemens/ITE.
- C. Cutler-Hammer.

2.02 PANELBOARDS

- A. Panelboards: NEMA PB1, circuit breaker type.
- B. Panelboard Bus: Tin-plated copper, ratings as indicated. Provide copper ground bus in each panelboard; provide insulated ground bus where scheduled.
- C. Minimum short circuit rating, shall be as indicated on the Drawings. Panelboards shall have a fully rated interrupting rating. Series-rated equipment will not be accepted.
- D. 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.
- E. Enclosure: NEMA PB 1, Type 1, or 3R as indicated on the Drawings.
- F. Cabinet box: 6 inches deep; width: 20 inches for 240 volt and less panelboards.
- G. Cabinet Front: Surface cabinet front with concealed trim clamps, concealed hinge, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

2.03 MODIFICATIONS TO EXISTING PANELBOARDS

- A. Provide and install all bus extensions, bus stabs, enclosures, etc. to install circuit breakers in existing panelboards.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1.
- B. Install panelboards plumb. Provide supports in accordance with Section 26 05 09.
- C. Install panelboards with middle at 48 inches, if less than 6'-6" tall. If panelboard is taller than 6'-6 inches, install with top at 7'-6".
- D. Provide filler plates for unused spaces in panelboards.
- E. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
- F. Provide engraved plastic nameplates under the provisions of Section 26 05 53.
- G. Provide a minimum of four (4) spare 20A/1P circuit breakers in each branch circuit panelboard or as indicated on the drawings.
- H. Install all screws and bolts in coverplates.
- I. Install knockout plugs in all unused openings in enclosure.
- J. Install nameplates on all circuit breakers of large panelboards.
- K. Bolt panelboards to mounting surface in accordance with Section 26 0548.
- L. Panelboards installed on basement walls or outside on exterior walls shall be installed on 1-1/2-inch channel.
- M. The first section of multi-section panelboards shall have feed-through lugs. Contractor shall install conductors with ampacities equal to the bus rating of the panelboards, from the feed-through lugs to the main lugs only of Section #2 panelboard.
- N. Touchup scratched or marred surfaces to match original finish.
- O. Neatly form wire inside of panelboard.

3.02 FIELD QUALITY CONTROL

- A. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.
- B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections using calibrated torque wrench for circuit breakers, bus stabs, and busses.

END OF SECTION 26 24 16

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Occupancy Sensors.
- D. Device plates.

1.02 RELATED SECTIONS

- A. Section 26 05 33 - Boxes.
- B. Section 26 05 53 - Electrical Identification: Labels on computer outlets.

1.03 REFERENCES

- A. NEMA WD 1 - General Purpose Wiring Devices.
- B. NEMA WD 6 - Wiring Device Configurations.
- C. UL 20 - General Use Snap Switches.
- D. UL 498 - Attachment Plugs and Receptacles.
- E. UL 894 - Switches for Use in Hazardous (Classified) Locations.
- F. UL 1010 - Receptacle Plug Combinations for Use in Hazardous (Classified) Locations.

1.04 SUBMITTALS

- A. Submit under provisions of Division 1 and Section 26 05 00.
- 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. Three-way Switch:
1. Hubbell #1223.
 2. Pass & Seymour #20AC3.
 3. Cooper Wiring Devices #2223.
 4. Leviton #1223.

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. 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.
- E. Color of devices as selected by Architect/Engineer.

2.03 OCCUPANCY SENSORS

- A. APPROVED MANUFACTURES
1. WattStopper
 2. 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. Wall-mounted Occupancy Sensors: Coverplates shall be suitable for sensor type and shape.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify conditions.
- B. Verify outlet boxes are installed at proper height.
- C. Verify wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- E. Verify color of all devices and coverplates.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from outlet boxes.

3.03 INSTALLATION

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

- B. Install devices plumb and level.
- C. Install single and double pole switches with OFF position down.
- D. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
- E. Install plates on switch, receptacle, and blank outlets in all areas.
- F. Connect wiring devices by wrapping conductor around screw terminal in clockwise direction and tightening screw. Where wiring device has two (2) plates tightened by a screw, this method may be used. However, other back-connected wiring devices, which depend upon a metal spring action, are not allowed.
- G. Use jumbo size plates for outlets installed in masonry walls.
- H. Install galvanized steel plates on outlet boxes and junction boxes above accessible ceilings, and on surface mounted outlets.
- I. All plates shall be secured by means of screws with heads matching plates.
- J. Vertically mounted receptacles shall be installed with equipment grounds down, unless local codes require otherwise. Horizontally mounted receptacles shall be installed with equipment grounds to the right, unless local codes require otherwise. Regardless, all receptacles, including GFCI receptacles, shall be installed in the same way with the ground, turned in the same direction.
- K. Install labels on computer outlets.

3.04 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 26 0533 to obtain mounting heights specified and indicated on Drawings.
- B. Install wall switches 48 inches above finished floor to the center of the box.
- C. Install convenience receptacle 18 (vertically oriented) inches above finished floor unless noted otherwise on Drawings.
- D. Install convenience receptacle 6 (horizontally oriented) inches above finished counter.

3.05 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.
- F. Check tightness of all conductor connections.

3.06 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

END OF SECTION 26 27 26

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 09 91 00 - Painting: Touchup.
- B. Section 26 05 29 – Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems.
- D. Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems.

1.04 SUBMITTALS

- A. Submit under provisions of Division 1 and Section 26 05 00.
- 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. Siemens ITE
 - 3. 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 05 53 - 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 26 28 16

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Interior luminaires and accessories
- B. LED luminaires
- C. Exit signs.
- D. Inverters

1.02 RELATED SECTIONS

- A. Section 26 05 29 – Hangers and Supports for Electrical Systems.
- B. Section 26 05 33 – Raceway and Boxes for Electrical Systems.
- C. Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems.

1.03 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.
- B. ANSI/NFPA 101 - Life Safety Code.
- C. NEMA WD 6 - Wiring Devices-Dimensional Requirements.
- D. UL 844 - Electric Lighting Fixtures for Use in Hazardous (Classified) Locations.
- E. UL 924 - Emergency Lighting and Power Equipment.
- F. NEMA SSL 1-2010 – Electronic Drivers for LED Devices, Arrays, or Systems

1.04 SUBMITTALS

- A. Submit under provisions of Division 1 and Section 26 05 00.
- 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 1 and Section 26 05 00.
- 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. All factory installed wiring shall be copper.

2.02 LED LUMINAIRES

- A. Furnish products as specified on Drawings.
- B. Color Temperature of 3500K for interior luminaires as listed in the fixture schedule on the plans, unless otherwise noted. The color temperature of exterior LED luminaires shall not exceed 4000K (nominal), unless otherwise noted.
- C. Luminaire Color Rendering Index (CRI) shall be a minimum of 80 for interior luminaires, and a minimum of 70 for exterior luminaires.
- D. Luminaire shall maintain 70% lumen output for a minimum of 50,000 hours.
- E. Driver shall have a rated life of 50,000 hours, minimum.
- F. Lumen output shall not depreciate more than 20% after 10,000 hours of use.
- G. LED driver shall be compatible with dimming controls where dimming controls where dimming is indicated on the plans. Dimmable drivers shall use Dimming Constant Current (DCC) or Pulse Width Modulation (PWM) operation.
- H. LED luminaires shall dim to (20%, 15%, 10%, 5%, or 0.1%) as specified in the fixture schedule on the plans without visible flicker or “popcorn effect”. “Popcorn effect” is defined as the luminaire being on a pre-set dimmed level (less than 100%), and going to 100% prior to returning to the pre-set level when power is returned to the luminaire.
- I. The LED luminaire shall carry a limited 5-year warranty minimum (not pro-rated) for LED light engine(s)/board array, driver(s), and LED components.

2.03 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. Battery: Nickel-cadmium with sufficient capacity to operate lights for 90 minutes.
- H. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.
- I. Lamps: Manufacturers standard LED lamps.
- J. Input Voltage: 120/277 volts.

2.04 INVERTERS

- A. Inverter Manufacturers:
 - 1. Bodine
 - 2. Dual-Lite
 - 3. Evenlite
- B. Emergency Inverters shall be sine-wave type, or have written confirmation from the luminaire manufacturer that the luminaire will function with a square-wave inverter.

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. In seismic design category D, E, & F, fixtures installed in lay-in ceiling grid shall be supported as follows in addition of being securely fastened to the ceiling grid. Refer to specification section 16880 for additional fixture support information.
 - 1. Less than 10lbs: one 12-gauge safety wire connected to structure.
 - 2. More than 10lbs but less than 56lbs: two 12-gage safety wires connected to structure.
 - 3. More than 56lbs: shall be supported directly from structure independent of the ceiling grid

- 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 26 05 33 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. 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.
- O. All supports, safety chains, swivels, etc. shall be furnished as required for a complete installation.
- P. Securely fasten all exit signs and emergency lighting units to surface to which they are mounted.
- Q. Replace all broken or cracked lens.
- R. Replace all scratched or bent reflectors and doorframes.
- S. Light fixtures shall be supported by lay-in ceilings or by supports to the building structure.
- T. Light fixtures shall not be supported from conduits, duct or piping.

- U. All recessed light fixtures shall have seismic clips firmly situated over tops of ceiling grid tees or plaster rings.
- V. All light fixtures that weigh more than 50 pounds shall have a safety chain or safety cable in addition to its other support.
- W. 2 by 2 light fixtures shall have louvers and lamps oriented in the same direction.
- X. Touchup scratched or marred surfaces to match original finish.
- Y. 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. Replace luminaires that have failed lamps at Substantial Completion. LED Diodes / Drivers 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 50 00

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Complete computer network system, including but not limited to:
 - 1. Conduit as specified in Section 26 05 33.
 - 2. Boxes as specified in Section 26 05 33.
 - 3. Cables.
 - 4. Outlets.
 - 5. Connections.
 - 6. Patch panels.
 - 7. Testing.
 - 8. 19-inch racks.
 - 9. Supporting devices as specified in Section 26 05 29.

1.02 RELATED SECTIONS

- A. Section 09 91 00 - Painting: Field painting of backboards and cabinets.
- B. Section 26 05 33 – Raceway and Boxes for Electrical Systems.
- C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- D. Section 26 05 29 – Hangers and Supports for Electrical Systems: Supports for conduits and backboards.
- E. Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems.

1.03 SUBMITTALS

- A. Submit under provisions of Division 1 and Section 26 05 00.
- B. Provide post-manufacture test reports of all wiring and cables.
- C. Submit factory training certificates of all installers.

1.04 REGULATORY REQUIREMENTS

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

1.05 PROJECT RECORD DOCUMENTS

- A. Submit record documents under provisions of Division 1 and Section 26 05 00.
- B. Final payment will not be made unless, and until, the Contractor has provided “as built” drawings of all work performed.

1.06 QUALITY ASSURANCE

- A. Install work in accordance with ANSI/EIA/TIA 568A Category 6 Addendum (Draft 5 or latest).
- B. Contractor shall have experience in the installation of structured cabling systems. All installers assigned by the Contractor to the installation work shall have factory certification that they are qualified to install and test the products provided.
- C. Provide all test equipment used to conduct acceptance tests. Use only test equipment, which will produce a printed report of test results, which cannot be edited or manipulated by any means.
- D. The contractor is to provide all materials, labor and equipment necessary to install conduit and wiring, anchors, hooks, and ladder racks required for a fully functioning computer network system when terminated to the main and intermediate distribution frames (MDF/IDF) hubs, servers, patch panels, computers or other system terminals.
- E. Contractor shall warrant installation against all product defects, and that all approved cabling components meet or exceed the requirement of TIA/EIA-568A, TIA/EIA-568-A-A5, and ISAO/IEC 11801 for a period of one (1) year.

PART 2 - PRODUCTS

2.01 EQUIPMENT

- A. Network Cable: comCables CAT 6, 550Mhz, Plenum rated cable, unshielded, twisted pair, blue sheathing. Colors to be determined, one color for cameras, one for data, one for WiFi, and one for security, for a total of 4 different colors.
- B. J-Hooks/Tri-hooks: Follow manufacturers printed instructions for installation. Support cable bundles at 4 feet on center maximum. Do not exceed 50% of hook. Maximum fill-50 cat 6 equal to cpi Rapid Trak J hook w/Velcro strap p/n 31422-801. Tri-hook pn 31424-808 max fill-150 cat 6.
- C. Cable pathway system – includes 10,000 series cable runway and all accessories. Equal to Chatsworth Product Incorporated, CPI.
- D. Chatsworth Racks: Wall mounted enclosed 20U rack. Racks shall be 19” wide with E.I.A. Channel, equal to CPI. Racks shall have vertical and horizontal cable management.
- E. General Note: For any device used for cable support, whether J-hook, caddy straps, or ladders racks, do NOT exceed 50% of support capacity. Product submittals must include

cable loading capacity information.

- F. Exposed wiring covers – All communications/computer wiring to be left exposed in rooms shall be enclosed in Panduit surface raceway system components. Provide Panduit Type ‘TM’ raceway products and accessories as required to fully conceal wiring exposed in rooms. Mod-Com compatible. Submit colors for approval. Submit products for approval as equal. No adhesive back.
- G. Provide fasteners compatible with cable support system products. All anchors and fasteners must be attached to building frame.
- H. Patch Panels – comCables modular patch Panel” 48 port CAT 6 rated.
- I. Outlets: Combination data/communications outlets on this Project shall be as follows:
 - 1. comCables mount faceplate with high band RJ45 Key a tone jacks – 6 rated
 - 2. Color of telephone jack shall match color of faceplate. Color of computer jack shall be white. Color of faceplate shall be selected by the Architect.
 - 3. Faceplate labels (which designate network ID #) shall be marked as directed by the Owner.

PART 3 - EXECUTION

- 3.01** Provide factory bends for all elbows on conduit. Do not install more than two (2) 90-degree bends without installing a pullbox. For conduit runs longer than 100'-0", install a pullbox. Where routing is above an accessible ceiling, conduit may be stubbed out from the wall box and turned horizontal above the ceiling and terminated with plastic bushing to protect emerging cable.
- 3.02** Contractor shall guarantee labor and materials for one year from date of acceptance.
- 3.03** No LB conduits shall be allowed.
- 3.04** If pull boxes are installed, they must be large enough to maintain a minimum bending radius for cables.
- 3.05** A complete set of "contractor revised" drawings of installation shall be provided upon completion of project.
- 3.06** Backboxes shall be mounted at 18 inches above the finished floor unless noted otherwise on the drawings.
- 3.07** Installer shall maintain the minimum distance from sources of electromagnetic interference: 6 inches from power circuits; 1 foot from fluorescent and HID lamps; and 4 feet from transformers, meters and variable frequency drives.
- 3.08** All raceway elbows shall be long radius elbows.
- 3.09** Install conduit where cables, not in conduit, pass through floors. Extend conduit at least 6 inches above top of floor.

- 3.10 Plenum rated cables shall be installed regardless if they are installed in air plenums or not.
- 3.11 Cables shall be continuous, without splicing, from patch panels to outlets.
- 3.12 Do not peel back cable sheath more than necessary to separate conductors.
- 3.13 Do not score copper conductors when peeling back conductor insulation. Scored conductors shall be replaced.
- 3.14 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.
- 3.15 Kinked, torn, or twisted cable sheaths are unacceptable and will be replaced.
- 3.16 Install cables to avoid water, high humidity, chemicals, cold temperature bending, pair spreading, pair wrapping, and different lengths of pairs in same cable.
- 3.17 Do not bundle more than 216 four-pair cables or 36 twenty-five pair cables.
- 3.18 Make sure conduits are properly terminated, reamed and brushed before installation of cable(s).
- 3.19 Do not crisscross pairs or allow them to become interwoven.
- 3.20 Verify proper conductor location at each termination before energizing.
- 3.21 Follow color code labels on individual pairs.
- 3.22 Cable sheaths shall be held in place by strain relief fittings.
- 3.23 Paint all junction boxes blue.
- 3.24 Bolt6 bottom of rack to floor and bolt top of rack to wall in accordance with Section 26 05 48.
- 3.25 Support all 2-1/2 inch or larger conduits and all cable trays in accordance with Section 26 05 48.
- 3.26 Install seismic flexible fitting on all 2-1/2 inch or larger conduits entering or leaving the building in accordance with Section 26 0548.
- 3.27 Install outlets at 18 inches above finished floor to center of outlet, unless noted otherwise on the Drawings.
- 3.28 Install outlets 6 inches above finished countertops to center of outlet.
- 3.29 Maintain the following clearances to cables;
 - A. 6 inches from power circuits.
 - B. 12 inches from light fixtures.
 - C. 12 inches from hot water pipes, steam pipes and flues.

- D. 48 inches from transformers, meters, VFD's, and power correction systems.

3.30 WIRE ROUTING PENETRATIONS

- A. Provide by core drilling or other acceptable means a direct route between distribution frames and to individual devices to be served.
 - 1. Penetrations 1 inch and larger shall be sleeved.
 - 2. Grout sleeves in place using materials similar to wall construction.
- B. Floor to floor penetrations should not exceed 4-inch diameter cleanly drilled and properly fire safed.
 - 1. Fire Safing:
 - a. Install fire safing and sealant at all floor penetrations and at the top of all fire-rated partitions.
 - b. Install safing insulation and sealant at all cable penetrations and other pipe through openings between floor and in fire walls.
 - 2. Materials:
 - a. General: All products equal to "Therma Fiber" mineral fiber insulation as manufactured by USG Interiors, Inc., Chicago, Illinois.
 - b. 4 inch thick, unfaced, mineral fiber insulation, regular color. Federal specification HH-1-558BB, Class 1.
 - c. Sealing Compound: "Therma Fiber" smoke seal compound.
 - 3. Workmanship:
 - a. Install in accordance with manufacturer's printed instructions.
 - b. Stuff around wiring and wiring bundles passing through walls and floors full depth minimum 2 inches; top safing insulation with 2-inch-thick smoke seal compound.

3.31 Each network cable will be a home run from the room and each device to the intermediate distribution frame (IDF). Allow no splices between the IDF and the device served.

3.32 All cables exiting a room will be collected/bundled above corridor ceilings and travel along corridors to the IDF.

3.33 Cable bundles containing more than four cables will be supported by J-hooks installed not more than 4 feet on center.

3.34 Owner to provide and install concentrators and all electronic equipment.

3.35 Contractor shall test and certify proper operation of computer network cables.

3.36 Install cables in ceilings in workmanlike manner to permit service, maintenance or replacement of adjacent equipment without disrupting the position of the network cables.

3.37 Cable bundles must be secured via Velcro straps, do not use tie wraps.

3.38 INSTALLATION AT THE MAIN DISTRIBUTION FRAME OR THE INTERMEDIATE DISTRIBUTION FRAME

- A. Cables entering the MDF or IDF location will be placed on J hooks then ladder racks.

Those devices will carry the network cable to the 19-inch racks where they will be terminated.

- B. Materials the contractor will install shall include Chatsworth racks, ladder racks, patch panels and optical fiber boxes.
- C. Terminate all network cables onto a patch panel. At patch panel terminations:
 - 1. Push pairs down in the cable slot against the block but not against the index strips.
 - 2. Keep pairs twisted up to termination.
 - 3. At patch panels, Velcro cable bundles.
 - 4. Terminate cabling to patch panels with lengths of cable sufficient to prevent binding on the brackets or angles of the rack.
 - 5. Provide a service ground at communication rack.

3.39 NETWORK CABLE IDENTIFICATION

- A. Every network cable installed will be labeled at the jack and on the patch panel. No label will be handwritten. Lettering on label will be ¼ inch tall. Labels located on faceplates will be black letters on a clear tape.
- B. Network cables will be labeled at the jack using the following system: IDF Floor. IDF Number. Patch Panel Letter. Patch Panel Port Number.
- C. Network Cables will be labeled on the patch panel with the room number the jack is terminated in.
- D. Each network cable will be given a circuit ID.
- E. The circuit ID will be assigned using the following system: Building Code. IDF Floor. IDF Number. Patch Panel Letter. Patch Panel Port Number. Room number the jack is in.
- F. The circuit ID will be used to identify network cables on any reports or documentation supplied by the contractor.

3.40 DOCUMENTATION OF CABLE PATHS

- A. Floor Plans:
 - 1. The contractor will be responsible for indicating J-Hook locations, network line paths, and optical fiber paths on one set of floor plans for each building in an organized and legible manner.

3.41 POST-INSTALLATION TEST AND CERTIFICATION

- A. Quality Assurance:
- B. The contractor shall provide sufficient skilled labor to complete testing with the agreed upon test period. Testing shall commence prior to owner's acceptance of a finished building.

- C. The contractor shall have experience installing structured cabling systems. All installers assigned by the Contractor to the installation shall have factory certification that they are qualified to install and test the provided products.
- D. The contractor is responsible for supplying all of the required test equipment used to conduct acceptance tests.
- E. The contractor is responsible for submitting acceptance documentation as defined below.

3.42 TEST PROCESS

- A. The owner reserves the right to be present during any or all of testing.
- B. Testing shall be of the Permanent Link. However, Contractor shall warrant performance based on Channel performance.
- C. All cabling not tested strictly in accordance with these procedures shall be retested at no additional cost to the owner.
- D. 100% of the installed cabling must be tested. All tests must pass acceptance criteria.
- E. Test equipment shall be fully charged prior to each days testing.

3.43 STANDARDS COMPLIANCE AND TEST REQUIREMENTS

- A. Cabling must meet the indicated performance specifications:

Network line Specifications – Minimum Channel Standards

Frequency	550MHz	
Length	295	or lower
Propagation Delay	72%	or higher
Delay Skew	45 ns	or lower
NEXT	35.4 dB	or higher
NEXT @ Remote	35.4 Db	or higher
Attenuation	31.5	or lower
ACR	1.4 dB	or higher
ACR @ Remote	1.4 dB	or higher
PSACR	.04 dB	or higher
PSACR @ Remote	.04 dB	or higher
RL	10 dB	or higher
RL @ Remote	11 dB	or higher
PSNEXT	34 dB	or higher
PSNEXT @ Remote	35 dB	or higher
ELFEXT	15.8 dB	or higher
ELFEXT @ Remote	15.8 dB	or higher
PSELFEXT	12.8 dB	or higher
PLELFEXT @ Remote	12.8 dB	or higher

3.44 TESTING

- A. All documentation must be accompanied by a certificate signed by an authorized representative of the contractor and a current Registered Communications Distribution Designer (RCDD) warranting the truth and accuracy of the report.
- B. All tests must be performed using a Fluke DSP 4300 meter using permanent link adapters or approved equal.
- C. The contractor will ensure that each test performed has the correct network cable identification.

3.45 ACCEPTANCE

- A. Once all work has been completed, test documentation has been submitted, and the owner is satisfied that all work is in accordance with contract documents.
- B. Acceptance Requirements:
 - 1. Contractor must warrant in writing that 100% of the installation meets the requirement specified under Standards Compliance and Test Requirements above.
- C. Owner reserves the right to conduct, using his own equipment and labor, a random re-test of up to five (5) percent of the cable plant to confirm documented results. Random re-testing can occur at any time during the warranty period. Any failing cabling shall be re-tested and restored to a passing condition. In the event more than two (2) percent of the cable plant fails during a re-test, the entire cable plant shall be re-tested and restored to a passing condition at no additional cost to the owner.
- D. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% Pass rating, and receipt of full documentation as outlined by the owner.

END OF SECTION 27 00 00

VOICE EVAC FIRE DETECTION AND ALARM (Addressable)

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 91 00 - Painting: Touchup and paint boxes.
- B. Section 23 09 23 – Direct Digital Control System for HVAC.
- C. Section 26 05 33 – Raceway and Boxes for Electrical Systems
- D. Section 26 05 19 – Low-Voltage Electrical Power Connectors and Cable.
- E. Section 26 05 29 – Hangers and Supports for Electrical Systems.
- F. Section 26 05 53 - Identification for Electrical Systems: Address directory and painted boxes.

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. Voice Evac. Fire Alarm System: NFPA 72, manual and automatic local fire alarm system with connections to campus or remote monitoring station.

1.05 SUBMITTALS

- A. Submit under provisions of Division 1 and Section 26 05 00.
- B. Shop Drawings: Shop drawings shall be submitted to the Architect for approval prior to installation. The submittal shall include complete schematic circuit diagrams for all equipment, address device type, label and reference detail, wiring diagrams showing connections between all system components, description of system operation, annunciator schedule, and manufacturer's literature marked to show model and catalog number for all equipment. Complete riser diagrams indicating wiring sequence of all alarm devices and control equipment shall be included with the submittal data. Submittals shall be a complete set; partial submittals will not be accepted. Electrical drawings shall not be on less than 8-1/2 inch by 11-inch sheets, and shall identify all modules if so constructed, shall be on a single sheet drawing with all circuit terminals and inter-connections identified. Six (6) copies of the shop drawings shall be submitted.
- C. Product Data: Provide electrical characteristics and connection requirements.
- D. Test Reports: Indicate satisfactory completion of required tests and inspections.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and

starting of products.

1.06 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1 and Section 26 05 00.
- B. Record actual locations of initiating devices, signaling appliances, and end-of-line devices.

1.07 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 1 and Section 26 05 00.
- 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.
- B. Installer: Company specializing in installing the products specified in this section, 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. 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/CELLULAR SERVICE

- A. Furnish monitoring and cellular service of fire alarm system for one year from Date of Substantial Completion.

PART 2 – PRODUCTS

2.01 MANUFACTURERS - LIMITED TO THE FOLLOWING

- A. FCI.
- B. Siemens
- C. EST
- D. Notifier
- E. Engineer approved.

2.02 VOICE EVAC 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 GSM Communicator: Provide and install a digital GSM communicator for remote station monitoring.
- N. Provide with a remote mic located at the firemen's entry.
- N. The fire alarm control panel shall be connected to the PCSSD building control system.

2.03 INITIATING DEVICES

- A. Manual Pull Station: Addressable semi-flush and surface mounted, non-coded type, double action, breakglass type manual station with breakglass 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° F or 20° 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 Speaker strobes: NFPA 72, ANSI 117.1, surface and/or flush type fire alarm horn. Speaker with adjust sound levels. 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 05

19.

- B. Initiating Device and Indicating Appliance Circuits: Multiplex cable as recommended by manufacturer of fire alarm system. Cable shall be red. Installed in conduit.
- C. All fire alarm wire and cable shall be installed in conduit as specified in Section 26 05 33.

2.06 INDIVIDUAL ADDRESSABLE MODULE

- A. Provide location specific addressable to a single initiating device by monitoring N.O. dry contacts.

2.07 DOOR HOLDERS

- A. Provide and install 24-volt DC door holders where indicated on the Drawings.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install manual station with operating handle 4 feet above floor to center of device. Install audible and visual signal devices 80 inches above floor to bottom of device or 6 inches below ceiling to top of device, whichever is lower (unless noted otherwise on Drawings).
- C. Use 16 AWG minimum size conductors for fire alarm detection and signal circuit conductors. Install wiring in conduit.
- D. Mount end-of-line device in control panel.
- E. Make conduit and wiring connections to sprinkler flow switches and sprinkler valve tamper switches.
- F. Automatic Detector Installation: Conform to NFPA 72.
- G. Duct detectors shall be interlocked with air handling unit starters to de-energize units upon activation of duct detectors. All associated smoke dampers shall be interlocked to close upon activation of duct detection. Fire alarm contractor shall install wire and conduit from duct detector to air handling unit starter. Fire alarm contractor shall connect wires to duct detector. Temperature controls contractor shall connect wires at motor starter. Both contractors shall test shut down.

- H. Make conduit and wiring connections to smoke damper actuator controller.
- I. Elevator recall for firefighter's service:
 - 1. Smoke detector located in the designated elevator recall lobby shall be connected to the first elevator control circuit.
 - 2. Smoke detectors in the remaining elevator lobbies, hoistways, and elevator machine room shall be connected to the second elevator control circuit, except that when the elevator machine room is located at the designated landing, then the elevator machine room smoke detector shall be connected to the first elevator control circuit.
 - 3. Install relays, addressable control modules, contacts, and all wiring, which will cause the elevator recall.
- K. Signal device shall sound different from other signal devices.
- L. Bolt control panel to mounting surface in accordance with Section 26 05 53.
- 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 exist.
- 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 28 31 00

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Earthwork for this project includes but is not necessarily limited to:
 - 1. Layout of building and site improvements.
 - 2. Excavating for foundations, utilities and other below grade work.
 - 3. Filling and backfilling of all excavations.
 - 4. Rough and finish grading of the site.
 - 5. Granular drainage fill.
- B. Perform excavation regardless of type, nature or condition of materials encountered.
- C. All excavation under this Section is unclassified and no allowances will be made for nature of material encountered. Contractor shall make soil investigations as he considers necessary for his own determination of types of materials existing at the site.
- D. There will be no extra compensation for dewatering.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
 - 1. Samples of all imported material. Provide 25 pound bags of material to Geotechnical engineer's office at least 10 days before the material is to be imported to the site.
 - 2. Samples of all on-site material to be used as fill.
 - 3. Certification that imported materials conform to the specification requirements along with copies of the test results from a qualified commercial testing laboratory.
 - 4. Proctor curves on fill material as prepared by approved laboratory.
- B. All fill material requires approval prior to placement.
- C. Substitutions will not be considered prior to the award of the General Contract.

1.04 JOB CONDITIONS

- A. Beginning work of this Section means acceptance of existing conditions.
- B. Dust Control: Control dust on and near the Work if dust is caused by Contractor's operations during performance of the Work or if resulting from condition in which Contractor leaves the site.

1.05 REFERENCES

- A. Arkansas State Highway and Transportation Department, Standard Specifications for Highway Construction, latest edition.
 - 1. AHTD Section 207 - Stone Backfill.
 - 2. AHTD Section 303 - Aggregate Base Course.
- B. ASTM International, 100 Barr Harbor drive, PO Box C700, West Conshohocken, PA 19428-2959, USA Phone: (610) 832-9585.
 - 1. ASTM D698 - Test for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb. Rammer and 12 in. Drop.
 - 2. ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.
 - 3. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 10 lb. Rammer and 18 in. Drop.
 - 4. ASTM D2216 - Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock and Soil-Aggregate Mixtures.
 - 5. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 6. ASTM D3017 - Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 7. ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
- C. AASHTO - American Association of State Highway and Transportation Officials
 - 1. AASHTO T 27 - Sieve Analysis of Fine and Coarse Aggregates.
- D. Occupational Safety and Health Administration (OSHA) Standard for Excavation and Trenches Safety System, 29 CFR 1926, Subpart P = Excavations.
- E. Arkansas Statute 291 of 1993.

1.06 DEFINITIONS

- A. Relative Compaction: The ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by the Standard Proctor Test, ASTM D698, or as determined by the Modified Proctor Test, ASTM D1557, as applicable. Corrections for oversize material may be applied to either the as-compacted field dry density or the maximum dry density, as determined by the Architect.

- B. Optimum Moisture Content: Moisture content of the material for which the maximum dry density is obtained as determined by ASTM D698 or D1557. Field moisture contents shall be determined on the basis of the fraction passing the 3/4" sieve.
- C. Completed Course: A course or layer that is ready for the next layer or the next phase of construction.
- D. Under-Cut: Additional excavation into native soils beyond sub-grade or stripping depth that is required to provide an adequate depth of suitable backfill bearing material.
- E. Sub-grade: The following shall define the sub-grade elevations:
 - 1. Footings: The elevation of the bottom of the footing.
 - 2. Building slabs: The elevation at the bottom of the capillary break.
 - 3. Walkways and Paving: The elevation at the bottom of the paving section.
 - 4. Utility Trenches: The elevation of the bottom of the pipe bedding.
 - 5. Landscaped Areas: The elevation below the stripping depth or the soil planting section, whichever is lower.
- F. Unsuitable material shall be that material below the sub-grade elevation that does not meet bearing capacity requirements as defined by the field Geotechnical engineer. Material not previously approved by Geotechnical engineer as unsuitable will not be considered for compensation.

1.07 UNSUITABLE MATERIAL

- A. The Contractor will be compensated beyond his base bid for excavation and off-site disposal of un-anticipated unsuitable soils only as verified and documented by the Geotechnical engineer in the field. No compensation will be made to the Contractor for unverified and undocumented quantities.
- B. Measure in-place bank yards of material that is to be removed by field measurement that shall be observed, verified, and documented by the Geotechnical Engineer prior to backfilling with imported Granular fill. Measurement by truck tickets will not be accepted. Measurement of excavation prior to backfilling will also be used to determine the quantity of excess import required to replace the excavated material.
- C. Soil integrity will be influenced by the weather conditions and the Contractor's handling and protection of the material as it is removed and placed. It is the sole responsibility of the Contractor to protect soils from the elements. The Contractor will be responsible for removing material, including previously inspected fill or exposed sub-grade, that is deemed unsuitable due to lack of protection and replacing with acceptable material at no additional cost to the Owner.
- D. Compensation will not be made for material that was not defined and verified in the field as unsuitable material by the Geotechnical engineer.

PART 2 - PRODUCTS

2.01 EARTH FILL

- A. Place earth fill in areas not designated to be structural fill or backfill.
- B. Free from roots, organic matter, trash and debris with maximum particle size of 1-1/2 inches.
- C. Imported fill is to consist of clayey sand (SC), sandy clay (CL) or clayey gravel (GC).
- D. Engineered fill is to consist of approved low volume-change material designated as CL or GC soils having a Liquid Limit less than 40 and a Plasticity Index less than 20 or Class 7 Aggregate Base Course.
- E. It is intended that fill be obtained from the site excavation to the maximum extent possible. DO NOT CONSTRUCT BORROW PITS ON SITE WITHOUT WRITTEN AUTHORIZATION FROM THE ARCHITECT.

2.02 STRUCTURAL (FLOWABLE) FILL

- A. Imported structural fill, Controlled Low Strength Material (CLSM), is to consist of a natural or artificial mixture of sand, coarse aggregate, cement and water, uniformly well graded from coarse to fine. The mix shall have good workability and flowability with self-compacting and self-leveling characteristics. Conform to ASTM D4832.
- B. Conform to the AHTD Section 303 classifications for Class 3, Class 4 or Class 7 as or as required by existing soil conditions.

2.03 UNDERSLAB DRAINAGE FILL

- A. Crushed stone or washed gravel, uniformly graded from 3/4" minimum size to 1-1/2" maximum size (ASTM C-33 #57 or equivalent).

2.04 CRUSHED SYENITE FILL

- A. Fill and Backfill Inside Building Walls: Crushed syenite, similar to Donna-Fill. Deliver to job in moist condition. Settle in place by completely immersing under water for optimum compaction. Keep water level above syenite at all times during placing.

2.05 TOPSOIL

- A. Selected topsoil from the site, properly stored and protected, free from roots, sticks, hard clay and stones which will not pass through a 1 in. square opening. Provide analysis of topsoil to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value.

- B. **Topsoil Removal:** Prior to the commencement of construction, the site shall be cleared of all vegetation in construction areas. After the site is cleared, all topsoil shall be stripped from the site and an adequate amount stored (4 inch minimum thickness) for reuse on the site for final seeding or landscaping. Excess topsoil may be used on embankment slopes or excavated slopes after final compaction of the embankment material or back-slopes. No topsoil shall be placed in areas to receive pavement, sidewalks or structures. Topsoil, because of its compressible organic content, shall not be used in areas that will support embankments, structures, or pavements.

2.06 COMPACTION EQUIPMENT

- A. Provide compaction equipment of suitable type and adequate to obtain the densities specified.
- B. Operate compaction equipment in strict accordance with the manufacturer's instructions and recommendations.
- C. Maintain equipment in such condition that it will deliver the manufacturer's rated compactive effort.
- D. Hand operated equipment shall be capable of achieving the specified densities.

2.07 MOISTURE CONTROL EQUIPMENT

- A. Provide equipment for applying water of a type and quality adequate for the work; it shall not leak and shall be equipped with a distributor bar or other approved device to assure uniform application.
- B. Provide equipment for mixing and drying out material consisting of blades, discs or other approved equipment.

2.08 WATER REMOVAL EQUIPMENT

- A. Provide and operate equipment adequate to keep excavation and trenches free of water, including but not limited to pumps and hoses.

2.09 SELECTED MATERIAL ACCEPTANCE

- A. Provide samples for testing representative of the actual material to be installed in the work. Take samples from material stockpiled. Depending on the uniformity of the material, Architect may request additional samples.
- B. Tests required at the borrow area:
 - 1. Standard Proctor.
 - 2. Atterberg limits.

- C. Forward test results to Architect at least 10 days before the material is required for use. If tests indicate that the material does not meet specification requirements, the material shall not be installed in the work.
- D. Material which is placed in the work but does not conform to the specification requirements shall be removed and replaced at the Contractor's expense.

2.10 OTHER MATERIALS

- A. Provide materials, not specifically described but required for proper completion of work of this Section, selected by Contractor subject to Architect approval.

PART 3 - EXECUTION

3.01 CLEARING AND GRUBBING

- A. Complete clearing and grubbing work as specified in Section 02 41 13 prior to beginning work in this section.

3.02 LAYOUT AND STAKING

- A. The Contractor will employ and pay a competent, independent, Registered Professional Land Surveyor with demonstrated ability to perform the layout work required.
- B. Definitions
 - 1. "Control Stakes" are the original reference points set by Engineer for the construction work.
 - 2. "Construction Staking" is an additional staking required as the project progresses which is the responsibility of Contractor.
- C. Engineer shall provide the following staking:
 - 1. Set temporary bench marks.
 - 2. Reset stakes found to be in error.
- D. Contractor shall provide the following staking:
 - 1. All construction staking except as provided by Engineer above.
 - 2. Reset stakes, marks or pins lost due to Contractor's operations.
- E. Electronic copies of surveying staking points will not be made available for this project.
- F. Control Staking
 - 1. Notify Engineer, in writing, at least five days in advance of the date when control staking services are desired.
 - 2. Engineer shall provide control staking.
 - 3. Examine stakes before commencing operations.
 - 4. Notify Engineer if validity of any control stake is questionable.

5. Engineer will check stake or stakes in question.
 6. Any control stakes found to be in error will be reset by Engineer.
 7. If stakes are valid, Contractor shall pay for cost of checking stakes.
 8. Contractor shall inform his employees, subcontractors and vendors of importance of control stakes and the necessity of their preservation.
 9. Contractor shall pay for resetting any control stakes, marks, or pins lost due to Contractor's operations.
- G. Construction Staking
1. Provide all construction staking as needed to complete the Work.
- H. If site conditions vary from those indicated, the Contractor shall notify the Architect immediately.

3.03 STRUCTURAL EXCAVATION

- A. Excavate subsoil required for building foundations both interior and exterior, construction operations and other work. Excavate for structures to the lines and grades shown or as required to accomplish the construction.
1. After excavating footings and prior to placing any fill material, Contractor is to arrange for qualified testing agency to perform hand held penetrometer tests at 10 foot intervals along entire length of perimeter footing and along all interior grade beams to determine that minimum soil bearing capacity has been achieved.
- B. The method of excavation used is optional; however, no equipment shall be operated within 5 feet of existing structures or newly completed construction.
- C. Excavation that cannot be accomplished without endangering present or new structures shall be done with hand tools.
- D. Machine slope banks to angle of repose or less until shored.
- E. Excavate to the depths and widths required.
- F. Do not interfere with normal 45 degree bearing splay of foundations.
- G. Allow for forms, working space, granular base and finish topsoil.
- H. Do not carry excavation for footings and slabs deeper than the elevation shown.
1. Fill over excavations under footings with concrete of equal strength to that of the footing when excavations are deeper than the elevation shown.
 2. Replace excavation carried below the grade lines shown or established by the Architect with the same fill Material as specified for the overlying fill or backfill, compact as required for such overlying fill or backfill.
 3. Where the overlying area is not to receive fill or backfill, replace the over excavated material and compact to a density not less than that of the underlying ground.

- 4. Correct over excavated areas and unauthorized excavation at the Contractor's expense.
- I. Correct cuts below grade by similarly cutting adjoining areas and creating a smooth transition.
- J. Hand trim excavation and leave free of loose matter.
- K. Remove lumped subsoil, boulders and rock.
- L. Stockpile excavated material in area designated on site and remove excess subsoil not being reused from site.

3.04 EXCAVATION SAFETY

- A. The Contractor shall be solely responsible for making the excavation in a safe manner.
- B. Provide appropriate measures to retain excavation side slopes to ensure that men working in or near the excavation are protected.

3.05 DEWATERING EXCAVATION

- A. Remove water during periods when concrete is being deposited, pipe is being laid and placing of backfill unless water settling is required and at such other times as required for efficient and safe execution of the work.
- B. Accomplish removal of groundwater in a manner that will preserve the strength of the foundation soils, will not cause instability of the excavation slopes and will not result in damage to existing structures.
- C. Where necessary to these purposes, lower water level in advance of excavation, utilizing wells, wellpoints or similar methods.
- D. Maintain the water level in the gravel stratum as measured in piezometers, a minimum of 3 feet below the prevailing excavation.
- E. Open pumping, sumps and ditches: If these methods result in boils, loss of fines, softening of the ground or instability of slopes, they will not be permitted.
- F. Install wells and wellpoints with suitable screens and filters so that continuous pumping of fines does not occur.
- G. Operate well points continuously so as to prevent boils and loss of consolidation.
- H. Arrange discharge to facilitate collection of samples by Architect.
- I. Avoid settlement or damage to adjacent property.

- J. Dispose of water in a manner that will not damage adjacent property, as approved by Architect.

3.06 UNDERCUTTING

- A. Undercut areas on the site that do not meet the permeability requirements to such depth as to allow placement of sufficient impervious material as determined by permeability testing at borrow area as stated in Part 2 of this section.
- B. Prior to placement of fill in the undercut area, scarify the upper 6" of subgrade and re-compact to 95 percent of ASTM D1557.

3.08 FOUNDATION SUBGRADE PREPARATION

- A. After completion of excavation and prior to foundation or fill construction, proofroll the excavation surface with a loaded tandem-axle dump truck or similar heavy wheeled vehicle to detect soft or loose zones.
- B. Conduct proof-rolling in the presence of Architect.
- C. If soft or loose zones are found, excavate the material to a depth accepted by Architect, then fill and compact as specified for the overlying fills.
- D. Prior to placement of overlying fill or concrete, scarify the upper 6" of subgrade and re-compact the foundation subgrade to at least 95 percent of ASTM D1557.

3.09 FILL MATERIAL

- A. Place structural fill material within the influence area beneath all piping, slabs, structures and other areas of excavation.
- B. Place fill in 6" loose lifts and compact each lift to 95 percent of ASTM D1557.
- C. Moisten material as required to aid compaction (+ or - 2 percent optimum moisture content).
- D. Place material in horizontal lifts and in a manner which avoids segregation.
- E. Correct and repair subsequent damage to slabs, piping, concrete structures, facilities or other structures caused by settlement of fill material.

3.10 BACKFILL

- A. Remove form materials and trash from excavation before placing backfill.
- B. Do not operate earth moving equipment within 5 feet of walls of concrete structures for the purpose of depositing or compacting backfill material.

- C. Compact backfill adjacent to concrete walls with hand operated tampers or similar equipment that will not damage the structure.
- D. Place backfill material in 6" loose lifts and compact each lift to 95 percent of ASTM D1557.
- E. Backfill all utility excavations and compact to minimum 95 percent of ASTM D698.

3.11 SUBGRADE PREPARATION AND FILL MATERIAL AT PAVED AREAS

- A. Paved areas include areas to receive Gravel Surfacing, Asphalt Concrete Paving, Portland Cement Concrete Paving, etc.
- B. Scarify upper 6" of natural subgrade and recompact to 90 percent of ASTM D1557.
- C. Place structural fill material to the lines and grades shown in maximum 6" loose lifts and compact each lift to not less than 90 percent of ASTM D1557.

3.12 MOISTURE CONTROL

- A. During compacting operations, maintain optimum practicable moisture content required for compaction purposes in each lift of fill.
- B. Maintain moisture content uniform throughout the lift.
- C. Add water to the material at the site of excavation. Supplement, if required, by sprinkling the fill.
- D. At the time of compaction, maintain the water content of the material at optimum moisture content, plus or minus 2 percent, except as otherwise specified for embankments.
- E. Do not attempt to compact fill material that contains excessive moisture.
- F. Aerate material by blading, discing, harrowing or other methods to hasten the drying process.

3.13 FIELD DENSITY TESTS

- A. Test Methods: ASTM D2922, D2216 and D3017.
- B. Cooperate with testing work by leveling small test areas designated by the Architect.
- C. Backfill test areas.
- D. Field density test shall be performed for every 50 cubic yards of fill material placed.

- E. Architect may order testing of any lift of fill at any time, location or elevation.

3.14 FINISH SITE GRADING AND TOPSOIL PLACEMENT

- A. **Finished Grading:** After all structures have been completed and all backfills have been compacted, all areas on the project construction site which have been disturbed by the Contractor shall be brought to true grade with a minimum of 4 inches of topsoil. Perform earthwork to lines and grades as shown with proper allowance for topsoil.
- B. Provide a minimum 4" depth of topsoil in all areas within the limits of construction that are disturbed during the course of this work except areas that are to receive sod or paving material.
- C. Shape, trim and finish slopes to conform with the lines, grades and cross sections shown.
- D. Make slopes free of loose exposed roots and stones exceeding 3 inches in diameter.
- E. Round tops of banks to circular curves, in general, not less than a 6 foot radius.
- F. Neatly and smoothly trim rounded surfaces; over excavating and backfilling to the proper grade are not acceptable.
- G. Finish site grading will be reviewed by Architect.

3.15 DISPOSAL OF EXCESS EXCAVATION

- A. Dispose of excess excavated materials, not required or suitable for use as backfill or fill off-site OR outside of the area of work.
- B. Compact excess material as specified for fill, dress the completed disposal area to slopes no greater than 4:1 (horizontal:vertical) and slope to drain.

3.16 SETTLEMENT

- A. Settlement in backfill, fill or in structures built over the backfill or fill, which may occur within the 1-year guarantee period in the General Conditions will be considered to be caused by improper compaction methods.
- B. Restore structures damaged by settlement to original condition.

END OF SECTION 31 00 10

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PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Excavating for footings, slabs-on-grade, paving, site structures, and utilities within the building.
- B. Trenching for utilities outside the building.

1.02 RELATED SECTIONS

- A. Section 00 31 10 - Geotechnical Investigation
- B. Section 31 23 17 - Trenching for Site Utilities: Excavating for utility trenches outside the building to utility main connections.
- C. Section 31 23 23 - Fill and Backfill: Fill materials, filling, and compacting.
- D. Section 32 22 13 - Grading: Soil removal from surface of site.

1.03 PROJECT CONDITIONS

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.
- B. Protect plants, lawns, and other features to remain.
- C. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, and protect utilities that remain and protect from damage.
- C. Notify utility company to remove and relocate utilities.

3.02 EXCAVATING

- A. Excavate to accommodate new structures and construction operations in accordance with requirements of the geotechnical investigation and as indicated on Drawings.
- B. Notify Architect and geotechnical engineer of unexpected subsurface conditions and discontinue Work in affected area until notified to resume work.
- C. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- D. Do not interfere with 45 degree bearing splay of foundations.
- E. Cut utility trenches wide enough to allow inspection of installed utilities.
- F. Hand trim excavations. Remove loose matter.

- G. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 31 2323.
- H. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- I. Remove excavated material that is unsuitable for re-use from site.
- J. Stockpile excavated material to be re-used in area designated on site in accordance with Section 32 2213.
- K. Remove excess excavated material from site.

3.03 PROTECTION

- A. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Backfilling and compacting for utilities outside the building to utility main connections.

1.02 RELATED SECTIONS

- A. Section 00 31 10 - Geotechnical Investigation
- B. Section 31 23 16 - Excavation: Building and foundation excavating.
- C. Section 31 23 23 - Fill and Backfill: Backfilling at building and foundations.
- D. Section 32 22 13 - Grading: Site grading.

1.03 REFERENCES

- A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2001.
- B. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2000a.
- C. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2000.
- D. ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2002.
- E. ASTM D 2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 1994(R 2001).
- F. ASTM D 2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2000.
- G. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2001.
- H. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2001.

1.04 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.
- B. Subgrade Elevations: 6 inches below finish grade elevations indicated on drawings, unless otherwise indicated.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Compaction Density Test Reports.

1.06 PROJECT CONDITIONS

- A. Provide sufficient quantities of fill to meet project schedule and requirements. When necessary, store materials on site in advance of need.
- B. Verify that survey bench marks and intended elevations for the Work are as indicated.
- C. Protect plants, lawns, rock outcroppings, and other features to remain.
- D. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

PART 2 – PRODUCTS

2.01 FILL MATERIALS

- A. General Fill: (to be used in areas not within 5' of building perimeter):
 - 1. Graded.
 - 2. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
 - 3. Conforming to ASTM D 2487 Group Symbol CL.
- B. Structural Fill: (to be used under all building areas and 5' outside of all building areas): Low plasticity sandy clay, clayey sand or clay and gravel blends, SC, SM, or GC. Fill should have a Plasticity Index between 5 and 20.
- C. Concrete for Fill (Flowable Fill - utility trenches passing under footings): Compressive strength of 2500 psi in conformance with AHTD Standard Specification for Highway Construction, Section 206.
- D. Granular Fill for drainage fill below slabs on grade - Gravel: Angular crushed stone; "C" Ballast, free of shale, clay, friable material and debris, with a minimum of "fines".
- E. Sand: Conforming to State of Arkansas Highway Department standard.
- F. Topsoil: See Section 32 2213.

2.02 SOURCE QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for testing and analysis of soil material.
- B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, and protect utilities that remain and protect from damage.
- C. Notify utility company to remove and relocate utilities.
- D. See Section 32 2213 for additional requirements.

3.02 TRENCHING

- A. Notify Architect of unexpected subsurface conditions and discontinue work in affected area until notified to resume work.
- B. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- C. Do not interfere with 45 degree bearing splay of foundations.
- D. Cut trenches wide enough to allow inspection of installed utilities.
- E. Hand trim excavations. Remove loose matter.
- F. Remove excavated material that is unsuitable for re-use from site.
- G. Remove excess excavated material from site.

3.03 PREPARATION FOR UTILITY PLACEMENT

- A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.
- B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

3.04 BACKFILLING

- A. Backfill to contours and elevations indicated using unfrozen materials.
- B. Fill up to subgrade elevations unless otherwise indicated.
- C. Employ a placement method that does not disturb or damage other work.
- D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches compacted depth.
- G. Slope grade away from building minimum 2 inches in 10 ft, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- H. Correct areas that are over-excavated.
 - 1. Thrust bearing surfaces: Fill with concrete.

2. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.
- I. Compaction Density Unless Otherwise Specified or Indicated:
 1. Under paving, slabs-on-grade, and similar construction: 97 percent of maximum dry density.
- J. Reshape and re-compact fills subjected to vehicular traffic.

3.05 BEDDING AND FILL AT SPECIFIC LOCATIONS

- A. Use general fill unless otherwise specified or indicated.
- B. Utility Piping, Conduits, and Duct Bank:
 1. Bedding: Use structural fill.
 2. Cover with general fill.
 3. Fill up to subgrade elevation.
 4. Compact in maximum 8-inch lifts to within two percentage points of optimum moisture content to 95 percent of Modified Proctor density.
- C. At Pipe Culverts:
 1. Bedding: Use structural fill.
 2. Cover with general fill.
 3. Fill up to subgrade elevation.
 4. Compact in maximum 8-inch lifts to within two percentage points of optimum moisture content to 95 percent of Modified Proctor density.
- D. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.
- E. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.

3.07 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D2922, or ASTM D3017.
- C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 ("standard Proctor"), ASTM D 1557 ("modified Proctor"), or AASHTO T 180.
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.

3.08 CLEAN-UP

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Filling, backfilling, and compacting for building volume below grade, footings, slabs-on-grade, paving, site structures, and utilities within the building.
- B. Backfilling and compacting for utilities outside the building to utility main connections.

1.02 RELATED SECTIONS

- A. Section 00 2200 - Site Preparation: Site grading.
- B. Section 00 3010 - Geotechnical Investigation.
- C. Section 03 3000 - Cast-in-Place Concrete.
- D. Section 31 2316 - Excavation: Removal and handling of soil to be re-used.
- E. Section 31 2317 - Trenching for Site Utilities: Excavating for utility trenches outside the building to utility main connections.
- F. Section 32 1314 – Integrally Colored Concrete Paving
- G. Section 32 2213 - Grading: Removal and handling of soil to be re-used.
- H. Section 32 2213 - Grading: Site grading.

1.03 REFERENCES

- A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2001.
- B. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2000a.
- C. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2000.
- D. ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2002.
- E. ASTM D 2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 1994(R 2001).
- F. ASTM D 2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2000.
- G. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2001.
- H. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2001.

1.04 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.
- B. Subgrade Elevations: 6 inches below finish grade elevations indicated on drawings, unless otherwise indicated.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- C. Compaction Density Test Reports.

1.06 PROJECT CONDITIONS

- A. Provide sufficient quantities of fill to meet project schedule and requirements. When necessary, store materials on site in advance of need.
- B. Verify that survey bench marks and intended elevations for the Work are as indicated.

PART 2 – PRODUCTS

2.01 FILL MATERIALS

- A. General Fill: (to be used in areas not within 5' of building perimeter):
 - 1. Graded.
 - 2. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
 - 3. Conforming to ASTM D 2487 Group Symbol CL.
 - 4. All fill material to be placed in a city right-of-way must be approved by the proper municipal department prior to placement.
- B. Structural Fill: (to be used under all building areas and 5' outside of all building areas): Low plasticity sandy clay, clayey sand or clay and gravel blends, SC, SM, or GC. Fill should have a Plasticity Index between 5 and 20.
- C. Concrete for Fill (Flowable Fill - utility trenches passing under footings): Compressive strength of 2500 psi in conformance with AHTD Standard Specification for Highway Construction, Section 206.
- D. Granular Fill for drainage fill below slabs on grade - Gravel: Angular crushed stone; "C" Ballast, free of shale, clay, friable material and debris, with a minimum of "fines".
- E. Granular Fill for Compacted Base Course - Gravel: Natural washed stone or crushed stone, free of shale, clay, friable material and debris.
 - 1. Graded in accordance with ASTM D 2487 Group Symbol CL.
- F. Sand: Conforming to State of Arkansas Highway Department standard.
- G. Topsoil: See Section 31 2213.

2.02 SOURCE QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for testing and analysis of soil material.

- B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 32 2213 for additional requirements.

3.02 PREPARATION

- A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill. Undercut unsuitable foundation or subgrade soils per the geotechnical investigation and replace with suitable fill compacted within two percentage points of optimum moisture content to a minimum of 95 % of the Modified Proctor (ASTM D-1557) as described below, placed in maximum 8" lifts.
- B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.03 FILLING

- A. Fill to contours and elevations indicated using unfrozen materials.
- B. Fill up to subgrade elevations unless otherwise indicated.
- C. Employ a placement method that does not disturb or damage other work.
- D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Granular Fill: Place and compact materials in equal continuous layers not exceeding 8 inches compacted depth.
- G. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches compacted depth.
- H. Slope grade away from building minimum 2 inches in 10 ft, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- I. Correct areas that are over-excavated.
 - 1. Load-bearing foundation surfaces and undercut areas within 5' of building perimeter: Use Structural Fill as described above.
 - 2. Other areas: Use general fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density.
- J. Compaction Density Unless Otherwise Specified or Indicated:
 - 1. Under all building areas and 8' outside of all building areas: within two percentage points

of optimum moisture content to a minimum 95 percent of Modified Proctor (ASTM D 1557).

2. At other locations: 95 percent of maximum dry density.

K. Reshape and re-compact fills subjected to vehicular traffic.

3.04 FILL AT SPECIFIC LOCATIONS

- A. Use general fill for areas not under building or 5' outside of building perimeter, or paving.
- B. Use Structural Fill at all areas under buildings and pavement including the area outside the building perimeter within 6 feet of the building.
 1. Use structural fill.
 2. Fill up to subgrade elevations.
 3. Maximum depth per lift: 8 inches, compacted.
 4. Compact to within two percentage points of optimum moisture content to a minimum 95 percent of Modified Proctor (ASTM D 1557).
- C. Over Buried Utility Piping, Conduits, and Duct Bank in Trenches:
 1. Bedding: Use structural fill.
 2. Cover with general fill.
 3. Fill up to subgrade elevation.
 4. Compact in maximum 8 inch lifts to 95 percent of maximum dry density.
- D. At Lawn Areas:
 1. Use general fill.
 2. Fill up to subgrade elevations.
 3. Compact to 95 percent of maximum dry density.
 4. See Section 32 2213 for topsoil placement.

3.05 TOLERANCES

- A. Top Surface of General Filling: Plus or minus 1 inch from required elevations.
- B. Top Surface of Filling under Paved Areas: Plus or minus 1 inch from required elevations.

3.06 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D2922, or ASTM D3017.
- C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 ("standard Proctor"), ASTM D 1557 ("modified Proctor"), or AASHTO T 180.
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- E. Frequency of Tests: for Building areas including areas within 10'-0" outside of building perimeter lines, not less than one test for every 500 sq. ft; for parking areas not less than one test per 7500 sq. ft.

3.07 CLEAN-UP

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Furnish all labor, equipment and materials needed to complete the Work as shown on the Plans and specified herein.
- B. The work performed under this section shall comply with the plan requirements for this project and with the requirements and intent of the NPDES Storm Water Discharge Permit program to the extent that it applies to this project.

1.02 RELATED SECTIONS

- A. Section 31 00 00 - EARTHWORK

1.03 QUALITY ASSURANCE

- A. Comply with applicable requirements of all governing authorities having jurisdiction. The Specifications and the Plans are not represented as being comprehensive, but rather to convey the intent to provide complete slope protection and erosion control for both the Owner's and adjacent property.
- B. Erosion control measures shall be established at the beginning of construction and maintained during the entire length of construction. On-site areas which are subject to severe erosion and off-site areas which are especially vulnerable to damage from erosion and/or sedimentation are to be identified and receive additional erosion control measures as directed by the Owner.
- C. All land-disturbing activities shall be planned and conducted to minimize the size of the area to be exposed at any one time and to minimize the time of exposure.
- D. Surface water runoff originating upgrate of exposed area shall be controlled to reduce erosion and sediment loss during the period of exposure.
- E. When the increase in the peak rates and velocity of storm water runoff resulting from a land-disturbing activity is sufficient to cause accelerated erosion of the receiving ditch or

stream, the Contractor shall install measures to control both the velocity and rate of release so as to minimize accelerated erosion and increased sedimentation of the stream as directed by the Owner.

- F. All land-disturbing activities shall be planned and conducted so as to minimize off-site sedimentation damage.
- G. The Contractor shall be responsible for periodically cleaning out and disposing of all sediment once the storage capacity of the drainage feature or structure receiving the sediment is reduced by one-half. The Contractor shall also be responsible for cleaning out and disposing of all sediment at the time of completion of the Work.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Silt Fence Fabric:
 - 1. MISF1776, Propex 2130, TerraTexSC, or approved equal.
 - 2. Minimum bursting strength: 300 psi.
 - 3. Edges treated to prevent unraveling.
 - 4. Furnished with o-rings or clips to facilitate attachment to woven wire fabric.
- B. Wire Fencing: Steel wire fencing (hog wire) with minimum 14 gauge wire and a maximum 14 gauge wire and a maximum opening of 6 inches.
- C. Posts:
 - 1. Steel, T-section minimum 4 feet 6 inches long, minimum of 1.3 pounds per foot without anchor plate.
 - 2. Anchor plate attached before coating.
 - 3. Fabricate with lugs or other approved means to prevent vertical movement from the wire fencing.

- D. Tie Wire: Galvanized in accordance with ASTM A112.
- E. Temporary cover for graded areas shall be undamaged, air dry threshed straw free from weed seeds.

PART 3 - EXECUTION

3.01 CONDITION OF SUBSTRATE:

- A. Erosion control measures must be implemented prior to the commencement of any soil disturbing activity.
- B. Stabilize fill and grade of areas to receive soil erosion and sediment control in accordance with Section 02220, "EARTHWORK". Maintain positive drainage to sediment and erosion control devices during and after grading operations.

3.02 SILT FENCE:

- A. Install posts on a minimum of 6-foot centers. Minimum embedment of 6".
- B. Minimum height of the silt fence to be 2 feet 6 inches with a 6-inch clearance between the top of the silt fence and the top of the posts.
- C. Install the steel posts on a slight angle towards the anticipated runoff surface.
- D. Trench in the toe of the silt fence so that the down slope face of the trench is flat and perpendicular to the line of flow.
- E. Minimum trench depth: 6 inches.
- F. Trench width: 6 inches.
- G. Attach wire fence (hog wire) to the posts.
- H. Attach the silt fence fabric to the wire fence (hog wire) and secure with a minimum of two wire ties per post.
- I. Backfill over the silt fence fabric in the trench.

- J. When build up of soil, silt, or any other material behind the silt fence reaches a height of 6 inches or when the silt fence is no longer functioning efficiently, remove all accumulated material and repair the silt fence as needed.

3.03 DUST CONTROL

- A. Dust control of the Contractor's performance of the Work shall be performed by the Contractor by applying water.
- B. Dust control shall be provided in the amounts and locations as ordered by the Owner's Representative.

3.04 PROTECTION AND MAINTENANCE:

- A. Protect erosion and sediment control devices from damage. Repair and replace dikes, silt fences and other measures when damaged by construction, natural and other physical causes. All soil erosion and sediment control devices shall be repaired or replaced at the expense of the Contractor and shall function as originally intended.
- B. Periodically (at least once every 7 days and after each rainfall event) inspect and maintain erosion and sediment control structures, until final stabilization of disturbed ground areas is achieved.
- C. All stock piled soil shall be surrounded by a silt fence to properly control sediment runoff.
- D. Inspection services provided by the Owner's Representatives do not relieve the Contractor's responsibility for inspection and maintenance of the erosion control measures.
- E. The Contractor is responsible for modifying or providing additional erosion control devices to control erosion from his operations on the site. This may become necessary due to disturbance of additional areas or phasing of the Contractor's operations.

3.05 STAGING AREAS:

At such time when the specific location of the staging areas are determined, silt fences, diversions, or equivalent sediment controls are required for all side slope and down slope boundaries of the staging area and shall be provided by the Contractor. The erosion control plan for each staging area shall be approved by the Owner's Representative and devices shall be in

place prior to occupation of the staging areas. All relative material and labor to construct and maintain the staging area erosion control plans shall be subsidiary to the other items of work.

3.06 The Contractor shall be responsible for complying with the Storm Water Pollution Prevention Plan as provided by Owner's Representative.

END OF DOCUMENT 31 25 00

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Perform foundation and under floor termite control treatment in accordance with the Arkansas Pest Control Law and to qualify construction under this Contract for continuous guaranteed protection specified.
 - 1. Reference is made to Section IIIA - Minimum Requirements on Structural Pest Work on Existing Structures.
- B. Applicable Regulations:
 - 1. International Building Code
 - 2. Arkansas Pest Control Law, A.C.A. 17-30-101 et. Seq. and Regulations
 - a. Circular 6 revised December, 2013
 - b. Arkansas State Plant Board
 - 3. Federal Insecticide, Fungicide and Rodenticide Act, (Public Law 92-516 of Oct. 21, 1972 as amended by Public Law 100-532, October 25, 1988).

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are located in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
- B. Substitutions will not be considered prior to the award of the General Contract.
- C. Submit a Termicide Application Plan, including Product Data, Design Data, Test Reports and Certificates.

1.04 GUARANTEE

- A. Furnish damage guarantee with service and re-service for any subterranean termite infestation without cost to Owner. Write Damage Guaranty Contract additionally to cover any and all subterranean termite damage to the structures and contents in amount of \$10,000. Such damage to be repaired, replaced or corrected at Contractor's expense.

- B. Furnish damage guarantee effective for 5 year period after completion of initial treatment without payment of additional fees or premiums by Owner. Upon expiration of 5-year period, Owner has option of extending damage guarantee contract at an annual fee mutually agreed upon by Owner and applicator. Owner reserves the right to cancel as of any anniversary date. Service, re-service, and Damage Guaranty provisions of the extended damage contract are noncancellable by applicator. Annual fee subject to revision by giving advance written notice to Owner.
- C. Include in the warranty annual inspections of the buildings, whether new or renovated, or building additions during the warranty period. If live subterranean termite infestation or subterranean termite damage is discovered during the warranty period, and the soil and building conditions have not been altered in the interim:
 - 1. Re-treat the site and perform other treatment as may be necessary for elimination of subterranean termite infestation;
 - 2. Repair damage caused by termite infestation; and
 - 3. Reinspect the building approximately 180 days after the re-treatment.

1.05 ADMINISTRATIVE

- A. Coordinate work related to final grades, landscape planting, foundations, or any other alterations to finished or renovated construction which might alter the condition of treated soils with this specification.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Chemical termite control uses liquid termiticide treatments applied to the soil, forming a continuous chemical barrier in the soil around both sides of the foundation. The application may be surface applied or rodded and trenched. This barrier prevents foraging termites from reaching the foundation and piers. Only the soil adjacent to these foundation elements is treated. For slab construction (including foundations, patios and garages), the entire soil (or gravel) surface shall be treated after tamping (Rodding method) and before the vapor barrier is installed and the slab poured over it. Soil treatment shall be coordinated with all building activities from foundation construction through final grading of the soil around the building's exterior. In order for the treatment to be effective, the final phase of the application must be done after final grading and, where required, after landscaping is completed so that treated soil is not disturbed.
 - 1. If tamping not utilized then broadcast spraying method over lightly scarified or loose ground surface is allowable. Verify with insecticide manufacturer.

2.02 TERMITE CONTROL CHEMICALS

- A. Use chemicals approved by the Arkansas State Plant Board and of type required to give guaranteed protection specified.

- B. Approved chemicals.
 - 1. Bifenthrin - Trade name Baseline, 1% emulsion.
 - 2. Cypermethrin - Pyrethroid, trade name Demon TC, 1%.
 - 3. Imidacloprid - Trade name Premise 75, .05% to .1%.
 - 4. Cyano - Trade name Tirbute, .5% to 1%.
 - 5. Other chemicals may be used as approved by appropriate regulatory agencies.
- C. All instructions on the manufacturers label shall be closely followed and all state and federal laws strictly obeyed.

PART 3 - EXECUTION

3.01 PREPARATION

- A. From investigation at the site determine soil texture or otherwise obtain this information from the County Agent, Soil Conservation Service or other approved authorities, if not already known.
- B. Eliminate food sources by removing debris from clearing and grubbing and post construction wood scraps such as ground stakes, form boards, and scrap lumber from the site, before termiticide application begins.

3.02 TREATMENT

- A. Perform foundation and under floor termite control treatment at buildings to be constructed and/or renovated under this Contract. Use type chemical approved by the Arkansas State Plant Board and currently known to give guaranteed protection for the soil and fill used at this Project. Apply chemical using applicator licensed by the Arkansas State Plant Board. Apply in sufficient quantity under and around the structures, to qualify building and contents for continuous guaranteed protection against damage by subterranean termites.
- B. Reapply soil treatment solution to areas disturbed by subsequent excavation or construction activities following application.
- C. **Under New Slabs:** Apply under slabs at the rate recommended by manufacturer. Apply after placement of gravel drainage fill and immediately prior to placement of vapor barrier. When necessary to insure proper penetration, the ground surface may be left loose or lightly scarified until treatment has been completed. Coordinate with general contractor or construction manager and relative subcontractors.
 - 1. **Existing Slab Construction:** Treatments should be made when swarms occur or damage is found, or as a preventive measure.
 - a. Treatment under the slab is accomplished by drilling holes in the slab or foundation through which chemical can be applied in accordance with label directions to establish a barrier in the soil. Long-rodging can sometimes be accomplished without drilling.

- b. Brick and stone veneer on slab construction is treated by drilling through the veneer and injecting the void between the veneer and the slab with chemical. Brick and stone veneer shall be treated with approved chemicals according to the label directions. If the label directions require drilling and treating and the maximum interval requirements are not specific, the intervals at which the operator drills to achieve adequate barriers shall be stated on the graph. In such cases if the maximum intervals are not stated on the graph the operator will be required to drill and treat at a maximum of 18 inch intervals.
- D. Critical Areas: Treat a one foot strip along critical areas under walls, around interior piers and pipes rising from the ground at the rate recommended by manufacturer. Treatment shall be applied as specified for overall treatment under slabs.
- E. Outside of Foundations: Apply a one foot strip along the outside of the foundations of the building at the rate recommended by manufacturer. Apply in a trench dug to a depth of approximately 2" below finish grade. Loosen earth in trench to a depth of 12" before treating. This treatment is to be performed prior to finish grading.
 - 1. If the exterior perimeter treatment is applied when the horizontal barrier is applied it will be damaged or removed before construction is completed. The exterior foundation perimeter treatment will have to occur in phases when any pads, porches, aprons, sidewalks, final grading or landscape planting are simultaneously involved adjacent to the building foundation. This treatment area should be coordinated after all major construction but before any pads, porches, or other items requiring special consideration are poured adjacent to the foundation walls. Submit written verification that final grading, landscape planting and other items adjacent to the foundation will not disturb treatment of the soil on the exterior sides of foundation walls, grade beams, and similar structures.

3.03 UTILITIES AND VENTS

- A. Turn off and block HVAC ducts and vents located in treatment area prior to application, to protect people and animals from termiticide. Submit written verification that the HVAC ducts and vents, water and sewer lines, and plumbing have been turned off or blocked prior to applying termiticide.

3.04 CRAWL AND PLENUM AIR SPACES

- A. Submit written verification that crawl and plenum air spaces have been located and identified prior to applying termiticide.

3.05 APPLICATION PLAN

- A. Prior to commencing application of termiticide, submit a Termiticide Application Plan addressing the following items:
 - a. proposed sequence of treatment work including dates and times of application
 - b. termiticide trade name

- c. EPA registration number
- d. chemical composition
- e. concentration of original and diluted material
- f. formulation
- g. manufacturer's recommended application rates
- h. regional requirements
- i. application rate of active ingredients
- j. method of application
- k. area or volume to be treated
- l. amount to be applied
- m. copy of the pest control business license
- n. copy of the pesticide applicator certificates

3.06 APPLICATION

- A. For areas to be treated, establish complete and unbroken vertical and horizontal soil poison barriers between the soil and all portions of the intended structure which may allow termite access to wood and wood related products. Make applications to crawl spaces in accordance with label directions. Applications to crawl space areas that are used as plenum air spaces will not be permitted.

3.07 EQUIPMENT CALIBRATION AND TANK MEASUREMENT

- A. Submit a list of equipment to be used. Conduct calibration test on the application equipment to be used immediately prior to commencement of termiticide application. Measure the volume and contents of the application tank. Testing must confirm that the application equipment is operating within the manufacturer's specifications and meets the specified requirements. Submit written certification of the equipment calibration test results within 1 week of testing. Where results from the equipment calibration and tank measurements tests are unsatisfactory, re-treatment will be required.

3.08 FIELD QUALITY CONTROL

- A. Verification of Measurement
 - 1. Once termiticide application has been completed, measure tank contents to determine the remaining volume. The total volume measurement of used contents for the application must equal the application rate established in the application plan. Submit written verification that the volume of termiticide used meets the application rate established in the application plan.
- B. Inspection
 - 1. Technical Representative: Provide a technical representative who is a certified pesticide applicator. The technical representative must be present at all meetings concerning treatment measures for subterranean termites and during treatment application.

3.09 CLOSEOUT ACTIVITIES

- A. Upon completion of this work, submit the Pest Management Report, or an equivalent computer product, to the contractor. This form shall identify the target pest, type of operation, brand name and manufacturer of pesticide, formulation, concentration or rate of application used.

3.10 PROTECTION OF TREATED AREA

- A. Immediately after the application, protect the area from other use by erecting barricades as required or directed, including signage. Place signage inside the entrances to crawl spaces and identify the space as treated with termiticide and not safe for children or animals. Cover treated areas with plastic if slab is not to be poured immediately following termiticide application.
- B. Disturbance of Treated Soils
 - 1. Re-treat soil and fill material disturbed after treatment before placement of slabs or other covering structures.

END OF SECTION 31 31 16

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Aggregate base course.

1.02 RELATED SECTIONS

- A. Section 31 2317 - Trenching for Site Utilities: Compacted fill over utility trenches under base course.
- B. Section 31 2323 - Fill and Backfill: Compacted fill under base course.
- C. Section 32 1216 - Bituminous Concrete Paving: Binder and finish asphalt courses.
- C. Section 32 2213 - Grading: Preparation of site for base course.

1.03 REFERENCES

- A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses; American Association of State Highway and Transportation Officials; 1965 (2000).
- B. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2001.
- C. ASTM C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2001.
- D. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2000a.
- E. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2000.
- F. ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2002.
- G. ASTM D 2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2000.
- H. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2001.
- I. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2001.
- J. ASTM D 4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2000.
- K. AHTD Section 303 – Aggregate Base Course

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Compaction Density Test Reports.

1.05 PROJECT CONDITIONS

- A. Provide sufficient quantities of aggregate to meet project schedule and requirements. When necessary, store materials on site in advance of need.
- B. When aggregate materials need to be stored on site, locate stockpiles where indicated.
 - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 - 2. Prevent contamination.
 - 3. Protect stockpiles from erosion and deterioration of materials.
- C. Verify that survey bench marks and intended elevations for the Work are as indicated.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Compacted Aggregate Base Course: AHTD Class 7.

2.02 SOURCE QUALITY CONTROL

- A. See Section 01400 - Quality Requirements, for general requirements for testing and analysis of aggregate materials.
- B. Where aggregate materials are specified using ASTM D 2487 classification, test and analyze samples for compliance before delivery to site.
- C. Provide materials of each type from same source throughout the Work.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.02 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place aggregate on soft, muddy, or frozen surfaces.

3.03 INSTALLATION

- A. Under Bituminous or Portland Cement Concrete Paving:
 - 1. Place Compacted Aggregate Base Course to a total compacted thickness as indicated on Drawings.
 - 2. Compact within two percentage points of optimum moisture content to 98 % Modified Proctor density.

- B. Place aggregate in maximum 4 inch layers and roller compact to specified density.
- C. Level and contour surfaces to elevations and gradients indicated.
- D. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
- E. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.04 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Scheduled Compacted Thickness: Within 1/4 inch.
- C. Variation from Design Elevation: Within 1/2 inch.

3.05 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Compaction density testing will be performed on compacted aggregate base course in accordance with ASTM D1557.
- C. Results will be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 ("standard Proctor").
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.

3.06 CLEAN-UP

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Single course bituminous concrete paving.

1.02 RELATED SECTIONS

- A. Section 32 2213 - Grading: Preparation of site for paving and base.
- B. Section 31 2323 - Fill and Backfill: Compacted subgrade for paving.
- C. Section 32 1123 - Aggregate Base Course: Aggregate base course.
- D. Section 32 1313 - Portland Cement Concrete Paving: Concrete curb and gutter and sidewalks.

1.03 REFERENCES

- A. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types; The Asphalt Institute; 1994, Sixth Edition.
- B. AI MS-19 - A Basic Asphalt Emulsion Manual; The Asphalt Institute; Third Edition.
- C. ASTM D 946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction; 1982 (Reapproved 1999).

1.04 PERFORMANCE REQUIREMENTS

- A. Design paving and subbase at streets and drives for light duty commercial vehicle traffic.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Arkansas Highways standard.
- B. Mixing Plant: Conform to State of Arkansas Highways standard.
- C. Obtain materials from same source throughout.

1.06 REGULATORY REQUIREMENTS

- A. Conform to Arkansas Highway and Transportation Department specification for paving work on public and private property.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F, or surface is wet or frozen.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Asphalt Cement: ASTM D 946.

- B. Aggregate for Wearing Course: Angular crushed washed stone; free of shale, clay, friable material and debris.
 - 1. Graded in accordance with ASTM C 136, within the following limits:
 - a. 2-inch sieve: 100 percent passing.
 - b. 1 inch sieve: 95 percent passing.
 - c. 3/4-inch sieve: 95 to 100 percent passing.
 - d. 5/8-inch sieve: 75 to 100 percent passing.
 - e. 3/8-inch sieve: 55 to 85 percent passing.
 - f. No. 4 sieve: 35 to 60 percent passing.
 - g. No. 16 sieve: 15 to 35 percent passing.
 - h. No. 40: 10 to 25 percent passing.
 - i. No. 200: 5 to 10 percent passing.
- C. Fine Aggregate: In accordance with State of Arkansas Highways standards.
- D. Mineral Filler: Finely ground particles of limestone, hydrated lime or other mineral dust, free of foreign matter.
- E. Primer: In accordance with State of Arkansas Highways standards.
- F. Tack Coat: Homogeneous, medium curing, liquid asphalt.

2.02 ASPHALT PAVING MIXES AND MIX DESIGN

- A. Wearing Course: State of Arkansas Highways standards, ACHM Type III.
- B. Submit proposed mix design of each class of mix for review prior to beginning of work.

2.03 SOURCE QUALITY CONTROL

- A. Test mix design and samples in accordance with Arkansas Highway and Transportation Department Standard Specifications.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that compacted subgrade and aggregate base course are dry and ready to support paving and imposed loads.
- B. Verify gradients and elevations of aggregate base course are correct.

3.02 PREPARATION - PRIMER

- A. Apply primer in accordance with manufacturer's instructions.
- B. Apply primer on aggregate base course at uniform rate of 1/3 gal/sq yd.
- C. Apply primer to contact surfaces of curbs, gutters, and concrete drainage structures.
- D. Use clean sand to blot excess primer.

3.03 PREPARATION - TACK COAT

- A. Apply tack coat in accordance with manufacturer's instructions.
- B. Apply tack coat on asphalt or concrete surfaces over subgrade surface at uniform rate of 1/3

gal/sq yd.

- C. Apply tack coat to contact surfaces of curbs, gutters and concrete drainage structures.
- D. Coat surfaces of manhole frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

3.04 PLACING ASPHALT PAVEMENT - SINGLE COURSE

- A. Install Work in accordance with State of Arkansas Highways standards.
- B. Place asphalt within 24 hours of applying primer or tack coat.
- C. Place compacted thickness as indicated on Drawings.
- D. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- E. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.05 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10-foot straight edge.
- B. Compacted Thickness: Within 1/4 inch of specified or indicated thickness. Average thickness shall meet or exceed plan thickness.
- C. Variation from True Elevation: Within 1/2 inch.

3.06 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for quality control.
- B. Provide field inspection and testing. Take samples and perform tests in accordance with AI MS-2.

3.07 PROTECTION

- A. Immediately after placement, protect pavement from mechanical injury for 3 days or until surface temperature is less than 140 degrees F.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Concrete sidewalks, integral curbs and gutters, aprons, and dumpster pad.

1.02 RELATED SECTIONS

- A. Section 00 3010 - Geotechnical Investigation
- B. Section 03 3000 - Cast-in-Place Concrete.
- C. Section 07 9000 - Joint Sealers: Sealant for joints.
- D. Section 31 2323 - Fill and Backfill: Compacted subbase for paving.
- E. Section 32 2213 - Grading: Preparation of site for paving and base.

1.03 REFERENCES

- A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 1997).
- B. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 1999.
- C. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.
- D. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 1999.
- E. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 1988.
- F. ASTM A 615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 2001b.
- G. ASTM C 33 - Standard Specification for Concrete Aggregates; 2002a.
- H. ASTM C 39/C 39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2001.
- I. ASTM C 94/C 94M - Standard Specification for Ready-Mixed Concrete; 2000.
- J. ASTM C 150 - Standard Specification for Portland Cement; 2002a.
- K. ASTM C 173/C 173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2001.
- L. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete; 2001.
- M. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 1998a.
- N. ASTM C 494/C 494M - Standard Specification for Chemical Admixtures for Concrete; 1999a.

- O. ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2003.
- P. ASTM C 685/C 685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2001.
- Q. ASTM D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (non-extruding and Resilient Bituminous Types); 1999.
- R. ASTM D 1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction; 1984 (Reapproved 1996).

1.04 PERFORMANCE REQUIREMENTS

- A. Design paving for parking, light duty commercial vehicles, and residential streets.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301.
- B. Obtain cementitious materials from same source throughout.
- C. Follow recommendations of ACI 305R when concreting during hot weather.
- D. Follow recommendations of ACI 306R when concreting during cold weather.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

PART 2 – PRODUCTS

2.01 FORM MATERIALS

- A. Form Materials: Conform to ACI 301.
- B. Joint Filler: Preformed; non-extruding bituminous type (ASTM D 1751) or sponge rubber or cork (ASTM D 1752).
 - 1. Thickness: 1/2 inch.

2.02 REINFORCEMENT

- A. Reinforcing Steel: ASTM A 615/A 615M Grade 40 (280); deformed billet steel bars; unfinished finish.
- B. Dowels: ASTM A 615/A 615M Grade 40 (280); deformed billet steel bars; unfinished finish.

2.03 CONCRETE MATERIALS

- A. Concrete Materials: As specified in Section 03 3000.

2.04 ACCESSORIES

- A. Curing Compound: ASTM C 309, Type 1, Class A.
- B. Joint Sealer: Self leveling type as specified in Section 07 9000.

2.05 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
- C. Concrete Properties:
 - 1. Compressive Strength, when tested in accordance with ASTM C 39/C 39M at 28 days: as specified on the plans.

2.06 MIXING

- A. Transit Mixers: Comply with ASTM C 94/C 94M.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

3.02 SUBBASE

- A. Prepare subbase in accordance with Arkansas Department of Transportation standards.

3.03 PREPARATION

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Coat surfaces of manhole frames with oil to prevent bond with concrete pavement.
- C. Notify Architect a minimum of 36 hours prior to commencement of concreting operations.

3.04 FORMING

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

3.05 REINFORCEMENT

- A. Place reinforcement as indicated.
- B. Place dowels to achieve pavement and curb alignment as detailed.

3.06 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Ensure reinforcement, inserts, embedded parts, formed joints are not disturbed during concrete placement.

3.07 JOINTS

- A. Align curb, gutter, and sidewalk joints.
- B. Provide scored joints:

1. At 6 feet intervals or as indicated on the drawings.
- C. Provide expansion joints.
 1. At maximum 20 foot intervals or as indicated on the drawings.

3.08 FINISHING

- A. Area Paving: Light broom, texture perpendicular to pavement direction.
- B. Sidewalk Paving: Light broom, texture perpendicular to direction of travel with troweled and radiused edge 1/4 inch radius.
- C. Curbs and Gutters: Light broom, texture parallel to pavement direction.

3.09 JOINT SEALING

- A. See Section 07 9000 for joint sealer requirements.

3.10 TOLERANCES

- A. Maximum Variation of Surface Flatness: 1/4 inch in 10 ft.
- B. Maximum Variation From True Position: 1/4 inch.

3.11 FIELD QUALITY CONTROL

- A. Independent testing agency will perform field quality control tests, as specified in Section 01400.
 1. Provide free access to concrete operations at project site and cooperate with appointed firm.
 2. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
 3. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
- B. Compressive Strength Tests: ASTM C 39/C 39M. For each test, mold and cure three concrete test cylinders. Obtain test samples for every 75 cu yd or less of each class of concrete placed each day.
 1. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

3.12 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit pedestrian traffic over pavement for 7 days minimum after finishing.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

- A. Paint parking lot lines, letters, directional arrows, island curbs, etc. as shown on the drawings.

1.02 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are located in Division 1 of the Specifications.

1.03 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01 33 00.
 - 1. Paint System Data Sheet (PSDS) from paint manufacturer for each system used.
 - 2. Technical Data Sheets for each product used in the paint system.
- B. Substitutions will not be considered prior to the award of the General Contract.

1.04 QUALITY ASSURANCE

- A. Inspection by Architect, or waiver of inspection of any particular portion of the work, shall not be construed to relieve Contractor of his responsibility to perform the work in accordance with these specifications.

1.05 WARRANTY

- A. Contractor shall warrant to Owner and guarantee work under this section against defective workmanship and materials for a period of 1 year commencing on the date of final acceptance of the work.

PART 2 - MATERIALS

2.01 TRAFFIC AND ZONE MARKING PAINT

- A. Provide Fast Dry Latex Supreme meeting Federal Specification TT-P-1952F, Type I and II as manufactured by RAE Products & Chemicals Corporation, 1-877-275-7550, www.RaePaint.com, or approved equal offering the following colors:
 - 1. White 9510

2. Yellow 9511
3. Blue 4834
4. Red 5408
5. Black 8512
6. Green 5708

PART 3 - EXECUTION

3.01 GENERAL

- A. Paint shall be applied in 2 coats to a clean dry surface using template or a stripping machine. Stripes shall be a uniform width of 4 inches wide. Other markings shall be as shown on drawings.

END OF SECTION 32 17 23

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Removal and storage of topsoil.
- B. Rough grading and excavating the site for site structures, building pads, and paving.
- C. Finish grading.

1.02 RELATED SECTIONS

- A. Section 00 30 10 - Geotechnical Investigation.
- B. Section 02 20 00 - Site Preparation.
- C. Section 31 23 16 - Excavation.
- D. Section 31 23 23 - Fill and Backfill: Filling and compaction.
- E. Section 31 23 17 - Trenching for Site Utilities: Trenching and backfilling for utilities.

1.03 SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.04 PROJECT CONDITIONS

- A. Protect above- and below-grade utilities that remain.
- B. Protect plants, lawns, and other features to remain as a portion of final landscaping.
- C. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from grading equipment and vehicular traffic.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Topsoil: Topsoil excavated on-site.
 - 1. Graded.
 - 2. Free of roots, rocks larger than 1 inch, subsoil, debris, large weeds and foreign matter.
- B. Other Fill Materials: See Section 31 23 23.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Stake and flag locations of known utilities.
- C. Locate, identify, and protect utilities that remain, from damage.

3.03 ROUGH GRADING

- A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.
- B. Do not remove topsoil when wet.
- C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.
- D. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.
- E. When excavating through roots, perform work by hand and cut roots with sharp axe.
- F. See Section 31 2323 for filling procedures.
- G. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key fill material to slope for firm bearing.
- H. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

3.04 SOIL REMOVAL

- A. Stockpile excavated topsoil on site.
- B. Remove excavated subsoil from site.
- C. Stockpiles: Use areas designated on site; pile depth not to exceed 8 feet; protect from erosion.

3.05 FINISH GRADING

- A. Before Finish Grading:
 - 1. Verify building and trench backfilling have been inspected.
 - 2. Verify subgrade has been contoured and compacted.
- B. Remove debris, roots, branches, stones, in excess of 1/2 inch in size. Remove soil contaminated with petroleum products.
- C. Where topsoil is to be placed, scarify surface to depth of 6 inches.
- D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 6 inches.
- E. Place topsoil in areas where seeding, sodding, and planting are indicated.
- F. Place topsoil where required to level finish grade.
- G. Place topsoil to the following compacted thicknesses:
 - 1. Areas to be Sodded: 6 inches.
 - 2. landscape Beds: 12 inches.
- H. Place topsoil during dry weather.
- I. Remove roots, weeds, rocks, and foreign material while spreading.

- J. Near plants spread topsoil manually to prevent damage.
- K. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
- L. Lightly compact placed topsoil.

3.06 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.
- B. Top Surface of Finish Grade: Plus or minus 1/2 inch.

3.07 FIELD QUALITY CONTROL

- A. See Section 02316 for compaction density testing.

3.08 CLEANING AND PROTECTION

- A. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water.
- B. Leave site clean and raked, ready to receive landscaping.

END OF SECTION

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. Extent of water distribution system work is indicated on drawings and by requirements of this section. This section includes the following work:
 - 1. Furnish and install new potable water system components.

1.02 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of pipe, fittings, valves, or accessories for use in potable water systems whose products have been used satisfactorily in similar service.
- B. All materials and workmanship will comply with the latest standards set forth by Central Arkansas Water.
- C. Codes and Standards: Comply with applicable requirements of the latest edition of standards including the following:
 - 1. Arkansas State Plumbing Code.
 - 2. Arkansas Department of Health Regulations.
 - 3. Standards of Central Arkansas Water, Little Rock, Arkansas.
 - 4. ASTM D 2241 "Standard Specification for Poly Vinyl Chloride (PVC) Plastic Pipe SDR-PR)".
 - 5. ASTM D1784 "Standard Specification for Rigid Poly Vinyl Chloride (PVC) Compounds".
 - 6. AWWA C104 "Standard for Cement-Mortar Lining for Ductile-Iron and Gray-Iron Pipe and Fittings for Water".
 - 7. AWWA C110 "Standard for Ductile-Iron and Gray-Iron Fittings, 3 inch through 48 inch, for Water and Other Liquids".
 - 8. AWWA C111 "Standard for Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings".
 - 9. AWWA C150 "American National Standard for the Thickness Design of Ductile-Iron Pipe".
 - 10. AWWA C151 "Standard for Ductile-Iron Pipe Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids".
 - 11. AWWA C153 "Standard for Ductile-Iron Compacted Fittings, 3 inch through 16 inch, for Water and Other Liquids".
 - 12. AWWA C500 "Standard for Gate Valves for Water and Sewerage Systems".
 - 13. AWWA C502 "Dry-Barrel Fire Hydrants".
 - 14. AWWA C509 "Standard for Resilient-Seated Gate Valves for Water and Sewerage Systems".
 - 15. AWWA C600 "Standard for Installation of Ductile-Iron Water Mains and Appurtenances".

16. AWWA C605-94 "Standard for Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water".
17. AWWA C651 "Standard for Disinfecting Water Mains". CDA Copper Tube Handbook.
18. AWWA C800 "Standard for Underground Service Line Valves and Fittings".
19. AWWA C900 "Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in., for Water Distribution".
20. Abbreviations: ASTM = American Society for Testing and Materials
21. AWWA = American Water Works Association

1.03 DELIVERY, STORAGE AND HANDLING

- A. Deliver, unload and handle pipe, fittings, and other materials in a manner which will prevent damage to materials. Do not drop pipe or other materials and do not allow pipe to collide with other pipe or materials. Do not subject materials to impact or jarring that might crack or otherwise damage materials.
- B. Store pipe and other materials in approved locations and blocked or otherwise stabilized to prevent rolling or falling. Cover or otherwise protect items which can be damaged by weather.

1.04 SUBMITTALS

- A. Submit the following product data for the Engineer's approval prior to ordering materials.
 1. Valves, pipe, hydrants, and accessories.
- B. At project closeout, submit one (1) copy of record drawings which legibly identify and accurately locate capped facilities and new installed work including valves, fittings, bends, etc.

1.05 DEFINITIONS

- A. Remove and Dispose: Remove and legally dispose off-site of items except those indicated to be reinstalled or salvaged.
- B. "City" shall mean the municipal utility department for the City of Little Rock, Arkansas.

PART 2 – PRODUCTS

2.01 PIPE AND PIPE FITTINGS

- A. General: Provide piping materials and factory fabricated piping products of sizes, types, pressure ratings, and capacities as indicated.
- B. PVC pipe 2 inch & smaller diameter:
 1. Class 200 psi (SDR 21) similar and equal to Johns-Manville PVC Ring-Tite pipe with rubber ring and integral thickened bell joints.
 2. Pipe shall meet requirements of ASTM D1784 and ASTM D2241; and bearing National Sanitation Foundation seal for potable water.
 3. Meet following minimum test criteria:
 - a. Quick burst test: Pass without failure 500 psi applied in 60 to 70 seconds tested per ASTM D1599 and D2241.
 - b. Sustained pressure test: Pass without failure for 1000 hours a pressure of 340 psi tested

per ASTM D1598 and referenced in ASTM D2241.

- c. Acetone immersion test: No visible spalling or cracking after 20 minutes immersion of 1" long sample ring in anhydrous acetone per ASTM D2152.
 - d. Vice test: No evidence of splitting or shattering in a 2" long ring section flattened between two flat parallel plates. Flattening not less than 60% of the outside diameter in 2 to 5 minutes elapsed time.
- C. PVC pipe 4 inch through 8 inch:
- 1. Pipe shall comply with requirements of AWWA C900 and shall be DR 14 (pressure class 200 psi) or DR 18 (pressure class 150 psi) unless otherwise shown on the Drawings.
 - 2. Pipe shall be manufactured from class 12454-A or class 12454-B materials.
- D. Fittings for PVC Pipe:
- 1. For 4" and larger pipe, provide MegaLug type ductile iron mechanical joint fittings meeting AWWA standards. Provide transition gaskets where required to fit pipe sizes.
 - 2. For 3" and smaller pipe, provide PVC fittings manufactured by the pipe manufacturer and meeting requirements of ASTM D 3139.
- E. Ductile Iron Pipe: 6-inch diameter and larger as indicated on drawings. AWWA C151, Class 50. for 6 thru 18-inch, Class 50 for 20-inch diameter.
- 1. Lining: AWWA C104, cement mortar.
 - 2. Gaskets: AWWA C111, rubber.
 - 3. Joints: AWWA C111
 - a. Except where indicated otherwise: Bell and socket push joint, rubber ring compression type gaskets.
 - b. Where indicated: Restrained joint of approved design with rubber ring compression type gaskets.
 - c. Where indicated: Flanged joint with rubber gaskets.
 - 4. Fittings:
 - a. Ductile Iron – AWWA C111 Mechanical Joint designed for working pressure of at least 250 psi. All joints shall be fitted with retainer glands.
 - b. Where indicated: Flanged joint fittings with rubber gaskets AWWA C115.
 - c. Retainer Glands: Mechanical joint designed for working pressure of at least 200 psi. Glands shall be designed to standard mechanical joint fittings AWWA C111.
- F. Service Fittings: Service line outlets or stubs shall be furnished with caps or plugs secured to withstand test pressure without leakage.
- G. Lubricant: Lubricant furnished for lubricating joints shall be non-toxic, shall not support the growth of bacteria, shall not be deleterious to gasket or pipe material, and shall not impart taste or odor to water. Lubricant containers shall be labeled with manufacturer's name and shall be NSF approved.

2.02 WATER SERVICE LINES

- A. Copper Tubing:

1. Type "K" seamless copper tubing meeting requirements of ASTM B88.
 2. Fittings: Provide bronze fittings designed for compressions joints.
- B. HDEP Tubing:
1. Drisco brand service line tubing.
 2. Fittings: Provide Ford-style bronze fittings.
- C. Service Line Disconnect:
1. Valve shall be a 2" ductile gate valve with 2" operating nut.
 2. Valves in the meter box shall be 2" brass hand-wheel with non-rising stem gate valve.

2.03 VALVES AND VALVE BOXES

- A. Gate Valves (2 Inches through 12 inch): Provide resilient seat iron bodied, bronze mounted, non rising stem, double gate designed for 200 psi (minimum) working pressure. Meet AWWA C509 requirements, with "o" ring stem seals and mechanical joints for ductile-iron pipe and push-on joints for PVC pipe. Provide valves by Mueller, Clow, American Valve & Hydrant, Waterous (or approved equal).
- B. Butterfly Valves: 16 inch and larger:
1. Provide valves conforming to AWWA C504.
 2. Body: ASTM A-126 Class B Cast Iron with mechanical joints. Rated for Class 150B service. Exterior bituminous coated for complete bury service.
 3. Shaft – ASTM A276 Type 304 Stainless Steel with "O-Ring" or Split-V seals, replaceable without removing the shaft.
 4. Valve Disc – ASTM A536 with 316 edge ductile iron with BUNA-N resilient seats bonded into a self-retaining recess in the body. Seats shall be field replaceable without removing the valve body from the main.
 5. Bearings – Teflon-lined and fiberglass backed.
 6. Actuators – Manual with totally enclosed mechanism. Traveling-nut type with steel drive screws and internally threaded bronze nut. 2" x 2" operating nut. No u-joints shall be used on the reach rods.
 7. Operator – Worm gears with bronze or ductile iron gears and hardened steel worm. Class 150B Torque requirements and AWWA C504 operator input requirements.
- C. Gate Valves (1 inch): All brass valves.
- D. Valve Boxes: Provide cast iron or steel valve boxes of two-piece adjustable screw type with cast iron lids for all buried valves and stops. Drop cover marked "WATER".
- E. Corporation and Curb Stops: AWWA C800 - Provide bronze stop for pressure rating not less than 125 psi with connection designed for application.
- F. Valve epoxy coating: Coat gate valve and butterfly valve interior surfaces which are not bronze or stainless steel with two-part thermosetting epoxy not less than 8-mil dry film thickness (DFT) & free of holidays. Before application of coating material, all surfaces shall be thoroughly cleaned to remove dirt, grease, oil and any other substances; all sharp angles, protrusions or irregularities which would interfere with proper coating coverage shall be removed; and the entire surface grit

blasted to white metal in accordance with SSPC Specifications SP5 resulting in an anchor pattern of at least one (1) mil. Thermo-set epoxy material shall be applied to the sand-blasted surfaces before the white metal begins to oxidize (darken in color). The thermo-set epoxy shall be approved for exposure to fluids for human consumption by the Federal Food and Drug Administration. The disc shall be post-cured for a sufficient period of time to assure full polymerization. Polymerization shall be checked by a direct impact test at 60-in-lb. with no cracking or chipping of the coating. The film thickness shall be checked using an accurate magnetic film thickness gauge. The entire coated surface shall be checked for holidays using a wet sponge type holiday detector. Any areas where the film thickness is found to be less than 8 mils or where holidays were detected, shall be recoated and rechecked. Valves shall be placed for shipment in such manner that the coating is protected from damage.

2.04 FIRE HYDRANTS

- A. General: Cast-iron body, compression-type valve, opening against pressure and closing with pressure, 6-inch mechanical joint inlet, 200-psi working pressure, Clow 5¼ " fire hydrant, as per City Requirements.
- B. Outlet Threads: NFPA 1963, external hose thread used by the local fire department. Outlets shall have cast-iron caps with steel chains.
- C. Operating and Cap Nuts: Pentagon 1 1/8 inch point to flat.
- D. Direction of Opening: Hydrant valves shall be opened by turning operating nut to the left, or counterclockwise.
- E. Finish: Yellow exterior alkyd gloss enamel paint.
- F. Dry-Barrel Fire Hydrants: AWWA C502, Traffic Model Fire Hydrant, two 2½ and one 4½ inch outlets, 5¼ inch main valve, drain valve, and 6-inch mechanical joint inlet. Four foot bury depth, except where otherwise indicated.

2.05 ACCESSORIES

- A. Provide accessories where indicated on drawings and where required for proper installation. Include clamps, saddles, transition fittings, couplings, bolts, concrete blocking, etc.
- B. Valve Wrenches: Provide two wrenches for each type valve operator.

2.06 PIPE ENCASEMENT FOR HIGHWAY CROSSING

- A. Provide asphalt coated spiral welded pipe with ¼" minimum thick walls and diameter as indicated on Drawings at highway and crossings. Pipe materials length, size, and installation shall be in accordance with the standards of the Arkansas State Highway and Transportation Department (ASHTD). At locations where an existing highway crossing encasement is to be extended, the encasement pipe shall match the diameter of the existing encasement pipe.

Encasement spacers shall be premanufactured stainless steel spacers that attach to the carrier pipe without aid of metal bands or straps. The spacers shall be sized & shall be spaced based on the manufacturer's recommendation.

Premanufactured seals shall be used to seal ends of encasement unless otherwise specified by the utility.

2.07 TRACE WIRE FOR NON-METALLIC PIPE

- A. Locator wire shall be placed in the trench along with all plastic water pipe. Locator wire shall be #12 copper wire and shall run continuous along the top of all plastic water pipe.

2.08 TAPPING SLEEVES

- A. Sleeves and bolts shall be two-piece Mueller MJ ductile iron tapping sleeve, designed for a working pressure of at least 200 psi.
- B. Outlets: ANSI B16.1, Class 125 flanges designed to accept tapping valves.

PART 3 – EXECUTION

3.01 GENERAL

- A. Coordinate installation of water distribution system with other work and utility locations.
- B. Maintain drainage at all times. Provide pumps and other equipment as required to dewater trenches.

3.02 SELECTIVE DEMOLITION

- A. Protect items indicated to remain against damage. Contractor shall repair any damage caused by his work at his expense.
- B. Except for items or materials indicated to be reused, salvaged or reinstalled, demolished materials shall be removed and disposed off-site.
- C. Contractor shall coordinate with the City for shutoff, capping and continuation of water service and shall schedule demolition and removal work to ensure uninterrupted service.
- D. Water lines to be plugged shall be sealed water tight and appropriate thrust restraints installed to prevent blow-off or leakage under normal system operating pressures and surges.

3.03 TRENCHING

- A. Provide trenches for water mains and service lines which are accurately graded for uniform pipe bearing and typical minimum depth of 30 inches cover over main pipes at finish grade and 24 inches cover under ditches unless otherwise shown on the Drawings. Provide 18 inches (minimum) cover at service lines. Excavate trench width as required for proper installation of piping, valves, etc. Increase trench depth where indicated and/or required for conditions including valve/box height.
- B. Stabilize mucky or unstable trench bottoms by over excavating and bedding pipe in select backfill.
- C. In rock bottom trenches provide 4-inch (minimum) cushion of select backfill for pipe bedding and on each side of pipe, valves and fittings.
- D. Where blasting is required, Contractor shall take proper precautions for protection of persons, the Work, and adjacent property. Any damage done to the Work or property by blasting shall be corrected by the Contractor at his expense.
 - 1. All operations involving the handling, storage and use of explosives shall be performed in accordance with local, State and Federal laws and regulations.

3.04 LAYING PIPE

- A. Lay pipe in prepared trenches carefully grading and bedding bell ends, fittings, and valves.
- B. Clean the inside of bell or coupling and outside of pipe end of all dirt, grease, or other foreign material before jointing pipe.
- C. Joint pipe lengths together as required by manufacturers' recommendations and instructions. Use

non-toxic lubricants recommended by pipe manufacturer. Avoid excessive deflections in pipe joints.

- D. Plug ends of pipe using temporary watertight plugs at end of each day's work.
- E. Periodically flush mains for cleansing during laying operations.
- F. Concrete thrust blocking shall be poured at all bends and fittings.
 - 1. Exercise care to avoid over-excavation in trench areas where thrust blocks are to be poured.
 - 2. Remove water from excavation. Pour thrust blocking against undisturbed earth.

3.05 BORES

- A. Bore under highway maintaining minimum depths, and bore length as shown on Drawings. Utilize construction techniques which comply with Highway Department Standards.

3.06 PIPE ENCASEMENT

- A. General: Excavate an area sufficient to allow the installation of the encasement. Use proper precautions to assure that the integrity of the highway bed is not disturbed by the excavation.
- B. Installation of One-Piece Encasement:
 - 1. Notify Owner before disrupting utility service.
 - 2. Remove tees, bends, valves, or other obstacles to allow free access to the pipe which is to be encased.
 - 3. Make sure that sufficient excavation has been done to allow installation of the encasement without placing undue bending stresses on the carrier pipe.
 - 4. Support the encasement extension to assure a true line from existing encasement to encasement extension. Weld continuously around the perimeter of the joints using approved welding techniques.
 - 5. The construction of encasement structures by tunneling or boring shall be carried out in such manner that settlement of the surface above the structure is minimal. The excavation shall be performed so that voids around the structures are held to a minimum. Voids around the periphery of the structures shall be filled by pressure grouting if required by Engineer and/or Utility. The grout shall be one (1) part portland cement and two (2) parts sand with water adequate to permit pumping on encasement structures 24-inches in diameter and larger. The grout shall be introduced through suitable fixtures and placed through the structure wall at intervals adequate to completely fill all voids. The fixtures shall have pressure type caps which shall be closed after the grouting operations have been completed. The grouting pressure shall be sufficient to completely fill all voids without causing upheaval of overburden above the encasement structure but shall not exceed five (5) psi. If voids exist around structures smaller than 24-inches in diameter, the Contractor shall introduce grout to completely fill the voids through suitable borings made from the surface.

3.07 BACKFILL

- A. After pipe work has been inspected and approved, trenches shall be backfilled with select material as shown on the Drawings and of proper moisture content. Select material shall be fine loose earth free from clods or stones larger than three (3) inches in any dimension. The select material shall be carefully deposited in layers not exceeding four (4) inches in thickness on both sides of the pipe and thoroughly and carefully rammed around the pipe. Additional select material shall be installed

to a minimum of twelve (12) inches above the top of pipe.

- B. All trenches and excavations shall be backfilled immediately after inspection and approval using methods which will not disturb the pipe. Material used for backfilling shall consist of the excavation or borrow of sand, gravel, or other materials approved by the Engineer and shall be free of trash, large rock, lumber, or other debris.
- C. All trenches shall be backfilled, settled and the ground restored to its original condition as soon as possible after pipe is installed. Any unnecessary delay in restoring trenches to original condition shall be cause for stopping all other work until trenches are so restored. The Contractor shall be responsible for all settlement of backfill in trenches and shall refill trenches as often as necessary to bring them back to original grade and during the period when settlement is occurring shall refill them frequently enough to maintain traffic without hazard at all times except when trenches are actually flooded.
- D. All excess excavated material shall be disposed of to the satisfaction of the Engineer. Surfaces shall be cleaned up, all hummocks and piles smoothed down and the surface left neat and workmanlike. Where existing drainage ditches are disturbed or obstructed with excavated material, such material shall be removed and the ditch restored to original line and grade.
- E. Backfill through traffic areas shall conform to requirements of the subsection Cutting And Replacing Special Surfaces herein.

3.08 VALVES AND VALVE BOXES

- A. Install valves with operating stems in true vertical position unless otherwise shown on the drawings.
- B. Block valve boxes to provide vertical support using concrete blocks or other approved methods and in a manner that no weight on the box is transferred to the valve or pipe.
- C. Adjust valve boxes to conform to adjacent finished grades.

3.09 FIRE HYDRANTS

- A. Properly locate fire hydrants with respect to property lines and streets and at proper elevations. Do not locate fire hydrants within highway right-of-way.
- B. Support fire hydrants on 4 inches (minimum) thick concrete slab not less than 18 inches square and provide concrete backing and blocking to prevent blow-off of hydrant from lead.
- C. Install retaining glands and restraining rods or bolts.
- D. Paint fire hydrant with two (2) coats of an approved fire hydrant paint.

3.10 CUTTING AND REPLACING SPECIAL SURFACES

- A. When necessary to disturb paved, graveled or other special surfaces, Contractor shall use care to minimize any such disturbances. Care shall be used in making the backfill to eliminate future settlement and the surface shall be restored using the same type of original surface materials.
- B. Asphalt and Concrete Pavement Surfaces: Edges of pavement shall be cut full depth along straight and true lines along each side of the trench using approved tools and equipment ahead of the trenching operation. All pavement materials shall be removed from the area prior to beginning the trenching work. Subgrade and base material shall match existing on both sides of the trench and all patches shall be made as approved by the Engineer.

Replace removed paving and base course with new material of equal or better quality and of the

same texture and color as the adjacent paved areas.

- C. Gravel Surfaces: Gravel shall be replaced after trenching and backfilling. After the backfill has been so placed that no further appreciable settlement will occur, gravel over the trench shall be replaced to the same compacted thickness as the original surfacing. During construction, the gravel of the remainder of the street not occupied by the trench may be covered with soil from the excavated material. After completion of the backfill, such soil shall be removed, in so far as possible, and additional gravel shall be placed on the street until the surface is as weather resistant and traffic resistant as the original surfacing.
- D. Seeded Areas: After heavy construction work is complete and equipment has been removed, clean all areas disturbed by the Contractor's Work. Seed as specified in Section 02920.
- E. Sodded Lawn Areas: Prepare any sodded areas for proper relaying of any previously removed sod. Remove trench and backfill materials from adjacent lawn areas to permit unhindered growth of grasses and safe operation of mowing equipment. Replace sod as specified in Section 02920. Sod and adjacent lawn areas that do not reestablish at the commencement of the next growing season shall be replaced at the Contractor's expense.
- F. Contractor shall maintain repaired areas as often as necessary to provide a smooth crossing not hazardous to traffic.
- G. Should local regulations pertaining to cutting and replacing special surfaces exist in the project area, they shall be considered to supersede this subsection. The Contractor shall comply with all such local codes or regulations.

3.11 SERVICE CONNECTIONS

- A. Service connections shall be furnished and installed as shown on the Drawings.

3.12 HYDROSTATIC TESTING

- A. General: Pressure test all water lines in presence of Engineer or Designated Authority. Contractor shall make arrangements for furnishing potable water for testing. Provide all pumps, gages, fittings and apparatus for testing. Pressure test after backfill is complete.
- B. Test isolated segments of the main as approved by the Engineer. Fill segment being tested with water while bleeding and purging air. Pressurize the main segment being tested using an approved pumping system to a pressure (P) not less than the pressure listed in the table below. Obtain the Engineer's approval of the testing procedure and the pressures to be used before beginning the test. Maintain pressure for period of eight hours, recording (using approved meter(s)) quantity of water required to maintain pressure. Line segments will be approved as passing the test if no noticeable leaks are present and quantity (Q) required to maintain pressure is less than indicated by Formula

$$Q = \frac{LD(P)^{0.5}}{148,000}$$

as defined by AWWA C605.

Where Q = quantity of makeup water in gallons per hour
L = length of pipe sections being tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the hydraulic test in PSI (gauge pressure)

- C. Repair all detected leaks regardless of test result. If segment fails to pass, re-test and continue procedure of repair and testing until line passes test.

- D. Repair all surfaces disturbed during test procedure using methods approved by the Engineer at no additional cost to the Owner.
- E. Test Records:
 - 1. Records shall be made of each piping system component tested. Records shall include:
 - a. Date of test.
 - b. Description and identification of piping tested.
 - c. Test fluid.
 - d. Test pressure.
 - e. Remarks, including such items as:
 - (1) Leaks - type and location.
 - (2) Repairs made on leaks.
 - f. Certification by Contractor and written approval by Engineer.

3.13 DISINFECTING

- A. Disinfect all water lines after tested and approved (but before placing in service) in accordance with AWWA Standard Specification C651. Use liquid chlorine or hypochlorite in such amount as to provide dosage of not less than 50 ppm and to maintain a chlorine residual of not less than 25 ppm for 24 hours.
- B. Flush chlorine solution from lines after contact period of not less than 24 hours.
- C. Sample water from disinfected lines and deliver samples to Arkansas Department of Health for bacteria analysis. Obtain samples as required from selected points with no less than two consecutive samples taken 24 hours apart from each point. Continue sampling and disinfecting process until two consecutive samples (24 hours apart) from each point are approved by the Arkansas Department of Health. Deliver samples to laboratory within 24 hours of sampling.
- D. Submit three (3) copies of Arkansas Department of Health reports to Engineer.
- E. Do not place sterilizing agents in pipes during construction. Install sterilizing agent after pressure testing is complete.

3.14 CLEAN UP AND WORK CLOSEOUT

- A. Clean work areas of all refuse, debris, excess materials, etc. Dispose of "clean-up" items off site.
- B. Grade level areas disturbed during construction.
- C. Completed water system improvements shall be placed in service only upon approval and acceptance of the City.

END OF SECTION

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. Extent of sanitary sewer collection system work is indicated on drawings and by requirements of this section. This Section includes the following work:
 - 1. Gravity sewer collection lines.
 - 2. Manholes.
 - 3. Pressure sewer lines (force mains).
 - 4. Testing of gravity and pressure sewer lines.
- B. Related Sections:
 - 1. Section 00 3010 – Geotechnical Investigation
 - 2. Section 02 2000 – Site Preparation
 - 3. Section 32 2213 – Grading
 - 4. Section 32 2316 – Excavation
 - 5. Section 31 2323 – Fill and Backfill
 - 6. Section 31 2317 – Trenching for Site Utilities

1.02 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of pipe, fittings, and accessories for use in sanitary sewer collection systems whose products have been used satisfactorily in similar service.
- B. Code and Standards: Comply with applicable requirements of standards including the following:
 - 1. Arkansas State Plumbing Code.
 - 2. Arkansas Department of Health Regulations.
 - 3. Standards of the Little Rock Water Reclamation Authority, Little Rock, Arkansas.
 - 4. ASTM D 2241-80 "Standard Specification for Poly Vinyl Chloride (PVC) Plastic Pipe (SDR-PR)".
 - 5. ASTM D1784 "Standard Specification for Rigid Poly Vinyl Chloride (PVC) Compounds".
 - 6. ASTM A536-84 "Specification for Ductile-Iron Castings".
 - 7. ASTM A746-86 "Specification for Ductile-Iron Gravity Sewer Pipe.
 - 8. Abbreviations: ASTM = American Society for Testing and Materials

1.03 DELIVERY, STORAGE AND HANDLING

- A. Deliver, unload and handle pipe, fittings, and other materials in a manner which will prevent damage to materials. Do not drop pipe or other materials and do not allow pipe to collide with other pipe or materials. Do not subject materials to impact or jarring that might crack or otherwise damage materials.
- B. Store pipe and other materials in approved locations and blocked or otherwise stabilized to prevent rolling or falling. Cover or otherwise protect items which can be damaged by weather.

1.04 FIELD ENGINEERING

- A. Owner will provide control staking as required for accurate construction of sewer mains, and services. Contractor will provide construction staking and furnish Engineer with cut sheets at 50 foot stations for approval prior to construction.
- B. For sewer main construction using laser light, maintain elevation and alignment controls at manhole locations and spot check laser light accuracy during construction.
- C. For sewer main construction without laser light, establish offset grade and alignment stakes along main.

1.05 SUBMITTALS

- A. Submit the following product data for Engineer's approval prior to ordering materials:
 - 1. Gravity pipe and joints.
 - 2. Pressure sewer pipe and joints.
 - 3. Pressure sewer services including boxes and valves.
 - 4. Manhole castings.
 - 5. Source, properties and description of bedding and granular fill materials.

1.06 DEFINITIONS

- A. Remove and Dispose: Remove and legally dispose off-site those items as indicated on the Drawings.
- B. "City": Shall mean the municipal utility department for the City of Little Rock, Arkansas.
- C. Relative Compaction: The ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by the Standard Proctor Test, ASTM D698, or as determined by the Modified Proctor Test, ASTM D1557, as applicable.
- D. Rock excavation, only when specifically listed in the Bid form as a pay item, consists of igneous, metamorphic, and sedimentary rock which cannot be excavated without blasting or with the use of rippers attached to a Caterpillar brand D-9 bulldozer, a Komatsu brand Model 400 excavator, or equivalent, and all boulders of other detached stones each having a volume of one (1) cubic yard or more.
- E. Project Conditions
 - 1. Blasting: Use of explosives is not allowed, without written authorization. Said authorization shall include but not be limited to obtaining any required regulatory permits. Contractor shall perform any blasting with proper precautions for protection of persons, the Work and adjacent property. Any damage done to the Work or property by blasting shall be corrected by the Contractor at his expense.

2. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.
 - a Protect structures, utilities, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
 - b Perform excavation by hand within dripline of large trees to remain. Protect root systems from damage or dryout to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with moistened burlap.
3. Excavation and Trench Safety: Occupational Safety and Health Administrative Standard for Excavation and Trenches Safety System, 29 CFR 1926 Subpart P. As required by Arkansas Act 291, 1993 requirements of 29 CFR 2926, Subpart P are specifically incorporated into this specification as if rewritten herein.
4. Submitting a bid on this Section shall mean acceptance of existing conditions.
5. Contractor shall make his own estimate of the kind and extent of the various materials to be excavated in order to accomplish the work.
6. There will be no extra compensation for dewatering.

PART 2 – PRODUCTS

2.01 PIPE AND PIPE FITTINGS

- A. General: Provide piping materials and factory fabricated fittings and accessories of sizes and types indicated on drawings or required. To assure uniformity and compatibility of piping systems, pipe, fittings and couplings shall be furnished by the same manufacturer.
- B. Gravity Sewer Pipe:
 1. Polyvinyl chloride (PVC) Sewer Pipe – Meet requirements of ASTM D 3034 for 4” – 15” and F-679 for 18”-21” PVC and shall be SDR 26 or SDR 35 as specified.
 2. Ductile Iron Sewer Pipe - Meet requirements of ASTM A 746 Class 50.
 - a Lining: Corrosion resistant conforming to ANSI A21.4.
 - b Joints: Rubber gasket push-on conforming to ASTM D 3139.
 3. Service Lines – PVC gravity sewer pipe with elastomeric gasketed joints, SDR 26 or SDR 35 as specified.
- C. Pressure Sewer Pipe (Force Mains)
 1. PVC Pressure Sewer Pipe – Meet requirements of ASTM D 2241, SDR 21, PR 200.
 2. Fittings – Ductile iron mechanical joint conforming to ANSI/AWWA C100/A21.10 and C111/A21.11.
- D. Service Fittings

Service line outlets or stubs shall be furnished with caps or plugs with same type gasket and joint as service connection pipe. Plug or cap shall be banded or otherwise secured to withstand test pressures without leakage.

E. Encasement Pipe

Smooth wall, welded steel pipe conforming to AASHTO M-190 for Type C coating. Stainless steel casing spacers shall be used to provide the annular space between the encasement pipe and sewer pipe as shown on the Drawings.

F. Special Fittings and Couplings

1. Connections between different types of pipe and for future connections shall be watertight.
2. Connection between plain ends of the same type pipe or transitions between different types of pipe shall be made with Fernco couplings.

2.02 MANHOLES

A. Poured in place manholes shall be cast-in-place concrete in accordance with Section 03 30 00 unless otherwise approved.

B. Precast concrete manholes are allowed upon prior approval. Precast concrete ring sections shall be equal in quality to reinforced concrete sewer pipe ASTM C76. Joints shall be rubber gasketed.

C. Manhole Steps:

1. Manhole steps shall not be required in new manholes unless otherwise specified.
2. Where specified, steps shall be cast iron or steel encased in PVC or fiberglass and conforming to OSHA requirements. Steps shall be Neenah Catalog No. R-1982-J or equal.

D. Manhole Frames and Covers:

1. Metal castings shall conform to ASTM A 48, class 35B gray iron with mating surfaces machined for secure bearing.
2. Covers shall be cast with lettering "Sanitary Sewer".
3. Frames and covers shall have a minimum opening and total weight, as shown on the Drawings, and be nonvented with provisions for removal.
4. Acceptable foundries: Deeter and East Jordan Iron Works or approved equal.

2.03 SOIL MATERIALS

A. Pipe bedding material shall be gravel or crushed stone, maximum diameter 1-1/4".

B. Trench Backfill and Fill Materials (not under traffic areas): Satisfactory soil materials free of clay, rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.

C. Trench Backfill (under traffic areas): See details on Drawings.

2.04 PIPE ENCASEMENT FOR HIGHWAY AND RAILROAD CROSSING

A. Where required by state highway, railroad, county or municipalities, furnish and install asphalt coated spiral welded pipe with 1/4" minimum thick walls and diameter as shown on the Drawings. Pipe materials length, size, and installation shall be in accordance with the standards of the applicable authority. At locations where an existing crossing encasement is to be extended, the encasement pipe shall match the diameter of the existing encasement pipe and shall be of sufficient size to install or remove the carrier pipe.

PART 3 – EXECUTION

3.01 TRENCHING

- A. Excavate trenches accurately to grade and alignment shown on Drawings or as established in the field by Engineer. Trench width as shown on the Drawings and not more than 36" at 12 inches above pipe.
- B. When excavation is carried below that required, fill space with concrete, bedding, or compacted select material at Contractor's expense.
- C. Trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between bell holes.
- D. Where necessary to protect labor, the work, or adjacent property the Contractor shall provide and install shoring. Such shoring shall remain in place until the backfill has proceeded to a point where it can be removed safely, except that, if in the opinion of the Engineer, damage is liable to result from withdrawing shoring, it shall remain in place.
- E. All excavation shall be dewatered before any construction is undertaken therein. Concrete shall be placed only upon dry, firm foundation material and pipe shall be laid only in dry trenches.
- F. In order to avoid superimposed loading in excess of the designed and specified pipe strength and to provide sufficient room for proper installation and bedding of the sewer pipe, the trench widths for the pipe sizes used shall be kept within the limits specified in the following:

Inside Pipe Diameter	Min. Width of Trench at Center of Pipe	Max. Width of Trench 12" above Outside Top of Pipe
6" - 8"	20"	36"
10" - 12"	24"	36"
15" - 18"	30"	42"
21" - 24"	36"	48"

- G. If it becomes necessary to reduce the earth load on the trench banks to prevent sliding and caving, it will be permissible to cut the trench banks back on a slope above an elevation two (2) feet above the outside top of the pipe. Under no circumstances, however, shall the specified maximum width twelve (12) inches above the outside top of the pipe be exceeded, except at points where the combined superimposed earth and live loads on the pipe are sufficiently low to permit an increase in the specified maximum trench width and then only where such an increase in trench width is authorized by the Engineer. All trenches must be undercut as shown on the pipe bedding detail of the Plans. The entire width of the trench shall be backfilled to pipe grade with pipe bedding material prior to laying the pipe.
- H. Where water occurs in trenches, pumps shall be kept operating, taking suction out of a sump below the pipe subgrade, so as to hold the water level well below the bottoms of all bells until the pipe laying operation is complete and ready for backfilling.
- I. The contractor will be required to keep the sides of the excavation vertical, except as hereinbefore provided.

- J. If rock is encountered, it may be excavated with jack hammer or by blasting. However, if the Contractor uses blasting, he must comply with the latest revised U.S. Bureau of Mines Code regarding public safety as well as employee safety. The Contractor shall also comply with all state and local codes for the handling and use of explosives, including the acquisition of any necessary permits or inspections.
- K. When rock is encountered, the trench shall be excavated to the same lines as that for earth excavation as shown on the Plans.
- L. The excavation of trenches shall not advance more than one hundred (100) feet ahead of the completed pipe work and backfill, except by permission of the Engineer.
- M. Trenches for force mains, pressure mains, pressure service line, electrical lines and conduits, and gravity service lines shall be of the width and depth necessary of the proper installation of the pipe according to the Plans. They shall have a minimum of thirty (30) inches cover from finish grade.

3.02 SELECTIVE DEMOLITION

- A. Protect items indicated to remain against damage. Contractor shall repair any damage caused by his work at his expense.
- B. Except for items indicated to be reused, salvaged or reinstalled, demolished materials shall be removed and disposed off-site.
- C. Contractor shall coordinate with the City for shut-off, capping and continuation of sewer service and shall schedule demolition and removal work to ensure uninterrupted service.
- D. Sewer lines to be plugged shall be sealed water tight as noted on the Drawings.

3.03 INSTALLATION OF PIPE

- A. Lay gravity pipe beginning at low point of system, true to grades and alignment indicated, with unbroken continuity of invert. Place bell ends of pipe facing upstream. Remove all loose material, rocks or other unsuitable material from trenches and place portion of bedding material below pipe before laying pipe. No pipe shall be laid in water or when, in the opinion of the Engineer, trench conditions are unsuitable.
- B. Clean end of pipe and insides of bell before making joints. Check gaskets and sealing rings and adjust if displaced, or replace if missing. Apply approved lubricant to joint, align pipe, and push pipe into bell distance required to make joint. Follow pipe manufacturers installation instructions.
- C. Cap ends of pipe with temporary mechanical, pneumatic, or other approved positive sealing plugs at end of each day's work. Anchor or apply weight to prevent pipes from floating. Clean pipe interior of dirt and other materials as work progresses.
- D. Remove and re-lay pipe displaced during construction or laid out of grade and alignment unless approved to remain by the Engineer.
- E. Do not backfill pipe until pipe has been inspected and approved.

3.04 CONCRETE ENCASEMENT, BACKING BLOCKS, AND COLLARS

- A. Provide concrete encasement around sewer pipes with less than 2 feet of cover, at points with special hazards and at locations indicated on the drawings.
- B. Provide concrete blocking where required to stabilize branch connections, wyes, and other points.

- C. Provide concrete collars around sewer pipe at locations as directed by the Engineer or indicated on drawings to resist longitudinal movement caused by steep grades, etc.
- D. Concrete thrust blocking shall be poured at all force main bends and fittings.
 - 1. Exercise care to avoid over-excavation in trench areas where thrust blocks are to be poured.
 - 2. Remove water from excavation. Pour thrust blocking against undisturbed earth.
 - 3. Cure thrust blocks a minimum of 5 days before conducting hydrostatic tests.

3.05 BACKFILL

- A. Do not backfill trenches until pipe has been inspected and approved.
- B. Bed pipe in bedding material as indicated on drawings, carefully placing and tamping material to insure bedding completely around pipes without voids. Apply bedding material in 4" layers.

Service lines under paved areas shall be bedded as required for mains, from the main to the limits of the pavement.
- C. Backfill remainder of trench above bedding material using approved backfill material and compacted to required density. All trenches shall be backfilled, settled, and the ground restored to its original condition as soon as possible after the pipe is installed. Any unnecessary delay in restoring trenches to their original condition shall constitute just cause for stopping all other work until the trenches are so restored. The Contractor shall be responsible for all settlement of backfill in trenches occasioned by the work covered herein. He shall refill trenches as often as necessary to bring them back to original grade and during the period when settlement is occurring shall refill them frequently enough to maintain traffic without hazard at all times except when trenches are actually flooded.
- D. Backfill around manholes as soon as concrete has cured sufficiently to resist loads without damage to manholes.
- E. Backfill under paved surfaces as shown on the Drawings. Backfill under paved surfaces shall be compacted with pneumatic tamper in layers not to exceed four (4) inches thick for the entire depth of the trench. Material shall not be deposited by dozer or other equipment when the paved surface is in place at the time of the backfill.
- F. All excavated material which is unsuitable or not needed for backfill shall be wasted or disposed of to the satisfaction of the Engineer. Surfaces shall be cleaned up, all hummocks and piles smoothed down, and the surface left neat and workmanlike. Where existing drainage ditches are disturbed or obstructed with excavated material, such material shall be entirely removed and the ditch left true to original line and grade.
- G. Unnecessary delays in backfilling, grading, cleaning, and restoring surfaces along trenches constitutes cause for stopping work until trenches are restored.

3.06 MANHOLES

- A. General: Construct manholes in accordance with Drawing details and with Section 03 3000.
- B. Invert channels shall be semi-circular in shape to allow for a smooth transition from one pipe to another. Form inverts directly in manhole concrete base.
- C. Frames shall set in a bed of mortar with mortar carried over flange of ring. Frames and covers shall be installed to prevent infiltration of surface or groundwater into manholes.

- D. Steps, where specified, shall be cast into manhole wall & installed to withstand a force of 350 pounds.
- E. Poured in Place Manholes:
 - 1. Manhole forms may be removed after cumulatively curing at not less than 50 degrees F (10 degrees C) for 8 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations and provided curing and protection operations are maintained.
 - 2. Manholes shall not be backfilled until they have cured a minimum of sixty four (64) hours at 70 degrees F or above.
- F. Precast Manholes:
 - 1. All joints between separate precast sections and between the cone and manhole ring shall be gasketed with Ram-Nek or approved equal to ensure watertightness.

3.07 CONNECTION TO EXISTING MANHOLES

- A. Where shown on the Drawings to connect to existing manhole and where no stubout exists or is of insufficient size or alignment, Contractor shall cut in an opening through the manhole wall of sufficient size (no more than 2" larger than the outside diameter of the pipe) to permit installation of new pipe to the indicated line and grade.
- B. Extend new pipe entirely through the wall, fitted with a premolded rubber waterstop. Fill the remaining void with an expansive hydraulic grout.
- C. Bottoms of existing manholes shall be refinished, removing portions of existing invert and re-grouting as necessary to provide a smooth and uniform invert.
- D. Connect to existing manholes only after all other upstream lines and manholes have been completed, cleaned, tested, inspected and approved. Connections shall be made under the supervision of the City.

3.08 BORES

- A. Bore under highways maintaining minimum depths and bore lengths as shown on the Drawings. Utilize construction techniques and comply with the requirements of the regulating authority.
- B. Pipe Encasement:
 - 1. Excavate an area sufficient to allow the installation of the encasement. Use proper precautions to assure that the integrity of the roadway or railroad bed is not disturbed by the excavation.

3.09 CUTTING AND REPLACING SPECIAL SURFACES

- A. When necessary to disturb paved, graveled or other special surfaces, Contractor shall use care to minimize any such disturbances. Care shall be used in making the backfill to eliminate future settlement and the surface shall be restored using the same type of original surface materials.
- B. Asphalt and Concrete Pavement Surfaces: Edges of pavement shall be cut full depth along straight and true lines along each side of the trench using approved tools and equipment ahead of the trenching operation. All pavement materials shall be removed from the area prior to beginning the trenching work. Subgrade and base material shall match existing on both sides of the trench and all patches shall be made as approved by the Engineer. Replace removed paving and base course with new material of equal or better quality and of the same texture and color as the adjacent paved areas.

- C. Gravel Surfaces: Gravel shall be replaced after trenching and backfilling. After the backfill has been so placed that no further appreciable settlement will occur, gravel over the trench shall be replaced to the same compacted thickness as the original surfacing. During construction, the gravel of the remainder of the street not occupied by the trench may be covered with soil from the excavated material. After completion of the backfill, such soil shall be removed, in so far as possible, and additional gravel shall be placed on the street until the surface is as weather resistant and traffic resistant as the original surfacing.
- D. Seeded Areas: After heavy construction work is complete and equipment has been removed, clean all areas disturbed by the Contractor's Work.
1. Clean all debris and grade to finish grade allowing for ample drainage away from all structures and to drainage channels.
 2. Loosen soil to a minimum depth of 1 ½ inches. Apply 10-20-10 fertilizer to all soil areas at a rate of 200 pounds per acre and seed with hulled bermuda grass seed at the rate of 20 pounds per acre.
 3. After seeding and fertilizing, spread straw over all areas. Straw shall be free of grass and weed seeds.
 4. Contractor shall be responsible for watering and maintaining all grass areas until a uniform growth of grass at least 1 ½ inches tall is developed over the entire area. Contractor shall, at his expense, regrade and reseed all areas that may become eroded during this period until the entire area has the required grass cover.
 5. If the Work is not ready for seeding prior to August 1 of the year, the Contractor may use rye grass in lieu of bermuda grass. All other requirements remain unchanged.
- E. Sodded Lawn Areas: Prepare any sodded areas for proper relaying of any previously removed sod. Remove trench and backfill materials from adjacent lawn areas to permit unhindered growth of grasses and safe operation of mowing equipment. Replace sod as specified in Section 02900. Sod and adjacent lawn areas that do not reestablish at the commencement of the next growing season shall be replaced at the Contractor's expense.
- F. Sidewalks:
1. When removal is necessary for pipeline installation, sidewalks shall be saw cut in a neat straight line along existing joints where possible. Finished sidewalk shall extend a minimum of nine (9) inches on either side of trench banks.
 2. Thickness of sidewalks shall be a minimum of 4 inches or match existing, whichever is greater. Concrete shall be placed true to grade to ensure that ponding of water will not occur.
 3. Place, finish, and cure concrete in accordance with Section 03305. Protect sidewalk from damage for 7 days minimum.
 4. Install 6 x 6-inch #10 welded wire mesh reinforcement.
 5. Repaired sidewalk surfaces shall be finished and tooled to match the existing walk. Install scored contraction joints at no less intervals than equal to the walk width and within 24 hours of concrete placement.
- G. Contractor shall maintain repaired areas as often as necessary to provide a smooth crossing not hazardous to traffic.
- H. Should local regulations pertaining to cutting and replacing special surfaces exist in the project

area, they shall be considered to supersede this subsection. The Contractor shall comply with all such local codes or regulations.

3.10 TESTING

A. Gravity Sewer Mains - Leakage Testing:

1. Inspect interior of sewer mains by lamping or other approved methods. Adjust or relay pipe which has been displaced or damaged.
2. Repair all detected leaks.
3. Observe sewer mains for infiltration after heavy rainfall. Infiltration shall not exceed 50 gallons per day per inch of pipe diameter per mile. Test and repair in presence of Engineer. Repair infiltration leaks.
4. Perform low pressure air test on completed sections of gravity mains and services from manhole to manhole. Test shall be conducted with completed backfill in place. Test as required by ASTM C828-78.
 - a Plug ends of lines to withstand internal pressures.
 - b Provide two taps at one plug for connecting air equipment.
 - c Connect air pressure equipment and pressurize section to 3.5 to 4.0 psig. Adjust air supply to maintain 3.5 psig for time required for inside air temperature to stabilize. Check for leaking plugs or noticeable leaks. Repair noticeable leaks or tighten plugs and restart test.
 - d After temperature has stabilized hold pressure at 3.5 psig and shut air supply. Record time required for pressure to drop to 3.0 psig. The minimum time required for the pressure to drop shall be as follows:

Pipe Size	Time
4"	2.5 minutes
6"	4.0 minutes
8"	5.0 minutes
10"	6.5 minutes
12"	7.5 minutes
15"	9.5 minutes

- e If section fails to meet time requirements, determine the cause, repair and retest the line. Repair and retest as required to meet air test requirements.

5. Repair detected leaks regardless of test result. If segment fails to pass, re-test and continue procedure of repair and testing until line passes test.
6. Repair all surfaces disturbed during test procedure using methods approved by the Engineer at no additional cost to the Owner.
7. All tests shall be conducted in the presence of the Engineer or Designated Authority.

B. Gravity Sewer Mains - Deflection Testing:

1. Perform deflection (reduction in vertical inside diameter) tests between successive manholes on PVC gravity sewer pipe a minimum of 30 days after installation and backfilling is complete.
2. Perform tests utilizing a sharp edge rigid Mandrel.
3. Deflection shall not exceed 5 percent.

Mandrel dimensions based on 5 percent deflection shall be as follows:

Pipe Diameter (inches)	Mandrel O.D. (inches)
6	5.70
8	7.60
10	9.50
12	11.40
15	14.25

C. Sewer Force Mains:

1. General: Pressure test all sewer force mains in presence of Engineer or Designated Authority. Contractor shall make arrangements for furnishing potable water or other approved source for testing. Provide all pumps, gages, fittings and apparatus for testing. Pressure test after backfill is complete.
2. Fill pipe with water while bleeding and purging air. Bleed air at high points of lines and at each service line. Pressurize lines using approved pumping system to a pressure one hundred (100) percent in excess of the normal pressure, but not less than 100 psig at high point of line. Maintain pressure for period of four hours, recording (using approved meter(s)) quantity of water required to maintain pressure. Line segments will be approved as passing the test if no noticeable leaks are present and quantity (L) required to maintain pressure is less than indicated by the Formula

$$L = \frac{ND(P)^{1/2}}{7400}$$

as defined by AWWA C-600-77.

Where L is allowable leakage gallons per hour.

N is number of joints in the segment being tested.

D is the nominal diameter of the pipe in inches.

P is the average test pressure in pounds per square inch gage.

3. Repair all detected leaks regardless of test result. If segment fails to pass, re-test and continue procedure of repair and testing until line passes test.
4. Repair all surfaces disturbed during test procedure using methods approved by the Engineer at no additional cost to the Owner.

D. Manholes:

1. Visual Testing:

Manhole interiors shall be visually inspected for detection of leaks. All visible leaks shall be corrected.

2. Hydrostatic Testing:

When, in Engineer's opinion, the groundwater table is too low to permit visual detection of leaks, Engineer may require hydrostatic testing of manholes as follows:

- a Plug all inlets and outlets, and fill manhole with water to base of cover ring.
- b Leakage in each manhole shall not exceed 0.1 gallons per hour per foot of head above invert.
- c Manhole may be filled 24 hours prior to time of testing, if desired, to permit normal absorption into walls.
- d Repair manholes that do not meet leakage test.

3. Vacuum Testing:

All newly constructed manholes, whether precast or poured in place, shall pass a vacuum test prior to acceptance. A vacuum of 10 inches Hg shall be placed on the manhole. The measured time for a vacuum loss of one (1) inch Hg shall not be less than 60 seconds.

E. Test Records:

1. Records shall be made of each piping system component tested. Records shall include:
 - a Date of test.
 - b Description and identification of piping tested.
 - c Test fluid.
 - d Test pressure.
 - e Remarks, including such items as:
 - (1) Leaks - type and location.
 - (2) Repairs made on leaks.
 - f Certification by Contractor and written approval by Engineer.

3.11 CLEAN-UP

- A. Clean construction area of all debris, refuse, excess material, etc. Dispose of off site.
- B. Clean interior of manholes and sewer mains of all dirt and other materials.

END OF SECTION

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. Extent of storm drainage system work is indicated on drawings and by requirements of this section. This section includes the following work:
 - 1. Culverts
- B. Related sections:
 - 1. Section 00 30 10 – Geotechnical Investigation
 - 2. Section 02 20 00 – Site Preparation
 - 3. Section 32 22 13 – Grading
 - 4. Section 31 23 16 – Excavation
 - 5. Section 31 23 23 – Fill and Backfill
 - 6. Section 31 23 17 – Trenching for Site Utilities

1.02 QUALITY ASSURANCE

- A. Code and Standards: Comply with applicable requirements of standards including the following:
 - 1. American Association of State Highway and Transportation Officials (AASHTO), 444 North Capitol Street, N.W., Suite 225, Washington, DC 20001.
 - a AASHTO M252 - Standard Specification for Polyethylene Corrugated Drainage Pipe.
 - b AASHTO M294 - Standard Specification for Corrugated Polyethylene Pipe, 12-inch to 24-inch diameter.
 - 2. American Society for Testing and Materials (ASTM), 1961 Race Street, Philadelphia, Pennsylvania 19103.
 - a ASTM C14 - Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
 - b ASTM C76 - Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
 - c ASTM C412 - Specification for Concrete Drain Tile.
 - d ASTM C443 - Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
 - e ASTM C444 - Specification for Preformed Concrete Pipe.
 - f ASTM C478 - Specification for Precast Reinforced and Nonreinforced Masonry.
 - g ASTM D1248 - Specification for Polyethylene Plastics Modeling and Extrusion Materials.
 - h ASTM D2321 - Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.

- i ASTM D2412 - Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
 - j ASTM F405 - Standard Specification for Corrugated Polyethylene Pipe and Fittings.
 - k ASTM F667 - Standard Specification for Large Diameter Corrugated Polyethylene Pipe and Fittings.
3. Arkansas Highway and Transportation Department (AHTD)
- a Standard Specifications for Highway Construction (latest edition).

1.03 SUBMITTALS

- A. Submit the following product data for Engineer's approval prior to ordering materials:
- 1. Pipe and fittings.
 - 2. Flared end sections.

PART 2 – PRODUCTS

2.01 PIPE AND PIPE FITTINGS

- A. General: Provide piping materials and factory fabricated fittings and accessories of sizes and types indicated on drawings or required. Pipe and fittings shall be free of foreign inclusions and visible defects.
- B. Corrugated Polyethylene Pipe:
- 1. Provide pipe and fittings manufactured of polyethylene compounds which meet or exceed the requirements of Type II, Category 4 or 5, Grade P33 or P34, Class C per ASTM D1248. Clean reworked material may be used.
 - 2. Minimum parallel plate pipe stiffness values at 5 per cent deflection (per ASTM D2412) shall be as follows:
 - a 12-inch: 45 psi.
 - b 15-inch: 42 psi.
 - c 18-inch: 40 psi
 - d 24-inch: 34 psi.
 - e 30-inch: 28 psi.
 - f 36-inch: 22 psi.
 - 3. Manufactured in accordance with ASTM F405, ASTM F667, AASHTO M252, and AASHTO M294.
 - 4. Fittings:
 - a Provide molded or fabricated fittings manufactured by pipe supplier. Fittings produced by manufacturer other than pipe supplier shall not be allowed.
 - b Provide split couplings.
 - (1) Corrugated to match pipe corrugations.
 - (2) Engage a minimum of 6 corrugations for 12-inch through 24-inch diameter and 4 corrugations for 30-inch and 36-inch diameter pipe.

- c Gaskets: Neoprene, where required by Engineer or shown on the Drawings.
 - d Manufactured in accordance with ASTM F405, ASTM F667, AASHTO M252, and AASHTO M294.
- C. Reinforced Concrete Pipe:
 - 1. Meet requirements of AHTD Section 606.
 - 2. Class III or as shown on the Drawings.
 - 3. Joints shall conform to ASTM C443.
- D. Cast-in-place Concrete:
 - 1. Conform to Section 03305 herein.
 - 2. Design mix to attain 4,000 psi compressive strength at 28 days.

PART 3 – EXECUTION

3.01 TRENCHING

- A. Excavate trenches accurately to grade and alignment shown on Drawings or as established in the field by Engineer. Provide ample space for storm drain construction. Trench widths as shown on Drawings.
- B. When excavation is carried below that required, fill space with concrete, pipe bedding, or approved compacted select material.
- C. Trenching and bedding shall meet requirements of AHTD Sections 606 and 607.
- D. Where soft, mucky, or otherwise unsuitable material is encountered, excavation shall continue until firm material is reached. The over-excavation shall be filled to grade with pipe bedding or approved compacted select material.

3.02 INSTALLATION OF PIPE AND CULVERTS

- A. Lay sections on properly compacted granular bedding to lines and grades as shown on Drawings.
- B. Backfill with approved imported granular materials as shown on the Drawings.
- C. Install joint band couplers in accordance with pipe manufacturer's recommendations and AASHTO guidelines. Use Ram Neck gasket material in end corrugation of each pipe end.
- D. Install reinforcing end collar where pipe terminates without protective end treatment such as headwall, inlet box, or grouted rip rap.
- E. Pipes (storm, sanitary, water) that cross each other with less than 1 foot clearance must have a concrete encased intersection.
- F. Cut pipe ends squarely and clean without rough edges so as not to affect jointing at couplings, structures and points of termination.

3.03 PIPE BEDDING AND BACKFILL

- A. Install pipe bedding material as shown on the Drawings and in layers not exceeding 4 inches maximum thickness. Thoroughly place bedding material around pipe haunches, shovel slicing as necessary to eliminate all voids.
- B. When flexible drainage pipe is used, the following special requirements apply:

1. Provide minimum 12 inches cover where located under traffic areas.
 2. Bedding shall be equal to AHTD Class 7 or Class 8 granular material.
 3. Bedding shall be a minimum of 4 inches below bottom of pipe, including bell ends, and shall extend a minimum of 12 inches above the top of pipe.
- C. Backfill remainder of trench above bedding material using approved backfill material and compacted to a minimum of 95 percent of Standard Proctor density.
- D. Backfill for all drainage pipe under paved surfaces with granular material as shown on the Drawings.
- E. Backfill in non-traffic areas for reinforced concrete pipe shall be made from suitable excavated materials.
- F. Backfill and restore trenches as soon as possible after pipe is laid. Unnecessary delays in backfilling, grading, cleaning and restoring disturbed surfaces constitutes cause for stopping work until trenches are restored.

3.04 CLEAN-UP

- A. Clean construction area of all debris, refuse, excess material, etc. Dispose of off site.
- B. Clean interior of structures of all dirt and other materials.

END OF SECTION