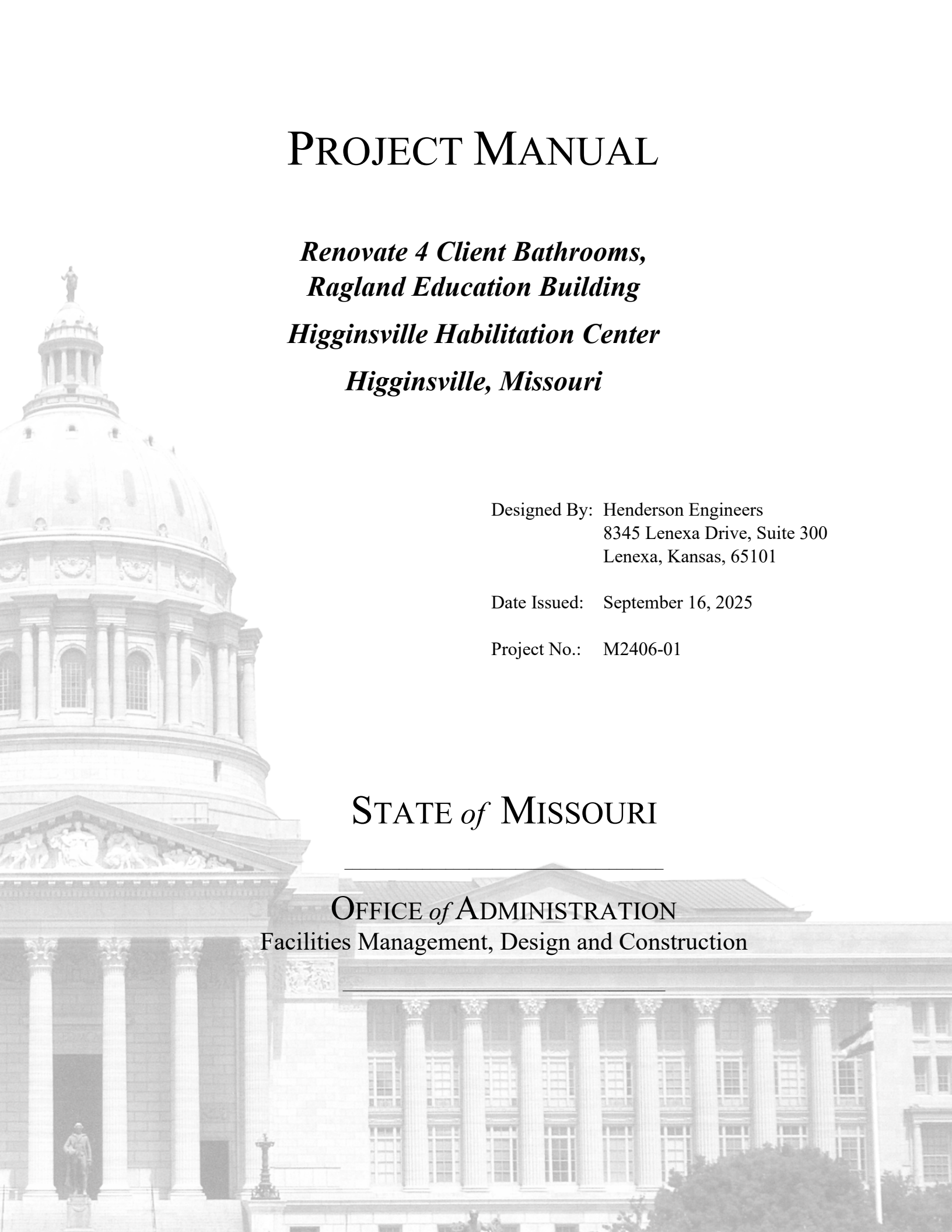




PROJECT MANUAL

Renovate 4 Client Bathrooms, Ragland Education Building Higginsville Habilitation Center Higginsville, Missouri

Designed By: Henderson Engineers
8345 Lenexa Drive, Suite 300
Lenexa, Kansas, 65101

Date Issued: September 16, 2025

Project No.: M2406-01

STATE *of* MISSOURI

OFFICE *of* ADMINISTRATION
Facilities Management, Design and Construction

SECTION 000107 - PROFESSIONAL SEALS AND CERTIFICATIONS

PROJECT NUMBER: M2406-01 "BATHROOM RENOVATIONS - HIGGINSVILLE
HABILITATION CENTER"

THE FOLLOWING DESIGN PROFESSIONALS HAVE SIGNED AND SEALED THE ORIGINAL
PLANS AND SPECIFICATIONS FOR THIS PROJECT, WHICH ARE ON FILE WITH THE
DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION:

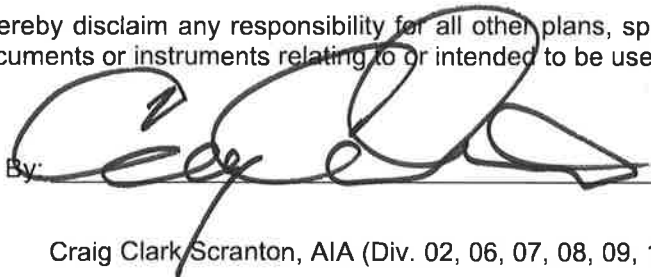
ARCHITECTURAL

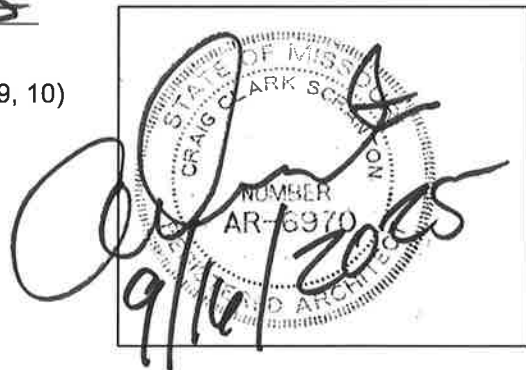
The documents intended to be authenticated by my seal are limited to:

Specifications: Division 02 all Sections.
Division 06 all Sections.
Division 07 all Sections.
Division 08 all Sections.
Division 09 all Sections.
Division 10 all Sections.

Drawings Sheets: A001, AD100, AD150, AD500, A010, A040, A100, A150, A500, A550, A560,
A600.

I hereby disclaim any responsibility for all other plans, specifications, estimates, reports or other
documents or instruments relating to or intended to be used for any part of the project.

By: 
Craig Clark Scranton, AIA (Div. 02, 06, 07, 08, 09, 10)



SECTION 000107 - PROFESSIONAL SEALS AND CERTIFICATIONS

PROJECT NUMBER: M2406-01 "BATHROOM RENOVATIONS – HIGGINSVILLE HABILITATION CENTER"

THE FOLLOWING DESIGN PROFESSIONALS HAVE SIGNED AND SEALED THE ORIGINAL PLANS AND SPECIFICATIONS FOR THIS PROJECT, WHICH ARE ON FILE WITH THE DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION:

PLUMBING/MECHANICAL/ELECTRICAL

The documents intended to be authenticated by my seal are limited to:

Specifications: Division 22 all Sections.
Division 23 all Sections.
Division 26 all Sections.
Division 28 all Sections.

Drawings Sheets: G-000, P-000, P-101, P-102, P-400, M-000, M-101, M-102, M-400, E-000, E-100, E-101, E-500, FA-000, FA-101, FA-102

I hereby disclaim any responsibility for all other plans, specifications, estimates, reports or other documents or instruments relating to or intended to be used for any part of the project.

By: _____

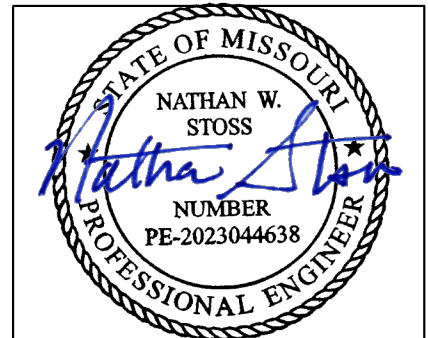
Kelley P. Cramm, P.E. (Div. 22 & 23)



9/16/2025

By: _____

Nathan W. Stoss, P.E. (Div. 26)



09/16/25

By: _____

Christopher J. Culp, P.E. (Div. 28)



9/16/2025

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The following procurement forms can be found on our website at:
<https://oa.mo.gov/facilities/bid-opportunities/bid-listing-electronic-plans>
and shall be submitted with your bid to FMDCBids@oa.mo.gov

004000 PROCUREMENT FORMS & SUPPLEMENTS

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SECTION 000115 – LIST OF DRAWINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section provides a comprehensive list of the drawings that comprise the Bid Documents for this project.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 LIST OF DRAWINGS

- A. The following list of drawings is a part of the Bid Documents:

	<u>TITLE</u>	<u>SHEET #</u>	<u>DATE</u>	<u>CAD #</u>
1.	Cover Sheet	G000	09/16/25	G000
2.	Occupant Load Review	A001	09/16/25	A001
3.	Architectural Demolition Plan	AD100	09/16/25	AD100
4.	Reflected Ceiling Demolition Plan	AD150	09/16/25	AD150
5.	Enlarged Architectural Demolition Plans	AD500	09/16/25	AD500
6.	Accessibility Guidelines	A010	09/16/25	A010
7.	Partition, Door, and Finish Schedules	A040	09/16/25	A040
8.	Floor Plan	A100	09/16/25	A100
9.	Reflected Ceiling Plan	A150	09/16/25	A150
10.	Enlarged Plans at Restroom	A500	09/16/25	A500
11.	Interior Elevations	A550	09/16/25	A550
12.	Interior Details	A560	09/16/25	A560
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14.	Mechanical General Notes and Legend	M000	09/16/25	M000

15.	HVAC Level 1 Plan - Overall	M101	09/16/25	M101
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17.	Mechanical Schedules and Details	M400	09/16/25	M400
18.	Electrical Legend and General Notes	E000	09/16/25	E000
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21.	Electrical Details and Schedules	E500	09/16/25	E500
22.	Plumbing General Notes and Legend	P000	09/16/25	P000
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24.	Plumbing Level 1 Plan - Enlarged Views	P102	09/16/25	P102
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26.	Fire Alarm General Notes and Legend	FA000	09/16/25	FA000
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29.	Asbestos Abatement Education Building First Floor	H101	09/16/25	H101

END OF SECTION 000115

SECTION 001116 - INVITATION FOR BID

1.0 OWNER:

- A. The State of Missouri
Office of Administration,
Division of Facilities Management, Design and Construction
Jefferson City, Missouri

2.0 PROJECT TITLE AND NUMBER:

- A. Renovate 4 Client Bathrooms, Ragland Education Building
Higginsville Habilitation Center
Higginsville, Missouri
Project No.: M2406-01

3.0 BIDS WILL BE RECEIVED:

- A. Until: 1:30 PM, December 9, 2025
- B. **Only electronic bids sent to FMDCBids@oa.mo.gov shall be accepted:** (See Instructions to Bidders for further detail)

4.0 DESCRIPTION:

- A. Scope: The project includes bathroom renovations at the Ragland Education building. The scope includes upgrading all finishes, modifications necessary to meet current ADA standards, replacement of plumbing fixtures, lighting, receptacles, fire alarm devices, and plumbing piping that is in poor condition. The scope also includes asbestos inspection and sampling for suspect surfaces that will be disturbed as a result of demolition.
- B. MBE/WBE/SDVE Goals: MBE 10%, WBE 10%, and SDVE 3%. **NOTE: Only MBE/WBE firms certified by the State of Missouri Office of Equal Opportunity as of the date of bid opening, or SDVE(s) meeting the requirements of Section 34.074, RSMo and 1 CSR 30-5.010, can be used to satisfy the MBE/WBE/SDVE participation goals for this project.**

5.0 PRE-BID MEETING:

- A. Place/Time: 10:00 AM, November 17, 2025, at Higginsville Habilitation Center; 100 W 1st Street Higginsville, MO 64037.
- B. Access to State of Missouri property requires presentation of a photo ID by all persons.

6.0 HOW TO GET PLANS & SPECIFICATIONS:

- A. View Only Electronic bid sets are available at no cost or paper bid sets for a deposit of \$100.00 from American Document Solutions (ADS). MAKE CHECKS PAYABLE TO: American Document Solutions. Mail to: American Document Solutions, 1400 Forum Blvd., Suite 7A, Columbia, Missouri 65203. Phone 573-446-7768, Fax 573-355-5433, <https://www.adsplanroom.net>. NOTE: Prime contractors will be allowed a maximum of two bid sets at the deposit rate shown above. Other requesters will be allowed only one bid set at this rate. Additional bid sets or parts thereof may be obtained by any bidder at the cost of printing and shipping by request to American Document Solutions at the address shown above. Bidder must secure at least one bid set to become a planholder.
- B. **Refunds: Return plans and specifications in unmarked condition within 15 working days of bid opening to American Document Solutions, 1400 Forum Blvd., Suite 7A, Columbia, Missouri 65203. Phone 573-446-7768, Fax 573-355-5433. Deposits for plans not returned within 15 working days shall be forfeited.**
- C. Information for upcoming bids, including downloadable plans, specifications, Invitation for Bid, bid tabulation, award, addenda, and access to the ADS planholders list, is available on the Division of Facilities Management, Design and Construction's web site: <https://oa.mo.gov/facilities/bid-opportunities/bid-listing-electronic-plans>.

7.0 POINT OF CONTACT:

- A. Designer: Henderson Engineers, Matt Swaback, (913) 742-5742, email: Matt.Swaback@hendersonengineers.com
- B. Project Manager: Aaron Libbert, (816) 797-3442, email: aaron.libbert@oa.mo.gov

8.0 GENERAL INFORMATION:

- A. The State reserves the right to reject any and all bids and to waive all informalities in bids. No bid may be withdrawn for a period of 20 working days subsequent to the specified bid opening time. The contractor shall pay not less than the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed, as determined by the Missouri Department of Labor and Industrial Relations and as set out in the detailed plans and specifications.
- B. Bid results will be available at <https://oa.mo.gov/facilities/bid-opportunities/bid-listing-electronic-plans> after it is verified that at least one bid is awardable and affordable.

SECTION 002113 – INSTRUCTIONS TO BIDDERS

1.0 - SPECIAL NOTICE TO BIDDERS

- A. If awarded a contract, the Bidder's employees, and the employees of all subcontractors, who perform the work on the project must adhere to requirements in Section 013513 – Site Security and Health Requirements as applicable per Agency.
- B. The Bidder's prices shall include all city, state, and federal sales, excise, and similar taxes that may lawfully be assessed in connection with the performance of work, and the purchased of materials to be incorporated in the work. **THIS PROJECT IS NOT TAX EXEMPT.**

2.0 - BID DOCUMENTS

- A. The number of sets obtainable by one (1) party may be limited in accordance with available supply.
- B. For the convenience of contractors, subcontractors and suppliers, bidding documents are available on the Owner's website at <https://oa.mo.gov/facilities/bid-opportunities/bid-listing-electronic-plans>.

3.0 - BIDDERS' OBLIGATIONS

- A. Bidders must carefully examine the entire site of the work and shall make all reasonable and necessary investigations to inform themselves thoroughly as to the facilities available as well as to all the difficulties involved in the completion of all work in accordance with the specifications and the plans. Bidders are required to examine all maps, plans and data mentioned in the specifications. No plea of ignorance concerning observable existing conditions or difficulties that may be encountered in the execution of the work under this contract will be accepted as an excuse for any failure or omission on the part of the successful Bidder (contractor) to fulfill every detail of the requirements of the contract, nor accepted as a basis for any claims for extra compensation or time extension.
- B. Under no circumstances will Bidders give their plans and specifications to other Bidders. It is highly encouraged, but not required, that all Bidders be on the official planholders list to receive project updates including but not limited to any addenda that are issued during the bidding process.

4.0 - INTERPRETATIONS

- A. No Bidder shall be entitled to rely on oral or written representations from any person as to the meaning of the plans and specifications or the acceptability of alternate products, materials, form or type of construction.
- B. Bidders shall make all requests for interpretations in writing and submit all requests to the Project Designer and Project Manager identified in Section 007300 – Supplementary Conditions with all necessary supporting documentation no less than five (5) working days before opening of bids. Responses to requests for interpretation will be issued via a written addendum and will be sent as promptly as is practicable to all official planholders and posted on the Owner's website. All such addenda shall become part of the bid and contract documents.
- C. Bidders shall make all requests for an "Acceptable Substitution" on the Section 006325 Substitution Request Form. The request shall be emailed to the Project Designer and Project Manager identified in Section 007300 – Supplementary Conditions no less than five (5) working days before opening of bids. Responses to requests for substitutions will be issued via a written addendum and will be sent as promptly as is practicable to all official planholders and posted on the Owner's website. All such addenda shall become part of the bid and contract documents.
- D. An "Acceptable Substitution" requested after the award of bid will only be approved if proven to the satisfaction of the Owner and the Designer that the product is acceptable in design, strength, durability, usefulness, and convenience for the purpose intended. Approval of the substitution after award is at the sole discretion of the Owner and all requests of this nature must be submitted in accordance with Article 3.1 of the General Conditions.

5.0 - BIDS AND BIDDING PROCEDURE

- A. Bidders shall submit all submission forms and accompanying documents listed in Section 004113 – Bid Form, Article 5.0, Attachments to Bid by the stated time on the bid documents or the bid will be rejected for being non-responsive.
- B. Depending on the specific project requirements, **the following is a GENERIC list** of all possible bid forms that may be due with bid submittals. Bidders must verify each specific project's requirements in Section 004113 to ensure they have provided all the required documentation with their submission.

Bid Submittal – due before stated date and time of bid opening (see IFB):

004113	Bid Form (all pages are always required)
004322	Unit Prices Form
004336	Proposed Subcontractors Form
004337	MBE/WBE/SDVE Compliance Evaluation Form
004338	MBE/WBE/SDVE Eligibility Determination for Joint Ventures
004339	MBE/WBE/SDVE GFE Determination
004340	SDVE Business Form
004541	Affidavit of Work Authorization
004545	Anti-Discrimination Against Israel Act Certification form

- C. The Bidder shall submit its bid on the forms provided by the Owner in the same file format (PDF) with each space fully and properly completed, typewritten or legibly printed, including all amounts required for alternate bids, unit prices, cost accounting data, etc. The Owner will reject bids that are not on the Owner's forms or that do not contain all requested information. All forms can be found on the Owner's website at <https://oa.mo.gov/facilities/bid-opportunities/bid-listing-electronic-plans> and shall be submitted with your bid to FMDCBids@oa.mo.gov.
- D. All bids shall be submitted without additional terms and conditions, modifications, or reservations. The completed forms should not include interlineations, alterations, or erasures. Bids not in compliance with the requirements of this paragraph will be rejected as non-responsive.
- E. All bids shall be accompanied by a bid bond executed by the bidder and a duly authorized surety company, certified check, cashier's check or bank draft made payable to the Division of Facilities Management, Design and Construction, State of Missouri, in the amount indicated in the bid documents in Section 004113. Failure of the Bidder to submit the duly authorized bid bond or the full amount required shall be sufficient cause to reject his bid. The Bidder agrees that the proceeds of the check, draft, or bond shall become the property of the State of Missouri, if for any reason the Bidder withdraws his bid after bid closing or if the Bidder, within ten (10) working days after notification of award, refuses or is unable to 1) execute the tendered contract, 2) provide an acceptable performance and payment bond, or 3) provide evidence of required insurance coverage.
- F. The bid bond check or draft submitted by the successful Bidder will be returned after the receipt of an acceptable performance and payment bond and execution of the formal contract. Checks or drafts of all other Bidders will be returned within a reasonable time after it is determined that the bid represented by same will receive no further consideration by the State of Missouri.

6.0 - SIGNING OF BIDS

- A. A bid should contain the full and correct legal name of the Bidder. If the Bidder is an entity registered with the Missouri Secretary of State, the Bidder's name on the bid form should appear as shown in the Secretary of State's records. If the Bidder is an entity organized in a state other than Missouri, the Bidder must provide a Certificate of Authority to do business in the State of Missouri.
- B. If the successful Bidder is doing business in the State of Missouri under a fictitious name, the Bidder shall furnish to Owner, attached to the Bid Form, a properly certified copy of the certificate of Registration of Fictitious Name from the State of Missouri, and such certificate shall remain on file with the Owner.
- C. A bid from an individual shall be signed as noted on the Bid Form.
- D. A bid from a partnership or joint venture shall require only one signature of a partner, an officer of the joint venture authorized to bind the venture, or an attorney-in-fact. If the bid is signed by an officer of

a joint venture or an attorney-in-fact, a document evidencing the individual's authority to execute contracts should be included with the bid form.

- E. A bid from a limited liability company (LLC) shall be signed by a manager or a managing member of the LLC.
- F. A bid from a corporation shall have the correct corporate name thereon and the signature of an authorized officer of the corporation. Title of office held by the person signing for the corporation shall appear, along with typed name of said individual and the corporate license number shall be provided. In addition, for corporate proposals, the President or Vice-President listed per the current filing with the Missouri Secretary of State should sign as the Bidder. If the signatory is other than the corporate president or vice president, the bidder must provide satisfactory evidence that the signatory has the legal authority to bind the corporation.

7.0 - RECEIVING BID SUBMITTALS

- A. It is the Bidder's sole responsibility to ensure receipt of the bid submittals by Owner on or before the date and time specified in the Invitation for Bid or as modified via written addenda. Bids received after the date and time specified will not be considered by the Owner.
- B. All bids shall be received via email at FMDCBids@oa.mo.gov and bids received by the Owner through any other means, including hard copies, will not be considered, and will be discarded by the Owner unopened.

8.0 - MODIFICATION AND WITHDRAWAL OF BIDS

- A. Bidder may withdraw a bid at any time prior to the scheduled closing time for receipt of bids, but no bidder may withdraw his bid for a period of twenty (20) working days after the scheduled closing time for receipt of bids.
- B. Bidder may modify a bid until the scheduled closing time by sending a revised bid to FMDCBids@oa.mo.gov with a note in the subject line and body of the email that it is a revised bid. All revised bids must be submitted to FMDCBids@oa.mo.gov, revised bids sent any other way will not be considered.

9.0 - AWARD OF CONTRACT

- A. The Owner reserves the right to reject any and/or all bids and further to waive all informalities in bidding when deemed in the best interest of the State of Missouri.
- B. The Owner reserves the right to let other contracts in connection with the work including, but not limited to, contracts for the furnishing and installation of furniture, equipment, machinery, appliances and other apparatuses.
- C. The Owner will award a contract to the lowest, responsive, and responsible Bidder in accordance with Section 8.250, RSMo. No contract will be awarded to any Bidder who has had a contract with the Owner terminated within the preceding twelve months for material breach of contract or who has been suspended or debarred by the Owner.
- D. Award of alternates, if any, will be made in numerical order unless all bids received are such that the order of acceptance of alternates does not affect the determination of the lowest, responsive, responsible bidder.
- E. No award shall be considered binding upon the Owner until the written contract has been properly executed and the following documentation has been provided: 1) performance and payment bond consistent with Article 6.1 of the General Conditions; 2) proof of the required insurance coverage; 3) an executed Section 004541 - Affidavit of Work Authorization form; and 4) documentation evidence enrollment and participation in a federal work authorization program.
- F. Failure to execute and return the contract and associated documents within the prescribed period shall be treated, at the option of the Owner, as a breach of Bidder's obligation and the Owner shall be under no further obligation to Bidder.
- G. Transient employers subject to Sections 285.230 and 285.234, RSMo, (out-of-state employers who temporarily transact any business in the State of Missouri) may be required to file a bond with the

Missouri Department of Revenue. No contract will be awarded by the Owner unless the successful Bidder certifies that he has complied with all applicable provisions of Section 285.230-234.

- H. Sections 285.525 and 285.530, RSMo, require business entities to enroll and participate in a federal work authorization program in order to be eligible to receive award of any state contract in excess of \$5,000. Bidders should submit with their bid an Affidavit of Work Authorization (Section 004541) along with appropriate documentation evidencing such enrollment and participation. Bidders must also submit an E-Verify Memorandum before the Owner may award a contract to the Bidder. Information regarding a E-Verify is located at <https://www.e-verify.gov/employers/enrolling-in-e-verify>. The contractor shall be responsible for ensuring that all subcontractors and suppliers associated with this contract enroll in E-Verify.
- I. The successful Bidder must be registered in MissouriBUYS powered by MOVERS at <https://missouribuyss.mo.gov/supplier-registration#> as an approved vendor prior to being issued a contract.

10.0 - CONTRACT SECURITY

- A. The successful Bidder shall furnish a performance/payment bond as set forth in General Conditions Article 6.1 prior to the State executing the contract and issuing a notice to proceed.

11.0 - LIST OF SUBCONTRACTORS

- A. If required by "Section 004113 – Bid Form," each Bidder must submit as part of their bid a list of subcontractors to be used in performing the work (Section 004336). The list must specify the name of the single designated subcontractor, manufacturer, or suppliers for each category of work listed in "Section 004336 - Proposed Subcontractors Form." If work within a category will be performed by more than one subcontractor, the bidder must provide the name of each subcontractor and specify the exact portion of the work to be done by each. If the Bidder intends to perform any of the designated subcontract work with the use of his own employees, the Bidder shall make that fact clear, by listing his own firm for the subject category. **If any category of work is left vacant or if more than one subcontractor is listed for any category without designating the portion of work to be performed by each, the bid shall be rejected.**

12.0 - WORKING DAYS

- A. Contract duration time is stated in working days and will use the following definition in determining the actual calendar date for contract completion:
 - 1. Working days are defined as all calendar days except Saturdays, Sundays and the following State of Missouri observed holidays: New Year's Day, Martin Luther King, Jr. Day, Lincoln Day, Washington's Birthday, Truman Day, Memorial Day, Juneteenth, Independence Day, Labor Day, Columbus Day, Veterans Day, Thanksgiving Day and Christmas Day.

13.0 - AMERICAN AND MISSOURI - MADE PRODUCTS AND FIRMS

- A. By signing the bid form and submitting a bid on this project, the Bidder certifies that it will use American and Missouri products as set forth in Article 1.7 of the General Conditions. Bidders are advised to review those requirements carefully prior to bidding.
- B. A preference shall be given to Missouri firms, corporations or individuals, or firms, corporations or individuals that maintain Missouri offices or places of business, when the quality of performance promised is equal or better and the price quoted is the same or less.
- C. Pursuant to Section 34.076, RSMo, a contractor or Bidder domiciled outside the boundaries of the State of Missouri shall be required, in order to be successful, to submit a bid the same percent less than the lowest bid submitted by a responsible contractor or Bidder domiciled in Missouri as would be required for such a Missouri domiciled contractor or Bidder to succeed over the bidding contractor or Bidder domiciled outside Missouri on a like contract or bid being let in the Bidder's domiciliary state and, further, the contractor or Bidder domiciled outside the boundaries of Missouri shall be required to submit an audited financial statement as would be required of a Missouri domiciled contractor or Bidder on a like contract or bid being let in the domiciliary state of that contractor or Bidder.

14.0 – ANTI-DISCRIMINATION AGAINST ISRAEL ACT CERTIFICATION:

- A. If the Bidder meets the section 34.600, RSMo., definition of a “company” and the Bidder has ten or more employees, the Bidder must certify in writing that the Bidder is not currently engaged in a boycott of goods or services from the State of Israel and shall not engage in a boycott of goods or services from the State of Israel, if awarded a contract, for the duration of the contract. The Bidder is required to complete and submit the applicable portion of Section 004545 - Anti-Discrimination Against Israel Act Certification with its Bid Form. The applicable portion of the exhibit must be submitted prior to execution of a contract by the Owner and issuance of Notice to Proceed.

15.0 – MBE/WBE/SDVE INSTRUCTIONS

A. Definitions:

1. **“MBE”** means a Minority Business Enterprise.
2. **“MINORITY”** has the same meaning as set forth in 1 C.S.R. 10-17.010.
3. **“MINORITY BUSINESS ENTERPRISE”** has the same meaning as set forth in section 37.020, RSMo.
4. **“WBE”** means a Women’s Business Enterprise.
5. **“WOMEN’S BUSINESS ENTERPRISE”** has the same meaning as set forth in section 37.020, RSMo.
6. **“SDVE”** means a Service-Disabled Veterans Enterprise.
7. **“SERVICE-DISABLED VETERAN”** has the same meaning as set forth in section 34.074, RSMo.
8. **“SERVICE-DISABLED VETERAN ENTERPRISE”** has the same meaning as “Service-Disabled Veteran Business” set forth in section 34.074, RSMo.

B. MBE/WBE/SDVE General Requirements:

1. For all bids greater than \$100,000, the Bidder shall obtain MBE, WBE and SDVE participation in an amount equal to or greater than the percentage goals set forth in the Invitation for Bid and the Bid Form, unless the Bidder is granted a Good Faith Effort waiver by the Director of the Division, as set forth below. If the Bidder does not meet the MBE, WBE and SDVE goals, or make a good faith effort to do so, the Bidder shall be nonresponsive, and its bid shall be rejected.
2. The Bidder should submit with its bid all the information requested in the MBE/WBE/SDVE Compliance Evaluation Form for every MBE, WBE, or SDVE subcontractor or material supplier the Bidder intends to use for the contract work. The Bidder is required to submit all MBE/WBE/SDVE documentation before the stated time and date set forth in the Invitation for Bid. If the Bidder fails to provide such information by the specified date and time, the Owner shall reject the bid.
3. The Director reserves the right to request additional information from a Bidder to clarify the Bidder’s proposed MBE, WBE, and/or SDVE participation. The Bidder shall submit the clarifying information requested by the Owner within two (2) working days of receiving the request for clarification.
4. Pursuant to section 34.074, RSMo, a Prime Bidder that qualifies as an SDVE shall receive a three-percentage point bonus preference in the contract award evaluation process. The bonus preference will be calculated and applied by reducing the bid amount of the eligible SDVE by three percent of the apparent low responsive Bidder’s bid. Based on this calculation, if the eligible SDVE’s evaluation is less than the apparent low responsive Bidder’s bid, the eligible SDVE’s bid will become the apparent low responsive bid. This reduction is for evaluation purposes only and will have no impact on the actual amount(s) of the bid or the amount(s) of any contract awarded. In order to be eligible for the SDVE preference, the Bidder must complete and submit with its bid the Missouri Service-Disabled Veteran Business Form, and any information required by the form.

C. Computation of MBE/WBE/SDVE Goal Participation:

1. A Bidder who is a MBE, WBE, or SDVE may count 100% of the contract towards the MBE, WBE or SDVE goal, less any amounts awarded to another MBE, WBE or SDVE. (NOTE: a MBE firm that bids as general contractor must obtain WBE and SDVE participation; a WBE firm that bids as

a general contractor must obtain MBE and SDVE participation; and a SDVE firm that bids as general contractor must obtain MBE and WBE participation.) For the remaining contract amount to be counted towards the MBE, WBE or SDVE goal, the Bidder must complete the MBE/WBE/SDVE Compliance Evaluation Form (Section 004337) identifying itself as an MBE, WBE or SDVE.

2. The total dollar value of the work granted to a certified MBE, WBE or SDVE by the Bidder shall be counted towards the applicable goal.
3. Expenditures for materials and supplies obtained from a certified MBE, WBE, or SDVE supplier or manufacturer may be counted towards the MBE, WBE and SDVE goals, if the MBE, WBE, or SDVE assumes the actual and contractual responsibility for the provision of the materials and supplies.
4. The total dollar value of the work granted to a second or subsequent tier subcontractor or a supplier may be counted towards a Bidder's MBE, WBE and SDVE goals, if the MBE, WBE, or SDVE properly assumes the actual and contractual responsibility for the work.
5. The total dollar value of work granted to a certified joint venture equal to the percentage of the ownership and control of the MBE, WBE, or SDVE partner in the joint venture may be counted towards the MBE/WBE/SDVE goals.
6. Only expenditures to a MBE, WBE, or SDVE that performs a commercially useful function in the work may be counted towards the MBE, WBE and SDVE goals. A MBE, WBE, or SDVE performs a commercially useful function when it is responsible for executing a distinct element of the work and carrying out its responsibilities by performing, managing and supervising the work or providing supplies or manufactured materials.

D. Certification of MBE/WBE/SDVE Subcontractors:

1. In order to be counted towards the goals, an MBE or WBE must be certified by the State of Missouri Office of Equal Opportunity and an SDVE must be certified by the State of Missouri, Office of Equal Opportunity or by the Federal U.S. Small Business Administration directory.
2. The Bidder may determine the certification status of a proposed MBE or WBE subcontractor or supplier by referring to the Office of Equal Opportunity (OEO)'s online MBE/WBE directory <https://apps1.mo.gov/MWBCertifiedFirms/>. The Bidder may determine the eligibility of a SDVE subcontractor or supplier by referring to the Office of Equal Opportunity online SDVE directory at <https://o eo.mo.gov/sdve-certification-program/> or the Federal U.S. Small Business Administration directory <https://veterans.certify.sba.gov/#search>.
3. Additional information, clarifications, or other information regarding the MBE/WBE/SDVE listings in the directories may be obtained by contacting the Contract Specialist of record as shown in the Supplementary Conditions (Section 007300).

E. Waiver of MBE/WBE/SDVE Participation:

1. If a Bidder has made a good faith effort to secure the required MBE, WBE and/or SDVE participation and has failed, the Bidder shall submit with its bid the information requested in MBE/WBE/SDVE Good Faith Effort (GFE) Determination form. The Director will determine if the Bidder made a good faith effort to meet the applicable goals. If the Director determines that the Bidder did not make a good faith effort, the bid shall be rejected as being nonresponsive to the bid requirements. Bidders who demonstrate that they have made a good faith effort to include MBE, WBE, and/or SDVE participation will be granted a waiver and will be considered to be responsive to the applicable participation goals, regardless of the percent of actual participation obtained, if the bid is otherwise acceptable.
2. In determining whether a Bidder has made a good faith effort to obtain MBE, WBE and/or SDVE participation, the Director may evaluate the factors set forth in 1 CSR 30-5.010(6)(C) and the following:
 - a. The amount of actual participation obtained;

- b. How and when the Bidder contacted potential MBE, WBE, and SDVE subcontractors and suppliers;
- c. The documentation provided by the Bidder to support its contacts, including whether the Bidder provided the names, addresses, phone numbers, and dates of contact for MBE/WBE/SDVE firms contacted for specific categories of work;
- d. If project information, including plans and specifications, were provided to MBE/WBE/SDVE subcontractors;
- e. Whether the Bidder made any attempts to follow-up with MBE, WBE or SDVE firms prior to bid;
- f. Amount of bids received from any of the subcontractors and/or suppliers that the Bidder contacted;
- g. The Bidder's stated reasons for rejecting any bids;

F. Contractor MBE/WBE/SDVE Obligations

- 1. If awarded a contract, the Bidder will be contractually required to subcontract with or obtain materials from the MBE, WBE, and SDVE firms listed in its bid, in amounts equal to or greater than the dollar amount in the bid, unless the amount is modified in writing by the Owner.
- 2. If the Contractor fails to meet or maintain the participation requirements contained in the Contractor's bid, the Contractor must satisfactorily explain to the Director why it cannot comply with the requirement and why failing meeting the requirement was beyond the Contractor's control. If the Director finds the Contractor's explanation unsatisfactory, the Director may take any appropriate action including, but not limited to:
 - a. Declaring the Contractor ineligible to participate in any contracts with the Division for up to twelve (12) months (suspension); and/or
 - b. Declaring the Contractor be nonresponsive to the Invitation for Bid, or in breach of contract and rejecting the bid or terminating the contract.
- 3. If the Contractor replaces an MBE, WBE, or SDVE during the course of the contract, the Contractor shall replace it with another MBE, WBE, or SDVE or make a good faith effort to do so. All MBE, WBE and SDVE substitutions must be approved by the Director in writing.
- 4. The Contractor shall provide the Owner with regular reports on its progress in meeting its MBE/WBE/SDVE obligations. At a minimum, the Contractor shall report the dollar-value of work completed by each MBE, WBE, or SDVE during the preceding month and the cumulative total of work completed by each MBE, WBE or SDVE to date with each monthly application for payment. The Contractor shall also make a final report, which shall include the total dollar-value of work completed by each MBE, WBE, and SDVE during the entire contract.



State of Missouri Construction Contract

THIS AGREEMENT is made (DATE) by and between:

Contractor Name and Address

hereinafter called the "Contractor," and the **State of Missouri**, hereinafter called the "**Owner**", represented by the Office of Administration, Division of Facilities Management, Design and Construction.

WITNESSETH, that the Contractor and the Owner, for the consideration stated herein agree as follows:

ARTICLE 1. STATEMENT OF WORK

The Contractor shall furnish all labor and materials and perform all work required for furnishing and installing all labor, materials, equipment and transportation and everything necessarily inferred from the general nature and tendency of the plans and specifications for the proper execution of the work for:

Project Name: Renovate 4 Client Bathrooms, Ragland Education Building
Higginsville Habilitation Center
Higginsville, Missouri

Project Number: M2406-01

in strict accordance with the Contract Documents as enumerated in Article 7, all of which are made a part hereof.

ARTICLE 2. TIME OF COMPLETION

The contract performance time is **140 working days** from the transmittal date of this agreement. The contract completion date is **MONTH, DAY, YEAR**. This time includes ten (10) working days for the Contractor to receive, sign and return the contract form along with required bonding and insurance certificates. Failure of the Contractor to provide correct bonding and insurance within the ten (10) working days shall not be grounds for a time extension. Receipt of proper bonding and insurance is a condition precedent to the formation of the contract and if not timely received, may result in forfeiture of the Contractor's bid security. Work may not commence until the Owner issues a written Notice to Proceed and must commence within seven (7) working days thereafter.

ARTICLE 3. LIQUIDATED DAMAGES

Whenever time is mentioned in this contract, time shall be and is of the essence of this contract. The Owner would suffer a loss should the Contractor fail to have the work embraced in this contract fully completed on or before the time above specified. THEREFORE, the parties hereto realize in order to adjust satisfactorily the damages on account of such failure that it might be impossible to compute accurately or estimate the amount of such loss or damages which the Owner would sustain by reason of failure to complete fully said work within the time required by this contract. The Contractor hereby covenants and agrees to pay the Owner, as and for **liquidated damages, the sum of \$1,000** per day for each and every day, Sunday and legal holidays excepted, during which the work remains incomplete and unfinished. Any sum which may be due the Owner for such damages shall be deducted and retained by the Owner from any balance which may be due the Contractor when said work shall have been finished and accepted. But such provisions shall not release the Bond of the Contractor from liability according to its terms. In case of failure to complete, the Owner will be under no obligation to show or prove any actual or specific loss or damage.

ARTICLE 4. CONTRACT SUM

The Owner shall pay the Contractor for the prompt, faithful and efficient performance of the conditions and undertakings of this contract, subject to additions, and deductions as provided herein, in current funds the sum of:

Base Bid: \$

Accepted Alternates, if applicable to the Project and accepted by the Owner.

TOTAL CONTRACT AMOUNT: (\$CONTRACT AMOUNT)

UNIT PRICES: The Owner accepts the following Unit Prices:

For changing specified quantities of work from those indicated by the contract drawings and specifications, upon written instructions of Owner, the following unit prices shall prevail. The unit prices include all labor, overhead and profit, materials, equipment, appliances, bailing, shoring, shoring removal, etc., to cover the finished work of the several kinds of work called for. Only a single unit price shall be given and it shall apply for either MORE or LESS work than that shown on the drawings and called for in the specifications or included in the Base Bid. In the event of more or less units than so indicated or included, change orders may be issued for the increased or decreased amount.

ARTICLE 5. PREVAILING WAGE RATE

MISSOURI PREVAILING WAGE LAW (Sections 290.210 to 290.340, RSMo): The Contractor shall pay not less than the specified hourly rate of wages, as set out in the wage order attached to and made part of the specifications for work under this contract, to all workers performing work under the contract, in accordance with sections 290.210 to 290.340, RSMo. The Contractor shall forfeit a penalty to the Owner of one hundred dollars per day (or portion of a day) for each worker that is paid less than the specified rates for any work done under the contract by the Contractor or by any subcontractor, in accordance with section 290.250, RSMo.

DAVIS-BACON ACT: If this Project is financed in whole or in part from Federal funds (as indicated in the Instructions to Bidders or other bid or contract documents for this Project), then this contract shall be subject to all applicable federal labor statutes, rules and regulations, including provisions of the Davis-Bacon Act, 40 U.S.C. §3141 et seq., and the "Federal Labor Standards Provisions," as further set forth in Section 007333 – Supplementary General Conditions for Federally Funded/Assisted Construction Projects, which is incorporated into the contract by reference. Where the Missouri Prevailing Wage Law and the Davis-Bacon Act require payment of different wages for work performed under this contract, the Contractor and all Subcontractors shall pay the greater of the wages required under either law, on a classification-by-classification basis.

ARTICLE 6. MINORITY/WOMEN/SERVICE DISABLED VETERAN BUSINESS ENTERPRISE PARTICIPATION

The Contractor has been granted a waiver of the 10% MBE and 10% WBE and 3% SDVE participation goals. The Contractor agrees to secure the MBE/WBE/SDVE participation amounts for this project as follows: (OR)

The Contractor has met the MBE/WBE/SDVE participation goals and agrees to secure the MBE/WBE/SDVE participation amounts for this project as follows:

MBE/WBE/SDVE Firm:	Subcontract Amt:\$
MBE/WBE/SDVE Firm:	Subcontract Amt:\$
MBE/WBE/SDVE Firm:	Subcontract Amt:\$

Total \$

MBE/WBE/SDVE assignments identified above shall not be changed without a contract change signed by the Owner.

The Director of the Division of Facilities Management, Design and Construction or his Designee shall be the final authority to resolve disputes and disagreements between the Contractor and the MBE/WBE/SDVE firms listed above when such disputes impact the subcontract amounts shown above.

ARTICLE 7. CONTRACT DOCUMENTS

The following documents are hereby incorporated into this contract by reference (all division/section numbers and titles are as utilized in the Project Manual published by the Owner for this Project):

1. Division 0 – Procurement and Contracting Information, including, but not limited to:
 - a. Invitation for Bid (Section 001116)
 - b. Instructions to Bidders (Section 002113)
 - c. Supplementary Instructions to Bidders (if applicable) (Section 002213)
 - d. The following documents as completed and executed by the Contractor and accepted by the Owner, if applicable:
 - i. Bid Form (Section 004113)
 - ii. MBE, WBE, SDVE Compliance Evaluation Form(s) (Section 004337)
 - iii. MBE, WBE, SDVE Eligibility Determination Form for Joint Ventures (Section 004338)
 - iv. MBE, WBE, SDVE Good Faith Effort (GFE) Determination Form (Section 004339)
 - v. Missouri Service Disabled Veteran Business Form (Section 004340)
 - vi. Affidavit of Work Authorization (Section 004541)
 - e. Performance and Payment Bond, completed and executed by the Contractor and surety (Section 006113)
 - f. General Conditions (Section 007213)
 - g. Supplementary Conditions (Section 007300)
 - h. Supplementary General Conditions for Federally Funded/Assisted Construction Projects (Section 007333), if applicable
 - i. Wage Rate(s) (Section 007346)
2. Division 1 – General Requirements
3. All Drawings identified in the Project Manual
4. All Technical Specifications included in the Project Manual
5. Addenda, if applicable

ARTICLE 8 – CERTIFICATION

By signing this contract, the Contractor hereby re-certifies compliance with all legal requirements set forth in Section 6.0, Bidder's Certifications of the Bid Form.

By signature below, the parties hereby execute this contract document.

APPROVED:

Brian Yansen, Director
Division of Facilities Management,
Design and Construction

Contractor's Authorized Signature

I, Corporate Secretary, certify that I am Secretary of the corporation named above and that (CONTRACTOR NAME), who signed said contract on behalf of the corporation, was then (TITLE) of said corporation and that said contract was duly signed for and in behalf of the corporation by authority of its governing body, and is within the scope of its corporate powers.

Corporate Secretary

SECTION 006113 - PERFORMANCE AND PAYMENT BOND FORM

KNOW ALL MEN BY THESE PRESENTS, THAT we _____

as principal, and _____

_____ as Surety, are held and firmly bound unto the

STATE OF MISSOURI. in the sum of _____ Dollars (\$ _____)

for payment whereof the Principal and Surety bind themselves, their heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

WHEREAS, the Principal has, by means of a written agreement dated the _____

day of _____, 20_____, enter into a contract with the State of Missouri for

(Insert Project Title and Number)

NOW, THEREFORE, if the Principal shall faithfully perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said contract during the original term of said contract and any extensions thereof that may be granted by the State of Missouri, with or without notice to the Surety and during the life of any guaranty required under the contract; and shall also faithfully perform and fulfill all undertakings, covenants, terms, conditions and agreements of any and all duly authorized modifications of said contract that may hereafter be made with or without notice to the Surety; and shall also promptly make payment for materials incorporated, consumed or used in connection with the work set forth in the contract referred to above, and all insurance premiums, both compensation and all other kinds of insurance, on said work, and for all labor performed on such work, whether by subcontractor or otherwise, at not less than the prevailing hourly rate of wages for work of a similar character (exclusive of maintenance work) in the locality in which the work is performed and not less than the prevailing hourly rate of wages for legal holiday and overtime work (exclusive of maintenance work) in the locality in which the work is performed both as determined by the Department of Labor and Industrial Relations or determined by the Court of Appeal, as provided for in said contract and in any and all duly authorized modifications of said contract that may be hereafter made, with or without notice to the Surety, then, this obligation shall be void and of no effect, but it is expressly understood that if the Principal should make default in or should fail to strictly, faithfully and efficiently do, perform and comply with any or more of the covenants, agreements, stipulations, conditions, requirements or undertakings, as specified in or by the terms of said contract, and with the time therein named, then this obligation shall be valid and binding upon each of the parties hereto and this bond shall remain in full force and effect; and the same may be sued on at the instance of any material man, laborer, mechanic, subcontractor, individual, or otherwise to whom such payment is due, in the name of the State of Missouri, to the use of any such person.

AND, IT IS FURTHER specifically provided that any modifications which may hereinafter be made in the terms of the contract or in the work to be done under it or the giving by the Owner of any extension of the time for the performance of the contract or any other forbearance on the part of either the Owner or the Principal to the other, shall not in any way release the Principal and the Surety, or either or any of them, their heirs, executors, administrators and successors, from their liability hereunder, notice to the Surety of any such extension, modifications or forbearance being hereby waived.

IN WITNESS WHEREOF, the above bounden parties have executed the within instrument this _____ day of _____, 20 ____.

AS APPLICABLE:

AN INDIVIDUAL

Name: _____

Signature: _____

A PARTNERSHIP

Name of Partner: _____

Signature of Partner: _____

Name of Partner: _____

Signature of Partner: _____

CORPORATION

Firm Name: _____

Signature of President: _____

SURETY

Surety Name: _____

Attorney-in-Fact: _____

Address of Attorney-in-Fact: _____

Telephone Number of Attorney-in-Fact: _____

Signature Attorney-in-Fact: _____

NOTE: Surety shall attach Power of Attorney



STATE OF MISSOURI
OFFICE OF ADMINISTRATION
DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION
PRODUCT SUBSTITUTION REQUEST

PROJECT NUMBER

PROJECT TITLE AND LOCATION

CHECK APPROPRIATE BOX

- ☐ **SUBSTITUTION PRIOR TO BID OPENING**
(Minimum of (5) working days prior to receipt of Bids as per Article 4 – Instructions to Bidders)
- ☐ **SUBSTITUTION FOLLOWING AWARD**
(Maximum of (20) working days from Notice to Proceed as per Article 3 – General Conditions)

FROM: BIDDER/CONTRACTOR (PRINT COMPANY NAME)

TO: ARCHITECT/ENGINEER (PRINT COMPANY NAME)

Bidder/Contractor hereby requests acceptance of the following product or systems as a substitution in accordance with provisions of Division One of the Bidding Documents:

SPECIFIED PRODUCT OR SYSTEM

SPECIFICATION SECTION NO.

SUPPORTING DATA

- ☐ Product data for proposed substitution is attached (include description of product, standards, performance, and test data)
- ☐ Sample ☐ Sample will be sent, if requested

QUALITY COMPARISON

	SPECIFIED PRODUCT	SUBSTITUTION REQUEST
NAME, BRAND		
CATALOG NO.		
MANUFACTURER		
VENDOR		

PREVIOUS INSTALLATIONS

PROJECT	ARCHITECT/ENGINEER
LOCATION	DATE INSTALLED

SIGNIFICANT VARIATIONS FROM SPECIFIED PRODUCT

REASON FOR SUBSTITUTION

DOES PROPOSED SUBSTITUTION AFFECT OTHER PARTS OF WORK?☐ YES ☐ NO

IF YES, EXPLAIN

SUBSTITUTION REQUIRES DIMENSIONAL REVISION OR REDESIGN OF STRUCTURE OR A/E WORK☐ YES ☐ NO**BIDDER'S/CONTRACTOR'S STATEMENT OF CONFORMANCE OF PROPOSED SUBSTITUTION TO CONTRACT REQUIREMENT:**

We have investigated the proposed substitution. We believe that it is equal or superior in all respects to specified product, except as stated above; that it will provide the same Warranty as specified product; that we have included complete implications of the substitution; that we will pay redesign and other costs caused by the substitution which subsequently become apparent; and that we will pay costs to modify other parts of the Work as may be needed, to make all parts of the Work complete and functioning as a result of the substitution.

BIDDER/CONTRACTOR

DATE

REVIEW AND ACTION☐ Resubmit Substitution Request with the following additional information:

☐ Substitution is accepted.☐ Substitution is accepted with the following comments:

☐ Substitution is not accepted.

ARCHITECT/ENGINEER

DATE



STATE OF MISSOURI
OFFICE OF ADMINISTRATION
DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION
FINAL RECEIPT OF PAYMENT AND RELEASE

PROJECT NUMBER

KNOW ALL MEN BY THESE PRESENT THAT: hereinafter called "Subcontractor" who heretofore entered into an agreement with hereinafter called "Contractor", for the performance of work and/or furnishing of material for the construction of the project entitled

(PROJECT TITLE, PROJECT LOCATION, AND PROJECT NUMBER)

at

(ADDRESS OF PROJECT)

for the State of Missouri (Owner) which said subcontract is by this reference incorporated herein, in consideration of such final payment by Contractor.

DOES HEREBY:

1. ACKNOWLEDGE that they have been **PAID IN FULL** all sums due for work and materials contracted or done by their Subcontractors, Material Vendors, Equipment and Fixture Suppliers, Agents and Employees, or otherwise in the performance of the Work called for by the aforesaid Contract and all modifications or extras or additions thereto, for the construction of said project or otherwise.
2. RELEASE and fully, finally, and forever discharge the Owner from any and all suits, actions, claims, and demands for payment for work performed or materials supplied by Subcontractor in accordance with the requirements of the above referenced Contract.
1. REPRESENT that all of their Employees, Subcontractors, Material Vendors, Equipment and Fixture Suppliers, and everyone else has been **paid in full** all sums due them, or any of them, in connection with performance of said Work, or anything done or omitted by them, or any of them in connection with the construction of said improvements, or otherwise.

DATED this day of , 20 .

NAME OF SUBCONTRACTOR

BY (TYPED OR PRINTED NAME)

SIGNATURE

TITLE

ORIGINAL: FILE/Closeout Documents



STATE OF MISSOURI
OFFICE OF ADMINISTRATION
DIVISION OF FACILITIES MANAGEMENT,
DESIGN AND CONSTRUCTION

MBE/WBE/SDVE PROGRESS REPORT

Remit with **ALL** Progress and Final Payments

(Please check appropriate box) ☐CONSULTANT ☐CONSTRUCTION

PAY APP NO.	PROJECT NUMBER
CHECK IF FINAL ☐ FINAL	DATE

PROJECT TITLE			
PROJECT LOCATION			
FIRM			
ORIGINAL CONTRACT SUM (Same as Line Item 1. on Form A of Application for Payment) \$		TOTAL CONTRACT SUM TO DATE (Same as Line Item 3. on Form A of Application for Payment) \$	
THE TOTAL MBE/WBE/SDVE PARTICIPATION DOLLAR AMOUNT OF THIS PROJECT AS INDICATED IN THE ORIGINAL CONTRACT: \$			
SELECT MBE, WBE, SDVE	ORIGINAL CONTRACT PARTICIPATION AMOUNT	PARTICIPATION AMOUNT PAID-TO-DATE (includes approved contract changes)	CONSULTANT/SUBCONSULTANT OR CONTRACTOR/SUBCONTRACTOR/SUPPLIER COMPANY NAME
☐ MBE ☐ WBE ☐ SDVE	\$	\$	
☐ MBE ☐ WBE ☐ SDVE	\$	\$	
☐ MBE ☐ WBE ☐ SDVE	\$	\$	
☐ MBE ☐ WBE ☐ SDVE	\$	\$	
☐ MBE ☐ WBE ☐ SDVE	\$	\$	
☐ MBE ☐ WBE ☐ SDVE	\$	\$	

Revised 06/2023

INSTRUCTIONS FOR MBE/WBE/SDVE PROGRESS REPORT

CONTRACTOR OR CONSULTANT TO FILL OUT AND REMIT WITH EACH PAY APPLICATION:

The MBE/WBE/SDVE Progress Report for the project is issued with the contract comprising values reported in the consultant's Proposal or on the successful contractor's Section 004337 Compliance Evaluation Forms.

At Initial Pay Application fill in the following:

1. Pay App No. Start with 1.
2. Fill in the Project Number and Date.
3. Enter Project Title, Project Location, and Firm.
4. Fill in the "Original Contract Sum" and "Total Contract Sum To Date" (Reference applicable Line Items on Form A of Application for Payment).
5. Indicate the Total Participation Dollar Amount from the Original Contract.
6. Select MBE, WBE, or SDVE for each Consultant/Subconsultant or Contractor/Subcontractor/Supplier.
7. Enter the "Total Amount of Subcontract", "\$ Amount (Paid-To-Date)", and Company Name.

For all subsequent Pay Applications fill in the following:

1. Pay App No.
2. If Final Pay App, check box.
3. Fill in the Project Number and Date.
4. Enter Project Title, Project Location, and Firm
5. At each Pay App fill in the "Original Contract Sum" and "Total Contract Sum To Date" (reference applicable Line Items on Form A of Application for Payment).
6. Indicate the Total Participation Dollar Amount from the Original Contract.
7. Select MBE, WBE, or SDVE for each Consultant/Subconsultant or Contractor/Subcontractor/Supplier
8. Enter the "Total Amount of Subcontract", "\$ Amount (Paid-To-Date)", and Company Name.



STATE OF MISSOURI
OFFICE OF ADMINISTRATION
DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION
AFFIDAVIT – COMPLIANCE WITH PREVAILING WAGE LAW

PROJECT NUMBER

Before me, the undersigned Notary Public, in and for the County of _____

State of _____ personally came and appeared _____

(NAME)

of the _____

(POSITION)

(NAME OF THE COMPANY)

(a corporation) (a partnership) (a proprietorship) and after being duly sworn did depose and say that all provisions and requirements set out in Chapter 290, Sections 290.210 through and including 290.340, Missouri Revised Statutes, pertaining to the payment of wages to workmen employed on public works project have been fully satisfied and there has been no exception to the full and completed compliance with said provisions and requirements

and with Wage Determination No: _____ issued by the

Department of Labor and Industrial Relations, State of Missouri on the _____ day of _____ 20 ____

in carrying out the contract and working in connection with _____

(NAME OF PROJECT)

Located at _____ in _____ County

(NAME OF THE INSTITUTION)

Missouri, and completed on the _____ day of _____ 20 ____

SIGNATURE

NOTARY INFORMATION

NOTARY PUBLIC EMBOSSEY OR
BLACK INK RUBBER STAMP SEAL

STATE

COUNTY (OR CITY OF ST. LOUIS)

SUBSCRIBED AND SWORN BEFORE ME, THIS

DAY OF

YEAR

USE RUBBER STAMP IN CLEAR AREA BELOW

NOTARY PUBLIC SIGNATURE

MY COMMISSION
EXPIRES

NOTARY PUBLIC NAME (TYPED OR PRINTED)

FILE: Closeout Documents

GENERAL CONDITIONS

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SECTION 007213 - GENERAL CONDITIONS

- A. These General Conditions apply to each section of these specifications. The Contractor is subject to the provisions contained herein.
- B. The General Conditions are intended to define the relationship of the Owner, the Designer and the Contractor thereby establishing certain rules and provisions governing the operation and performance of the work so that the work may be performed in a safe, orderly, expeditious and workmanlike manner.

ARTICLE 1 – GENERAL PROVISIONS

ARTICLE 1.1 - DEFINITIONS

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

1. **"COMMISSIONER"**: The Commissioner of the Office of Administration.
2. **"CONSTRUCTION DOCUMENTS"**: The "Construction Documents" shall consist of the Project Manual, Drawings and Addenda.
3. **"CONSTRUCTION REPRESENTATIVE"**: Whenever the term "Construction Representative" is used, it shall mean the Owner's Representative at the work site.
4. **"CONTRACTOR"**: Party or parties who have entered into a contract with the Owner to furnish work under these specifications and drawings.
5. **"DESIGNER"**: When the term "Designer" is used herein, it shall refer to the Architect, Engineer, or Consultant of Record specified and defined in Paragraph 2.0 of the Supplemental Conditions, or his duly authorized representative. The Designer may be either a consultant or state employee.
6. **"DIRECTOR"**: Whenever the term "Director" is used, it shall mean the Director of the Division of Facilities Management, Design and Construction or his Designee, representing the Office of Administration, State of Missouri. The Director is the agent of the Owner.
7. **"DIVISION"**: Shall mean the Division of Facilities Management, Design and Construction, State of Missouri.
8. **"INCIDENTAL JOB BURDENS"**: Shall mean those expenses relating to the cost of work, incurred either in the home office or on the job-site, which are necessary in the course of doing business but are incidental to the job. Such costs include office supplies and equipment, postage, courier services, telephone expenses including long distance, water and ice and other similar expenses.
9. **"JOINT VENTURE"**: An association of two (2) or more businesses to carry out a single business enterprise for profit for which purpose they combine their property, capital, efforts, skills and knowledge.
10. **"OWNER"**: Whenever the term "Owner" is used, it shall mean the State of Missouri. Acting by and through the Office of Administration, Division of Facilities Management, Design and Construction.
11. **"PROJECT"**: Wherever the term "Project" is used, it shall mean the work required to be completed by the construction contract.
12. **"PROJECT MANUAL"**: The "Project Manual" shall consist of Introductory Information, Invitation for Bid, Instructions to Bidders, Bid Documents, Additional Information, Standard Forms, General Conditions, Supplemental General Conditions, General Requirements and Technical Specifications.
13. **"SUBCONTRACTOR"**: Party or parties who contract under, or for the performance of part or this entire Contract between the Owner and Contractor. The subcontract may or may not be direct with the Contractor.
14. **"WORK"**: All supervision, labor, materials, tools, supplies, equipment, and any incidental operations and/or activities required by or reasonably inferable from the Contract Documents necessary to construct the Project and to produce the results intended by the Contract Documents in a safe, expeditious, orderly, and workmanlike manner so that the project shall be complete and finished in the best manner known to each respective trade.
15. **"WORKING DAYS"**: are all calendar days except Saturdays, Sundays and the following holidays: New Year's Day, Martin Luther King, Jr. Day, Lincoln Day, Washington's Birthday (observed), Truman Day, Memorial Day, Juneteenth, Independence Day, Labor Day, Columbus Day, Veterans Day (observed), Thanksgiving Day, Christmas Day.

ARTICLE 1.2 DRAWINGS AND SPECIFICATIONS

- A. In case of discrepancy between drawings and specifications, specifications shall govern. Should discrepancies in architectural drawings, structural drawings and mechanical drawings occur, architectural drawings shall govern and, in case of conflict between structural and mechanical drawings, structural drawings shall govern.
- B. Specifications are separated into titled divisions for convenience of reference only and to facilitate letting of contracts and subcontracts. The Contractor is responsible for establishing the scope of work for subcontractors, which may cross titled divisions. Neither the Owner nor Designer will establish limits and jurisdiction of subcontracts.
- C. Figured dimensions take precedence over scaled measurements and details over smaller scale general drawings. In the event of conflict between any of the documents contained within the contract, the documents shall take precedence and be controlling in the following sequence: addenda, supplementary general conditions, general conditions, division 1 specifications, technical division specifications, drawings, bid form and instructions to bidders.
- D. Anything shown on drawings and not mentioned in these specifications or vice versa, as well as any incidental work which is obviously necessary to complete the project within the limits established by the drawings and specifications, although not shown on or described therein, shall be performed by the Contractor at no additional cost as a part of his contract.
- E. Upon encountering conditions differing materially from those indicated in the contract documents, the Contractor shall promptly notify the Designer and Construction Representative in writing before such conditions are disturbed. The Designer shall promptly investigate said conditions and report to the Owner, with a recommended course of action. If conditions do materially differ and cause an increase or decrease in contract cost or time required for completion of any portion of the work, a contract change will be initiated as outlined in Article 4 of these General Conditions.
- E. Only work included in the contract documents is authorized, and the Contractor shall do no work other than that described therein or in accordance with appropriately authorized and approved contract changes.

ARTICLE 1.3 - COMPLIANCE WITH LAWS, PERMITS, REGULATIONS AND INSPECTIONS

- A. Since the Owner is the State of Missouri, municipal or political subdivisions, zoning ordinances, construction codes (other than licensing of trades), and other like ordinances are not applicable to construction on Owner's property, and Contractor will not be required to submit drawings and specifications to any municipal or political subdivision, authority, obtain construction permits or any other licenses (other than licensing of trades) or permits from or submit to inspections by any municipality or political subdivision relating to the construction for this project. All permits or licenses required by municipality or political subdivision for operation on property not belonging to Owner shall be obtained by and paid for by Contractor. Each Contractor shall comply with all applicable laws, ordinances, rules and regulations that pertain to the work of this contract.
- B. Contractors, subcontractors and their employees engaged in the businesses of electrical, mechanical, plumbing, carpentry, sprinkler system work, and other construction related trades shall be licensed to perform such work by the municipal or political subdivision where the project is located, if such licensure is required by local code. Local codes shall dictate the level (master, journeyman, and apprentice) and the number, type and ratio of licensed tradesmen required for this project within the jurisdiction of such municipal or political subdivision.
- C. Equipment and controls manufacturers and their authorized service and installation technicians that do not maintain an office within the jurisdiction of the municipal or political subdivision but are a listed or specified contractor or subcontractor on this project are exempt from Paragraph 1.3 B above.
- D. The Contractor shall post a copy of the wage determination issued for the project and included as a part of the contract documents, in a prominent and easily accessible location at the site of construction for the duration of the project.
- E. Any contractor or subcontractor to such contractor at any tier signing a contract to work on this project shall provide a ten-hour Occupational Safety and Health Administration (OSHA) construction safety program for their on-site employees which includes a course in construction safety and health approved by OSHA or a similar program approved by the Department of Labor and Industrial Relations which is at least as stringent as an approved OSHA program. The contractor shall forfeit as a penalty to the public body on whose

behalf the contract is made or awarded, two thousand five hundred dollars plus one hundred dollars for each employee employed by the contractor or subcontractor, for each calendar day, or portion thereof, such employee is employed without the required training.

ARTICLE 1.4 - NONDISCRIMINATION IN EMPLOYMENT

A. The Contractor and his subcontractors will not discriminate against individuals based on race, color, religion, national origin, sex, disability, or age, but may use restrictions which relate to bona fide occupational qualifications. Specifically, the Contractor and his subcontractors shall not discriminate:

1. Against recipients of service on the basis of race, color, religion, national origin, sex, disability or age.
2. Against any employee or applicant, for employment on the basis of race, color, religion, national origin, sex or otherwise qualified disability status.
3. Against any applicant for employment or employee on the basis of age, where such applicant or employee is between ages 40 and 70 and where such Contractor employs at least 20 persons.
4. Against any applicant for employment or employee on the basis of that person's status as a disabled or Vietnam-era veteran.

The Contractor and his Subcontractors will ensure applicants for employment and employees are treated equally without regard to race, color, religion, national origin, sex, disability, or age. Such action shall include, but not be limited to, the following: employment, upgrading, demotion and transfer; recruitment or recruitment advertising; and selection for training, including apprenticeship. The Contractor and his Subcontractors will give written notice of their commitments under this clause to any labor union with which they have bargaining or other agreements under this clause to any labor union with which they have bargaining or other agreements.

B. In the event of the Contractor's or his subcontractor's noncompliance with any provisions of this Article of the Contract, the Owner may cancel this contract in whole or in part or require the Contractor to terminate his contract with the subcontractor.

ARTICLE 1.5 - ANTI-KICKBACK

No employee of the division, shall have or acquire any pecuniary interest, whether direct or indirect, in this contract or in any part hereof. No officer, employee, designer, attorney, or administrator of or for the Owner who is authorized in such capacity and on behalf of the Owner to exercise any legislative, executive, supervisory or other similar functions in connection with the construction of the project, shall have or acquire any pecuniary interest, whether direct or indirect, in this contract, any material supply contract, subcontract, insurance contract, or any other contract pertaining to the project.

ARTICLE 1.6 - PATENTS AND ROYALTIES

A. The Contractor shall hold and save the Owner and its officers, agents, servants, and employees harmless from liabilities of any nature or kind, including cost and expenses, for, or on account of, any patented or unpatented invention, process, article or appliance manufactured or used in the performance of this contract, including its use by the Owner, unless otherwise specifically stipulated in the contract documents.

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

ARTICLE 1.7 - PREFERENCE FOR AMERICAN AND MISSOURI PRODUCTS AND SERVICES

- A. By virtue of statutory authority a preference will be given to Missouri labor and to products of mines, forests and quarries of the state of Missouri when they are found in marketable quantities in the state, and all such materials shall be of the best quality and suitable character that can be obtained at reasonable market prices, all as provided for in Section 8.280, Missouri Revised Statutes and Cumulative Supplements.
- B. Furthermore, pursuant to Section 34.076 Missouri Revised Statutes and Cumulative Supplements, a preference shall be given to those persons doing business as Missouri firms, corporations, or individuals, or which maintain Missouri offices or places of business, when the quality of performance promised is equal or better and the price quoted is the same or less. In addition, in order for a non-domiciliary bidder to be successful, his bid must be that same percentage lower than a domiciliary Missouri bidder's bid, as would be required for a Missouri bidder to successfully bid in the non-domiciliary state.
- C. In accordance with the Missouri Domestic Products Procurement Act Section 34.350 RSMo and Cumulative Supplements any manufactured goods or commodities used or supplied in the performance of this contract or any subcontract thereto shall be manufactured, assembled or produced in the United States, unless the specified products are not manufactured, assembled or produced in the United States in sufficient quantities to meet the agency's requirements or cannot be manufactured, assembled or produced in the United States within the necessary time in sufficient quantities to meet the contract requirements, or if obtaining the specified products manufactured, assembled or produced in the United States would increase the cost of this contract for purchase of the product by more than ten percent.

ARTICLE 1.8 - COMMUNICATIONS

- A. All notices, requests, instructions, approvals, and claims must be in writing and shall be delivered to the Designer and copied to the Construction Representative for the project except as required by Article 1.12 Disputes and Disagreements, or as otherwise specified by the Owner in writing as stated in Section 012600. Any such notice shall be deemed to have been given as of the time of actual receipt.
- B. The Contractor shall attend on-site progress and coordination meetings, as scheduled by the Construction Representative, no less than once a month.

- C. The Contractor shall ensure that major subcontractors and suppliers shall attend monthly progress meetings as necessary to coordinate the work, and as specifically requested by the Construction Representative.

ARTICLE 1.9 - SEPARATE CONTRACTS AND COOPERATION

- A. The Owner reserves the right to let other contracts in connection with this work. The Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work and shall properly connect and coordinate his work with theirs.
- B. The Contractor shall consult the drawings for all other contractors in connection with this work. Any work conflicting with the above shall be brought to the attention of the Owner's Representative before the work is performed. If the Contractor fails to do this, and constructs any work which interferes with the work of another contractor, the Contractor shall remove any part so conflicting and rebuild same, as directed by the Owner's Representative at no additional cost to the Owner.
- C. Each contractor shall be required to coordinate his work with other contractors so as to afford others reasonable opportunity for execution of their work. No contractor shall delay any other contractor by neglecting to perform contract work at the proper time. If any contractor causes delay to another, they shall be liable directly to that contractor for such delay in addition to any liquidated damages which might be due the Owner.
- D. Should the Contractor or project associated subcontractors refuse to cooperate with the instructions and reasonable requests of other Contractors or other subcontractors in the overall coordinating of the work, the Owner may take such appropriate action and issue directions, as required, to avoid unnecessary and unwarranted delays.
- E. Each Contractor shall be responsible for damage done to Owner's or other Contractor's property by him/her or workers in his employ through their fault or negligence.
- F. Should a Contractor sustain any damage through any act or omission of any other Contractor having a contract with the Owner, the Contractor so damaged shall have no claim or cause of action against the Owner for such damage, but shall have a claim or cause of action against the other Contractor to recover any and all damages sustained by reason of the acts or omissions of such Contractor. The phrase "acts or omissions" as used in this section shall be defined to include, but

not be limited to, any unreasonable delay on the part of any such contractors.

ARTICLE 1.10 - ASSIGNMENT OF CONTRACT

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

ARTICLE 1.11 - INDEMNIFICATION

- A. Contractor agrees to indemnify and save harmless Owner and its respective commissioners, officers, officials, agents, consultants and employees and Designer, their agents, servants and employees, from and against any and all liability for damage arising from injuries to persons or damage to property occasioned by any acts or omissions of Contractor, any subcontractors, agents, servants or employees, including any and all expense, legal or otherwise, which may be incurred by Owner or Designer, its agents, servants or employees, in defense of any claim, action or suit.
- B. The obligations of the Contractor under this paragraph shall not extend to the liability of the Designer, his agents or employees, arising out of (1) the preparation or approval of maps, drawings, opinions, reports, surveys, contract changes, design or specifications, or (2) giving of or the failure to give directions or instructions by the Designer, his agents or employees as required by this contract documents provided such giving or failure to give is the primary cause of the injury or damage.

ARTICLE 1.12 - DISPUTES AND DISAGREEMENTS

It is hereby expressly agreed and understood that in case any controversy or difference of opinion arises during construction, best efforts will be given to resolution at the field level. Should those efforts be unsuccessful, the Contractor has the right to appeal in writing, the decision of the Director's Designee to the Director at Room 730 Truman Building, P.O. Box 809, Jefferson City, Missouri 65102. The decision of the Director shall be final and binding on all parties.

ARTICLE 2 -- OWNER/DESIGNER RESPONSIBILITIES

- A. The Owner shall give all orders and directions contemplated under this contract relative to the execution of the work. During progress of work the Owner will be represented at the project site by the Construction Representative and/or Designer, whose responsibilities are to see that this contract is properly fulfilled.
- B. The Owner shall at all times have access to the work whenever it is in preparation or progress. The Contractors shall provide proper facilities for such access and for inspection and supervision.
- C. All materials and workmanship used in the work shall be subject to the inspection of the Designer and Construction Representative, and any work which is deemed defective shall be removed, rebuilt or made good immediately upon notice. The cost of such correction shall be borne by the Contractor. Contractor shall not be entitled to an extension of the contract completion date in order to remedy defective work. All rejected materials shall be immediately removed from the site of the work.
- D. If the Contractor fails to proceed at once with the correction of rejected defective materials or workmanship, the Owner may, by separate contract or otherwise, have the defects remedied or rejected. Materials removed from the site and charge the cost of the same against any monies which may be due the Contractor, without prejudice to any other rights or remedies of the Owner.
- E. Failure or neglect on the part of Owner to observe faulty work, or work done which is not in accordance with the drawings and specifications shall not relieve the Contractor from responsibility for correcting such work without additional compensation.
- F. The Owner shall have the right to direct the Contractor to uncover any completed work.
 - 1. If the Contractor fails to adequately notify the Construction Representative and/or Designer of an inspection as required by the Contract Documents, the Contractor shall, upon written request, uncover the work. The Contractor shall bear all costs associated with uncovering and again covering the work exposed.
 - 2. If the Contractor is directed to uncover work, which was not otherwise required by the Contract Documents to be inspected, and the work is found to be defective in any respect, no compensation shall be allowed for this work. If, however, such work is found to meet

the requirements of this contract, the actual cost of labor and material necessarily involved in the examination and replacement plus 10% shall be allowed the Contractor.

- G. The Designer shall give all orders and directions contemplated under this contract relative to the scope of the work and shall give the initial interpretation of the contract documents.
- H. The Owner may file a written notice to the Contractor to dismiss immediately any subcontractors, project managers, superintendents, foremen, workers, watchmen or other employees whom the Owner may deem incompetent, careless or a hindrance to proper or timely execution of the work. The Contractor shall comply with such notice as promptly as practicable without detriment to the work or its progress.
- I. If in the Owner's judgment it becomes necessary at any time to accelerate work, when ordered by the Owner in writing, the Contractor shall redirect resources to such work items and execute such portions of the work as may be required to complete the work within the current approved contract schedule.

ARTICLE 3 -- CONTRACTOR RESPONSIBILITIES

The Contractor shall register and utilize the Owner's eBuilder digital project management system for submission of documents described in the following sections. This includes but is not limited to submittals as required by designer, payment applications, Request for Information (RFI), construction change orders, Request for Proposals (RFP), Designer Supplemental Instructions (DSI), etc.

ARTICLE 3.1 -- ACCEPTABLE SUBSTITUTIONS

- A. The Contractor may request use of any article, device, product, material, fixture, form or type of construction which in the judgment of the Owner and Designer is equal in all respects to that named. Standard products of manufacturers other than those specified will be accepted when, prior to the ordering or use thereof, it is proven to the satisfaction of the Owner and Designer that they are equal in design, strength, durability, usefulness and convenience for the purpose intended.
- B. Any changes required in the details and dimensions indicated on the drawings for the substitution of products other than those specified shall be properly made at the expense of the Contractor requesting the substitution or change.
- C. The Contractor shall submit a request for such substitutions in writing to the Owner and Designer within twenty (20) working days after the date of

the "Notice to Proceed." Thereafter no consideration will be given to alternate forms of accomplishing the work. This Article does not preclude the Owner from exercising the provisions of Article 4 hereof.

- D. Any request for substitution by the Contractor shall be submitted in accordance with SECTION 002113 - INSTRUCTIONS TO BIDDERS.
- E. When a material has been approved, no change in brand or make will be permitted unless:
 - 1. Written verification is received from the manufacturer stating they cannot make delivery on the date previously agreed, or
 - 2. Material delivered fails to comply with contract requirements.

ARTICLE 3.2 -- SUBMITTALS

- A. The Contractor's submittals must be submitted with such promptness as to allow for review and approval so as not to cause delay in the work. The Contractor shall coordinate preparation and processing of submittals with performance of construction activities.

Coordinate each submittal with fabrication, = purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

Submit four (4) copies to the Designer and additional copies as required for the subcontractors and material suppliers. Also provide copies to meet the requirements for maintenance manuals.

- B. All subcontractors' shop drawings and schedules shall be submitted by the Contractor and shall bear evidence that Contractor has received, reviewed, and approved them. Any shop drawings and schedules submitted without this evidence will be returned to the Contractor for resubmission.
- C. The Contractor shall include with the shop drawing, a letter indicating any and all deviations from the drawings and/or specifications. Failure to notify the Designer of such deviations will be grounds for subsequent rejection of the related work or materials. If, in the opinion of the Designer, the deviations are not acceptable, the Contractor will be required to furnish the item as specified and indicated on the drawings.
- D. The Designer shall check shop drawings and schedules with reasonable promptness and approve them only if they conform to the design concept of the project and comply with the information given in the contract documents. The approval shall not relieve the Contractor from the responsibility to comply with the drawings and specifications, unless the Contractor has called the Designer's attention to the deviation, in writing, at the time of

submission and the Designer has knowingly approved thereof. An approval of any such modification will be given only under the following conditions:

1. It is in the best interest of the Owner
 2. It does not increase the contract sum and/or completion time
 3. It does not deviate from the design intent
 4. It is without prejudice to any and all rights under the surety bond.
- E. No extension of time will be granted because of the Contractor's failure to submit shop drawings and schedules in ample time to allow for review, possible resubmission, and approval. Fabrication of work shall not commence until the Contractor has received approval. The Contractor shall furnish prints of approved shop drawings and schedules to all subcontractors whose work is in any way related to the work under this contract. Only prints bearing this approval will be allowed on the site of construction
- F. The Contractor shall maintain a complete file on-site of approved shop drawings available for use by the Construction Representative.

ARTICLE 3.3 – AS-BUILT DRAWINGS

- A. The Contractor shall update a complete set of the construction drawings, shop drawings and schedules of all work monthly by marking changes, and at the completion of their work (prior to submission of request for final payment) note all changes and turn the set over to the Construction Representative. The updates shall show all addenda, all field changes that were made to adapt to field conditions, changes resulting from contract changes or supplemental instructions, and all locations of structures, buried installations of piping, conduit, and utility services. All buried and concealed items both inside and outside shall be accurately located as to depth and referenced to permanent features such as interior or exterior wall faces and dimensions shall be given in a neat and legible manner in a contrasting colored pencil or ink. If approved by the Designer, an electronic file format may be provided.

ARTICLE 3.4 – GUARANTY AND WARRANTIES

- A. General Guaranty
1. Neither the final certificate of payment nor any provision in the contract documents nor partial use or occupancy of the premises by the Owner shall constitute an acceptance of work not done in accordance with contract requirements.

2. The Contractor or surety shall remedy any defects in the work and pay for any damage to property resulting there from which shall appear within a period of one (1) year from the date of substantial completion unless a longer period is otherwise specified or a differing guaranty period has been established in the substantial completion certificate. The Owner will give notice of observed defects with reasonable promptness.
3. In case of default on the part of the Contractor in fulfilling this part of this contract, the Owner may correct the work or repair the damage and the cost and expense incurred in such event shall be paid by or recoverable from the Contractor or surety.
4. The work will be free from defects not inherent in the quality required or permitted, and that the Work will conform to the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Contractor's guaranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage. If required by the Owner, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment

B. Extended Warranty

Manufacturer's certificates of warranty shall be obtained for all major equipment. Warranty shall be obtained for at least one year. Where a longer period is offered at no additional cost or called for in the specific equipment specifications, the longer period shall govern.

ARTICLE 3.5 -- OPERATION AND MAINTENANCE MANUALS

- A. Immediately after equipment submittals are approved and no later than ten (10) working days prior to the substantial completion inspection, the Contractor shall provide to the Designer three (3) copies of operating instructions and service manuals, containing the following:
1. Start-up and Shut-down Procedures: Provide a step-by-step write up of all major equipment. When manufacturer's printed start-up, trouble shooting and shut-down procedures are available; they may be incorporated into the operating manual for reference.

2. Operating Instructions: Written operating instructions shall be included for the efficient and safe operation of all equipment.
 3. Equipment List: List of all major equipment as installed shall be prepared to include model number, capacities, flow rate, name plate data, shop drawings and air and water balance reports.
 4. Service Instructions: Provide the following information for all pieces of equipment.
 - a. Recommended spare parts including catalog number and name of local supplier or factory representative.
 - b. Belt sizes, types, and lengths.
 - c. Wiring diagrams.
 5. Manufacturer's Certificate of Warranty as described in Article 3.4.
 6. Prior to the final payment, furnish to the Designer three (4) copies of parts catalogs for each piece of equipment furnished by him/her on the project with the components identified by number for replacement ordering.
- B. Submission of operating instructions shall be done in the following manner.
1. Manuals shall be in quadruplicate, and all materials shall be bound into volumes of standard 8½" x 11" hard binders. Large drawings too bulky to be folded into 8½" x 11" shall be separately bound or folded and in envelopes, cross referenced and indexed with the manuals.
 2. The manuals shall identify project name, project number, and include the name and address of the Contractor, subcontractors and manufacturers who were involved with the activity described in that particular manual.
 3. Internally subdivide the binder contents with permanent page dividers, logically organized with tab titles clearly printed under reinforced laminated plastic tabs.
 4. Contents: Prepare a Table of Contents for each volume, with each product or system description identified.

ARTICLE 3.6 – OTHER CONTRACTOR RESPONSIBILITIES

- A. The Contractor shall keep on site, during progress of the work, a competent superintendent satisfactory to the Construction Representative. The superintendent shall represent the Contractor and all agreements made by the superintendent shall be binding. The superintendent shall

carefully study and compare all drawings, specifications and other instructions and shall promptly notify the Construction Representative and Designer, in writing, any error, inconsistency or omission which may be discovered. The superintendent shall coordinate all work on the project. Any change of the superintendent shall be approved by the Construction Representative.

- B. Contractor shall, at all times, enforce strict discipline and good order among his employees, and shall not employ on the work any unfit person or anyone not skilled in the work assigned to him/her.
- C. The Contractor shall supply sufficient labor, material, plant and equipment and pay when due any laborer, subcontractor or supplier for supplies furnished and otherwise prosecute the work with diligence to prevent work stoppage and ensure completion thereof within the time specified.
- D. The Contractor and each of his subcontractors shall submit to the Construction Representative, through the Designer such schedules of quantities and costs, progress schedules, payrolls, reports, estimates, records and other data as the Owner may request concerning work performed or to be performed under this contract.
- E. The Contractor, subcontractors, and material suppliers shall upon written request, give the Owner access to all time cards, material invoices, payrolls, estimates, profit and loss statements, and all other direct or indirect costs related to this work.
- F. The Contractor shall be responsible for laying out all contract work such as layout of architectural, structural, mechanical and electrical work, which shall be coordinated with layouts of subcontractors for general construction work. The Contractor is also responsible for unloading, uncrating and handling of all materials and equipment to be erected or placed by him/her, whether furnished by Contractor or others. No extra charges or compensation will be allowed as a result of failure to verify dimensions before ordering materials or fabricating items.
- G. The Contractor must notify the Construction Representative at least one working day before placing concrete or burying underground utilities, pipelines, etc.
- H. Contractors shall prearrange time with the Construction Representative for the interruption of any facility operation. Unless otherwise specified in these documents, all connections, alterations or relocations as well as all other portions of the work will be performed during normal working hours.

- I. The Contractor shall coordinate all work so there will not be prolonged interruptions of existing equipment operation. Any existing plumbing, heating, ventilating, air conditioning or electrical disconnections necessary for the project, which affect portions of this construction or building or any other building must be scheduled with the Construction Representative to minimize or avoid any disruption of facility operations. In no case, unless previously approved in writing by the Construction Representative, shall utilities be left disconnected at the end of a work day or over a weekend. Any interruption of utilities either intentionally or accidentally shall not relieve the Contractor responsible for the interruption from the responsibility to repair and restore the utility to normal service. Repairs and restoration shall be made before the workers responsible for the repair and restoration leave the job.
- J. Contractors shall limit operations and storage of materials to the area within the project, except as necessary to connect to existing utilities, and shall not encroach on neighboring property. The Contractor shall be responsible for repair of their damage to property on or off the project site occurring during construction of project. All such repairs shall be made to the satisfaction of the property owner.
- K. Unless otherwise permitted, all materials shall be new and both workmanship and materials shall be of the best quality.
- L. Unless otherwise provided and stipulated within these specifications, the Contractor shall furnish, construct, and/or install and pay for materials, devices, mechanisms, equipment, all necessary personnel, utilities including, but not limited to water, heat, light and electric power, transportation services, applicable taxes of every nature, and all other facilities necessary for the proper execution and completion of the work.
- M. Contractor shall carefully examine the plans and drawings and shall be responsible for the proper fitting of his material, equipment and apparatus into the building.
- N. The Contractor or subcontractors shall not overload, or permit others to overload, any part of any structure during the performance of this contract.
- O. All temporary shoring, bracing, etc., required for the removal of existing work and/or for the installation of new work shall be included in this contract. The Contractor shall make good, at no cost to the Owner, any damage caused by improper support or failure of shoring in any respect. Each Contractor shall be responsible for shoring required to protect his work or adjacent property and improvements of Owner and shall be responsible for shoring or for giving written notice to adjacent property owners. Shoring shall be removed only after completion of permanent supports.
- P. The Contractor shall provide at the proper time such material as is required for support of the work. If openings are required, whether shown on drawings or not, the Contractor shall see that they are properly constructed.
- Q. During the performance of work the Contractor shall be responsible for providing and maintaining warning signs, lights, signal devices, barricades, guard rails, fences and other devices appropriately located on site which will give proper and understandable warning to all persons of danger of entry onto land, structure or equipment.
- R. The Contractor shall be responsible for protection, including weather protection, and proper maintenance of all equipment and materials.
- S. The Contractor shall be responsible for care of the finished work and shall protect same from damage or defacement until substantial completion by the Owner. If the work is damaged by any cause, the Contractor shall immediately begin to make repairs in accordance with the drawings and specifications. Contractor shall be liable for all damage or loss unless attributable to the acts or omissions of the Owner or Designer. Any claim for reimbursement shall be submitted in accordance with Article 4. After substantial completion the Contractor will only be responsible for damage resulting from acts or omissions of the Contractor or subcontractors through final warranty.
- T. In the event the Contractor encounters an unforeseen hazardous material, the Contractor shall immediately stop work in the area affected and report the condition to the Owner and Designer in writing. The Contractor shall not be required, pursuant to Article 4, to perform, any work relating to hazardous materials.
- U. In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 4.
- V. Before commencing work, Contractors shall confer with the Construction Representative and facility representative and review any facility rules and regulations which may affect the conduct of the work.

- W. Project signs will only be erected on major projects and only as described in the specifications. If no sign is specified, none shall be erected.

ARTICLE 3.7 -- SUBCONTRACTS

- A. Subcontractor assignments as identified in the bid form shall not be changed without written approval of the Owner. The Owner will not approve changes of a listed subcontractor unless the Contractor documents, to the satisfaction of the Owner that the subcontractor cannot or will not perform the work as specified.
- B. The Contractor is fully responsible to the Owner for the acts and omissions of all subcontractors and of persons either directly or indirectly employed by them.
- C. Every subcontractor shall be bound by the applicable terms and provisions of these contract documents, but no contractual relationship shall exist between any subcontractor and the Owner unless the right of the Contractor to proceed with the work is suspended or this contract is terminated as herein provided, and the Owner in writing elects to assume the subcontract.
- D. The Contractor shall upon receipt of "Notice to Proceed" and prior to submission of the first payment request, notify the Designer and Construction Representative in writing of the names of any subcontractors to be used in addition to those identified in the bid form and all major material suppliers proposed for all parts of the work.

ARTICLE 4 -- CHANGES IN THE WORK

4.1 CHANGES IN THE WORK

- A. The Construction Representative, without giving notice to the surety and without invalidating this contract, may order extra work or make changes by altering, adding to or deducting from the work, this contract sum being adjusted accordingly. All such work shall be executed under the conditions of the original contract. A claim for extension of time caused by any change must be adjusted at the time of ordering such change. No future request for time will be considered.
- B. Each Contract Change shall include all costs required to perform the work including all labor, material, equipment, overheads and profit, delay, disruptions, or other miscellaneous expenses. No subsequent requests for additional compensation including claims for delay, disruption, or reduced efficiency as a result of each change will be considered. Values from the Schedule of Values will not be binding as a basis for additions to or deductions from the contract price.

- C. The amount of any adjustment in this contract price for authorized changes shall be agreed upon before such changes become effective and shall be determined, through submission of a request for proposal, as follows:

1. By an acceptable fixed price proposal from the Contractor. Breakdowns shall include all takeoff sheets of each Contractor and subcontractor. Breakdown shall include a listing of each item of material with unit prices and number of hours of labor for each task. Labor costs per hour shall be included with labor burden identified, which shall be not less than the prevailing wage rate, etc. Overhead and profit shall be shown separately for each subcontractor and the Contractor.
2. By a cost-plus-fixed-fee (time and material) basis with maximum price, total cost not to exceed said maximum. Breakdown shall include a listing of each item of material with unit prices and number of hours of labor for each task. Labor costs per hour shall be included with labor burden identified, which shall be not less than the prevailing wage rate, etc. Overhead and profit shall be shown separately for each subcontractor and the Contractor.
3. By unit prices contained in Contractor's original bid form and incorporated in the construction contract.

- D. Overhead and Profit on Contract Changes shall be applied as follows:

1. The overhead and profit charge by the Contractor and all subcontractors shall be considered to include, but is not limited to: incidental job burdens, small truck (under 1 ton) expense, mileage, small hand tools, warranty costs, company benefits and general office overhead. Project supervision including field supervision and job site office expense shall be considered a part of overhead and profit unless a compensable time extension is granted.
2. The percentages for overhead and profit charged on Contract Changes shall be subject to the following limits: (a) the percentage mark-up for the Contractor shall be limited to the Contractor's fee; (b) fifteen percent (15%) maximum for Work directly performed by employees of a subcontractor, or sub-subcontractor; (c) five percent (5%) maximum for the Work performed or passed through to the Owner by the Contractor; (d) five percent (5%) maximum subcontractor's mark-up for

Work performed by a sub-subcontractor and passed through to the Owner by the subcontractor and Contractor; and (e) in no case shall the total overhead and profit paid by the Owner on any Contract Changes exceed twenty-five percent (25%) of the cost of materials, labor and equipment (exclusive of Contractor or any Subcontractor overhead and profit) necessary to put the contract change work in place.

3. The Contractor will be allowed to add the cost of Contractor's payment and performance bonding, builder's risk insurance, and general liability insurance to their cost of work. The above listed bonding and insurance cost shall not exceed two percent (2%) and shall be allowed on the total cost of the added work, including overhead and profit.
 4. On proposals covering both increases and decreases in the amount of this contract, the application of overhead and profit shall be on the net change in the cost of the work.
 5. The percentage(s) for overhead and profit to be credited to the Owner on Contract Changes that are solely decreases in the quantity of work or materials shall be the same as those for additive Contract Changes provided above.
- E. No claim for an addition to this contract sum shall be valid unless authorized as aforesaid in writing by the Owner. In the event that none of the foregoing methods are agreed upon, the Owner may order the Contractor to perform work on a time and material basis. The cost of such work shall be determined by the Contractor's actual labor and material cost to perform the work plus overhead and profit as outlined herein. The Designer and Construction Representative shall approve the Contractor's daily time and material invoices for the work involved.
- F. If the Contractor claims that any instructions involve extra cost under this contract, the Contractor shall give the Owner's Representative written notice thereof within a reasonable time after the receipt of such instructions, and in any event before proceeding to execute the work. No such claim shall be valid unless so made and authorized by the Owner, in writing.
- G. In an emergency affecting the safety of life or of the structure or of adjoining property, the Contractor, without special instruction or authorization from the Construction Representative, is hereby permitted to act at their discretion to prevent such threatened loss or injury. The Contractor shall submit a claim for compensation for such emergency work in writing to the Owner's Representative.

ARTICLE 4.2 – CHANGES IN COMPLETION TIME

- A. Extension of the number of work days stipulated in the Contract for completion of the work with compensation may be made when:
1. The contractor documents that proposed Changes in the work, as provided in Article 4.1, extends construction activities critical to contract completion date, OR
 2. The Owner suspends all work for convenience of the Owner as provided in Article 7.3, OR
 3. An Owner caused delay extends construction activities critical to contract completion (except as provided elsewhere in these General Conditions). The Contractor is to review the work activities yet to begin and evaluate the possibility of rescheduling the work to minimize the overall project delay.
- B. Extension of the number of work days stipulated in the Contract for completion of the work without compensation may be made when:
1. Weather-related delays occur, subject to provisions for the inclusion of a specified number of "bad weather" days when provided for in Section 012100-Allowances, OR
 2. Labor strikes or acts of God occur, OR
 3. The work of the Contractor is delayed on account of conditions which were beyond the control of the Contractor, subcontractors or suppliers, and were not the result of their fault or negligence.
- C. No time extension or compensation will be provided for delays caused by or within the control of the Contractor, subcontractors or suppliers and for concurrent delays caused by the Owner.
- D. The Contractor shall notify the Owner promptly of any occurrence or conditions which in the Contractor's opinion results in a need for an extension of time. The notice shall be in writing and shall include all necessary supporting materials with details of any resultant costs and be submitted in time to permit full investigation and evaluation of the Contractor's claim. The Owner shall promptly acknowledge the Contractor's notice and, after recommendation from the Owner's Representative and/or Designer, shall provide a decision to the Contractor. Failure on the part of the Contractor to provide such notice and to detail the costs shall constitute a waiver by the Contractor of any claim. Requests for extensions of time shall be for working days only.

ARTICLE 5 - CONSTRUCTION AND COMPLETION

ARTICLE 5.1 – CONSTRUCTION COMMENCEMENT

A. Upon receipt of the "Intent to Award" letter, the Contractor must submit the following properly executed instruments to the Owner:

1. Contract;
2. Performance/payment bond as described in Article 6.1;
3. Certificates of Insurance, or the actual policies themselves, showing that the Contractor has obtained the insurance coverage required by Article 6.2.

Above referenced items must be received by the Owner within ten (10) working days after the effective date of the contract. If not received, the Owner may treat the failure to timely submit them as a refusal by the Contractor to accept a contract for this work and may retain as liquidated damages the Contractor's bid bond, cashier's check or certified check as provided in the Instructions to Bidders. Upon receipt the Owner will issue a "Notice to Proceed" with the work to the Contractor.

B. Within the time frame noted in Section 013200 - Schedules, following receipt of the "Notice to Proceed", the Contractor shall submit to the Owner a progress schedule and schedule of values, showing activities through the end of the contract period. Should the Contractor not receive written notification from the Owner of the disapproval of the schedule of values within fifteen (15) working days, the Contractor may consider it approved for purpose of determining when the first monthly Application and Certification for Payment may be submitted.

C. The Contractor may commence work upon receipt of the Division of Facilities Management, Design and Construction's "Notice to Proceed" letter. Contractor shall prosecute the work with faithfulness and energy, and shall complete the entire work on or before the completion time stated in the contract documents or pay to the Owner the damages resulting from the failure to timely complete the work as set out within Article 5.4.

ARTICLE 5.2 -- PROJECT CONSTRUCTION

A. Each Contractor shall submit for the Owner's approval, in reproducible form, a progress schedule showing the rate of progress and the order of the work proposed to carry on various phases of the project. The schedule shall be in conformance

with the requirements outlined in Section 013200 – Schedules.

B. Contractor shall employ and supply a sufficient force of workers, material, and equipment and shall pay when due, any worker, subcontractor or supplier and otherwise prosecute the work with such diligence so as to maintain the rate of progress indicated on the progress schedule, prevent work stoppage, and insure completion of the project within the time specified.

ARTICLE 5.3 -- PROJECT COMPLETION

A. Substantial Completion. A Project is substantially complete when construction is essentially complete and work items remaining to be completed can be done without interfering with the Owner's ability to use the Project for its intended purpose.

1. Once the Contractor has reached what they believe is Substantial Completion, the Contractor shall notify the Designer and the Construction Representative of the following:
 - a. That work is essentially complete with the exception of certain listed work items. The list shall be referred to as the "Contractor's Punch."
 - b. That all Operation and Maintenance Manuals have been assembled and submitted in accordance with Article 3.5A.
 - c. That the Work is ready for inspection by the Designer and Construction Representative. The Owner shall be entitled to a minimum of ten working days notice before the inspection shall be performed.
2. If the work is acceptable, the Owner shall issue a Certificate of Substantial Completion, which shall set forth the responsibilities of the Owner and the Contractor for utilities, security, maintenance, damage to the work and risk of loss. The Certificate shall also identify those remaining items of work to be performed by the Contractor. All such work items shall be complete within 30 working days of the date of the Certificate, unless the Certificate specifies a different time. If the Contractor shall be required to perform tests that must be delayed due to climatic conditions, it is understood that such tests and affected equipment will be identified on the Certificate and shall be accomplished by the Contractor at the earliest possible date. Performance of the tests may not be required before Substantial Completion can be issued. The date of the issuance of the Certificate of

Substantial Completion shall determine whether or not the work was completed within the contract time and whether or not Liquidated Damages are due.

3. If the work is not acceptable, and the Owner does not issue a Certificate of Substantial Completion, the Owner shall be entitled to charge the Contractor with the Designer's and Owner's costs of re-inspection, including time and travel.
- B. Partial Occupancy. Contractor agrees that the Owner shall be permitted to occupy and use any completed or partially completed portions of the Project, when such occupancy and use is in the Owner's best interest. Owner shall notify Contractor of its desire and intention to take Partial Occupancy as soon as possible but at least ten (10) working days before the Owner intends to occupy. If the Contractor believes that the portion of the work the Owner intends to occupy is not ready for occupancy, the Contractor shall notify the Owner immediately. The Designer shall inspect the work in accordance with the procedures above. If the Contractor claims increased cost of the project or delay in completion as a result of the occupancy, he shall notify the Owner immediately but in all cases before occupancy occurs.
- C. Final Completion. The Project is finally complete when the Certificate of Substantial Completion has been issued and all work items identified therein as incomplete have been completed, and when all administrative items required by the contract have been completed. Final Completion entitles the Contractor to payment of the outstanding balance of the contract amount including all change orders and retainage. Within five (5) working days of the date of the Certificate of Substantial Completion, the Contractor shall identify the cost to complete any outstanding items of work. The Designer shall review the Contractor's estimate and either approve it or provide an independent estimate for all such items. If the Contractor fails to complete the remaining items within the time specified in the Certificate, the Owner may terminate the contract and go to the surety for project completion in accordance with Article 7.2 or release the contract balance to the Contractor less 150% of the approved estimate to complete the outstanding items. Upon completion of the outstanding items, when a final cost has been established, any monies remaining shall be paid to the Contractor. Failure to complete items of work does not relieve the Contractor from the obligation to complete the administrative requirements of the contract, such as the provisions of Article 5.3 FAILURE TO COMPLETE ALL ITEMS OF WORK UNDER THE CONTRACT SHALL BE CONSIDERED A

DEFAULT AND BE GROUNDS FOR CONTRACT TERMINATION AND DEBARMENT.

- D. Liquidated Damages. Contractor agrees that the Owner may deduct from the contract price and retain as liquidated damages, and not as penalty or forfeiture, the sum stipulated in this contract for each work day after the Contract Completion Day on which work is not Substantially Complete. Assessment of Liquidated Damages shall not relieve the Contractor or the surety of any responsibility or obligation under the Contract. In addition, the Owner may, without prejudice to any other rights, claims, or remedies the Owner may have including the right to Liquidated Damages, charge the Contractor for all additional expenses incurred by the Owner and/or Designer as the result of the extended contract period through Final Completion. Additional Expenses shall include but not be limited to the costs of additional inspections.
- E. Early Completion. The Contractor has the right to finish the work before the contract completion date; however, the Owner assumes no liability for any hindrances to the Contractor unless Owner caused delays result in a time extension to the contract completion date. The Contractor shall not be entitled to any claims for lost efficiencies or for delay if a Certificate of Substantial Completion is given on or before the Contract Completion Date.

ARTICLE 5.4 -- PAYMENT TO CONTRACTOR

- A. Payments on account of this contract will be made monthly in proportion to the work which has been completed. Request for payment must be submitted on the Owner's forms. No other pay request will be processed. Supporting breakdowns must be in the same format as Owner's forms and must provide the same level of detail. The Designer will, within 5 working days from receipt of the contractor's request for payment either issue a Certificate for Payment to the Owner, for such amount as the Designer determines is properly due, or notify the Contractor in writing of reasons for withholding a Certificate. The Owner shall make payment within 30 calendar days after the "Application and Certification for Payment" has been received and certified by the Designer. The following items are to be attached to the contractor's pay request:
 1. Updated construction schedule
 2. Certified payrolls consisting of name, occupation and craft, number of hours worked and actual wages paid for each individual employee, of the Contractor and all subcontractors working on the project

- B. The Owner shall retain 5 percent of the amount of each such payment application, except as allowed by Article 5.4, until final completion and acceptance of all work covered by this contract.
- C. Each payment made to Contractor shall be on account of the total amount payable to Contractor and all material and work covered by paid partial payment shall thereupon become the sole property of Owner. This provision shall not be construed as relieving Contractor from sole responsibility for care and protection of materials and work upon which payments have been made or restoration of any damaged work or as a waiver of the right of Owner to require fulfillment of all terms of this contract.
- D. Materials delivered to the work site and not incorporated in the work will be allowed in the Application and Certification for Payment on the basis of one hundred (100%) percent of value, subject to the 5% retainage providing that they are suitably stored on the site or in an approved warehouse in accordance with the following requirements:
 - 1. Material has previously been approved through submittal and acceptance of shop drawings conforming to requirements of Article 3.2 of General Conditions.
 - 2. Delivery is made in accordance with the time frame on the approved schedule.
 - 3. Materials, equipment, etc., are properly stored and protected from damage and deterioration and remain so - if not, previously approved amounts will be deleted from subsequent pay applications.
 - 4. The payment request is accompanied by a breakdown identifying the material equipment, etc. in sufficient detail to establish quantity and value.
- E. The Contractor shall be allowed to include in the Application and Certification for Payment, one hundred (100%) of the value, subject to retainage, of major equipment and material stored off the site if all of the following conditions are met:
 - 1. The request for consideration of payment for materials stored off site is made at least 15 working days prior to submittal of the Application for Payment including such material. Only materials inspected will be considered for inclusion on Application for Payment requests.
 - 2. Materials stored in one location off site are valued in excess of \$25,000.
 - 3. That a Certificate of Insurance is provided indicating adequate protection from loss, theft

conversion or damage for materials stored off site. This Certificate shall show the State of Missouri as an additional insured for this loss.

- 4. The materials are stored in a facility approved and inspected, by the Construction Representative.
- 5. Contractor shall be responsible for, Owner costs to inspect out of state facilities, and any delays in the completion of the work caused by damage to the material or for any other failure of the Contractor to have access to this material for the execution of the work.
- F. The Owner shall determine the amount, quality and acceptability of the work and materials which are to be paid for under this contract. In the event any questions shall arise between the parties, relative to this contract or specifications, determination or decision of the Owner or the Construction Representative and the Designer shall be a condition precedent to the right of the Contractor to receive any money or payment for work under this contract affected in any manner or to any extent by such question.
- G. Payments Withheld: The Owner may withhold or nullify in whole or part any certificate to such extent as may be necessary to protect the Owner from loss on account of:
 - 1. Defective work not remedied. When a notice of noncompliance is issued on an item or items, corrective action shall be undertaken immediately. Until corrective action is completed, no monies will be paid and no additional time will be allowed for the item or items. The cost of corrective action(s) shall be borne by the Contractor.
 - 2. A reasonable doubt that this contract can be completed for the unpaid balance.
 - 3. Failure of the Contractor to update as-built drawings monthly for review by the Construction Representative.
 - 4. Failure of the Contractor to update the construction schedule.When the Construction Representative is satisfied the Contractor has remedied above deficiencies, payment shall be released.
- H. Final Payment: Upon receipt of written notice from the Contractor to the Designer and Project Representative that the work is ready for final inspection and acceptance, the Designer and Project Representative, with the Contractor, shall promptly make such inspection. If the work is acceptable and the contract fully performed, the Construction Representative shall complete a final acceptance report and the Contractor will be

directed to submit a final Application and Certification for Payment. If the Owner approves the same, the entire balance shall be due and payable, with the exception of deductions as provided for under Article 5.4.

1. Where the specifications provide for the performance by the Contractor of (certain tests for the purpose of balancing and checking the air conditioning and heating equipment and the Contractor shall have furnished and installed all such equipment in accordance with the specifications, but said test cannot then be made because of climatic conditions, such test shall may be considered as required under the provisions of the specifications, Section 013300 and this contract may be substantial Full payment will not be made until the tests have been made and the equipment and system is finally accepted. If the tests are not completed when scheduled, the Owner may deduct 150% of the value of the tests from the final payment.
2. The final payment shall not become due until the Contractor delivers to the Construction Representative:
 - a) A complete file of releases, on the standard form included in the contract documents as "Final Receipt of Payment and Release Form", from subcontractors and material suppliers evidencing payment in full for services, equipment and materials, as the case may require, if the Owner approves, or a consent from the Surety to final payment accepting liability for any unpaid amounts.
 - b) An Affidavit of Compliance with Prevailing Wage Law, in the form as included in this contract specifications, properly executed by each subcontractor, and the Contractor
 - c) Certified copies of all payrolls
 - d) As-built drawings
3. If any claim remains unsatisfied after all payments are made, the Contractor shall refund to the Owner all monies that the latter may be compelled to pay in discharging such a claim including all costs and a reasonable attorney's fee.
4. Missouri statute requires prompt payment from the Owner to the Contractor within thirty calendar days and from the Contractor to his subcontractors within fifteen calendar days. Failure to make payments within the required

time frame entitles the receiving party to charge interest at the rate of one and one half percent per month calculated from the expiration of the statutory time period until paid.

5. The value of all unused unit price allowances and/or 150% of the value of the outstanding work items, and/or liquidated damages may be deducted from the final pay request without executing a Contract Change. Any unit price items which exceed the number of units in the contract may be added by Contract Change.

ARTICLE 6 -- INSURANCE AND BONDS

ARTICLE 6.1 -- BOND

- A. Contractor shall furnish a performance/payment bond in an amount equal to 100% of the contract price to guarantee faithful performance of the contract and 100% of the contract price to guarantee the payment of all persons performing labor on the project and furnishing materials in connection therewith under this contract as set forth in the standard form of performance and payment bond included in the contract documents. The surety on such bond shall be issued by a surety company authorized by the Missouri Department of Insurance to do business in the state of Missouri.
- B. All Performance/Payment Bonds furnished in response to this provision shall be provided by a bonding company with a rating of B+ or higher as established by A.M. Best Company, Inc. in their most recent publication.

ARTICLE 6.2 – INSURANCE

A. The successful Contractor shall procure and maintain for the duration of the contract issued a policy or policies of insurance for the protection of both the Contractor and the Owner and their respective officers, officials, agents, consultants and employees. The Owner requires certification of insurance coverage from the Contractor prior to commencing work.

B. Minimum Scope and Extent of Coverage

1. General Liability

Commercial General Liability, ISO coverage form number or equivalent CG 00 01 ("occurrence" basis), or I-SO coverage form number CG 00 02, or ISO equivalent.

If ISO equivalent or manuscript general liability coverage forms are used, minimum coverage will be as follows: Premises/Operations; Independent Contractors; Products/Completed Operations; personal Injury; Broad Form Property Damage including Completed Operations; Broad Form Contractual Liability Coverage to include Contractor's obligations under Article 1.11 Indemnification and any other Special Hazards required by the work of the contract.

2. Automobile Liability

Business Automobile Liability Insurance, ISO Coverage form number or equivalent CA 00 01 covering automobile liability, code 1 "ANY AUTO".

3. Workers' Compensation and Employer's Liability

Statutory Workers' Compensation Insurance for Missouri and standard Employer's Liability Insurance, or the authorization to self-insure for such liability from the Missouri Division of Workers' Compensation.

4. Builder's Risk or Installation Floater Insurance

Insurance upon the work and all materials, equipment, supplies, temporary structures and similar items which may be incident to the performance of the work and located at or adjacent to the site, against loss or damage from fire and such other casualties as are included in extended coverage in broad "All Risk" form, including coverage for Flood and Earthquake, in an amount not less than the replacement cost of the work or this contract price, whichever is greater, with loss payable to Contractor and Owner as their respective interests may appear.

Contractor shall maintain sufficient insurance to cover the full value of the work and materials as the work progresses, and shall furnish Owner copies of all endorsements. If Builder's Risk Reporting- Form of Endorsement is used, Contractor shall make all reports as required therein so as to keep in force an amount of insurance which will equal the replacement cost of the work, materials, equipment, supplies, temporary structures, and other property covered thereby; and if, as a result of Contractor's failure to make any such report, the amount of insurance so recoverable shall be less than such replacement cost, Contractor's interest in the proceeds of such insurance, if any, shall be subordinated to Owner's interest to the end that Owner may receive full reimbursement for its loss.

C. Minimum Limits of Insurance

1. General Liability

Contractor

\$2,000,000	combined single limit per occurrence for bodily injury, personal injury, and property damage

\$2,000,000	annual aggregate

2. Automobile Liability

\$2,000,000	combined single limit per occurrence for bodily injury and property damage

3. Workers' Compensation and Employers Liability

Workers' Compensation limits as required by applicable State Statutes (generally unlimited) and minimum of \$1,000,000 limit per accident for Employer's Liability.

General Liability and Automobile Liability insurance may be arranged under individual policies for the full limits required or by a combination of underlying policies with the balance provided by a form-following Excess or Umbrella Liability policy.

D. Deductibles and Self-Insured Retentions

All deductibles, co-payment clauses, and self-insured retentions must be declared to and approved by the Owner. The Owner reserves the right to request the reduction or elimination of unacceptable deductibles or self-insured retentions, as they would apply to the Owner, and their respective officers, officials, agents, consultants and employees. Alternatively, the Owner may request Contractor to procure a bond guaranteeing

payment of losses and related investigations, claims administration, and defense expenses.

E. Other Insurance Provisions and Requirements

The respective insurance policies and coverage, as specified below, must contain, or be endorsed to contain the following conditions or provisions:

1. General Liability

The Owner, and its respective commissioners, officers, officials, agents, consultants and employees shall be endorsed as additional insured's by ISO form CG 20 26 Additional Insured - Designated Person or Organization. As additional insured's, they shall be covered as to work performed by or on behalf of the Contractor or as to liability which arises out of Contractor's activities or resulting from the performance of services or the delivery of goods called for by the Contract.

Contractor's insurance coverage shall be primary with respect to all additional insured's. Insurance of self-insurance programs maintained by the designated additional -insured's shall be excess of the Contractor's insurance and shall not contribute with it.

Additionally, the Contractor and Contractor's general liability insurer shall agree to waive all rights of subrogation against the Owner and any of their respective officers, officials, agents, consultants or employees for claims, losses, or expenses which arise out of Contractor's activities or result from the performance of services or the delivery of goods called for by the Contract.

Contractor's failure to comply with the terms and conditions of these insurance policies shall not affect or abridge coverage for the Owner, or for any of their officers, officials, agents, consultants or employees.

2. Automobile Insurance

The Owner, and their respective officers, officials, agents, consultants and employees shall be endorsed as additional insured's by ISO form CG 20 26 - Additional Insured Designated Person or Organization. As additional insured's, they shall be covered as to work performed by or on behalf of the Contractor or as to liability which arises out of Contractor's activities or resulting from the performance of services or the delivery of goods called for by the Contract.

Contractor's insurance coverage shall be primary with respect to all additional insured's. Insurance or self-insurance

programs maintained by the designated additional insured's shall be in excess of the Contractor's insurance and shall not contribute with it.

Additionally, the Contractor and Contractor's automobile insurer shall agree to waive all rights of subrogation against the Owner and any of their respective officers, officials, agents, consultants or employees for claims, losses, or expenses which arise out of Contractor's activities or result from the performance of services or the delivery of goods called for by the Contract.

Contractor's failure to comply with the terms and conditions of these insurance policies shall not affect or abridge coverage for the Owner or for any of its officers, officials, agents, consultants or employees.

3. Workers' Compensation/Employer's Liability

Contractor's workers' compensation insurance shall be endorsed with NCCI form WC 00 03 01 A - Alternative Employer Endorsement. The Alternative Employer Endorsement shall designate the Owner as "alternate employers."

4. All Coverages

Each insurance policy required by this section of the Contract shall contain a stipulation, endorsed if necessary, that the Owner will receive a minimum of a thirty (30) calendar day advance notice of any policy cancellation. Ten (10) calendar days advance notice is required for policy cancellation due to non-payment of premium.

F. Insurer Qualifications and Acceptability

Insurance required hereunder shall be issued by an A.M. Best, "B+" rated, Class IX insurance company approved to conduct insurance business in the state of Missouri.

G. Verification of Insurance Coverage

Prior to Owner issuing a Notice to Proceed, the Contractor shall furnish the Owner with Certificate(s) of Insurance and with any applicable original endorsements evidencing the required insurance coverage. The insurance certificates and endorsements are to be signed by a person authorized by that insurer to bind coverage on its behalf. All certificates and endorsements received by the Owner are subject to review and approval by the Owner. The Owner reserves the right to require certified copies of all required policies at any time. If the scope of this contract will exceed one (1) year - or, if any of Contractor's applicable insurance coverage expires prior to completion of the work or services required under this contract -

the Contractor will provide a renewal or replacement certificate before continuing work or services hereunder. If the Contractor fails to provide documentation of required insurance coverage, the Owner may issue a stop work order and no additional contract completion time and/or compensation shall be granted as a result thereof.

ARTICLE 7 – SUSPENSION OR TERMINATION OF CONTRACT

ARTICLE 7.1 - FOR SITE CONDITIONS

When conditions at the site of the proposed work are considered by the Owner to be unsatisfactory for prosecution of the work, the Contractor may be ordered in writing to suspend the work or any part thereof until reasonable conditions exist. When such suspension is not due to fault or negligence of the Contractor, time allowed for completion of such suspended work will be extended by a period of time equal to that lost due to delay occasioned by ordered suspension. This will be a no cost time extension.

ARTICLE 7.2 - FOR CAUSE

A. Termination or Suspension for Cause:

1. If the Contractor shall file for bankruptcy, or should make a general assignment for the benefit of the creditors, or if a receiver should be appointed on account of insolvency, or if the contractor should persistently or repeatedly refuse or fail to supply enough properly skilled workers or proper materials, or if the contractor should fail to make prompt payment to subcontractors or for material or labor, or persistently disregard laws, ordinances or the instructions of the Owner, or otherwise be guilty of a substantial violation of any provision of this contract, then the Owner may serve notice on the Contractor and the surety setting forth the violations and demanding compliance with this contract. Unless within ten (10) consecutive calendar days after serving such notice, such violations shall cease and satisfactory arrangements for correction be made, the Owner may suspend the Contractor's right to proceed with the work or terminate this contract.
2. In the event the Owner suspends Contractor's right to proceed with the work or terminates the contract, the Owner may demand that the Contractor's surety take over and complete the work on this contract, after the surety submits a written proposal to the Owner and receives written approval and upon the surety's failure or refusal to do so within ten (10) consecutive

calendar days after demand therefore, the Owner may take over the work and prosecute the same to completion by bid or negotiated contract, or the Owner may elect to take possession of and utilize in completing the work such materials, supplies, appliances and plant as may be on the site of the work, and all subcontractors, if the Owner elects, shall be bound to perform their contracts.

- B. The Contractor and its surety shall be and remain liable to the Owner for any excess cost or damages occasioned to the Owner as a result of the actions above set forth.
- C. The Contractor in the event of such suspension or termination shall not be entitled to receive any further payments under this contract until the work is wholly finished. Then if the unpaid balance under this contract shall exceed all expenses of the Owner as certified by the Director, such excess shall be paid to the Contractor; but, if such expenses shall exceed the unpaid balance as certified by the Director, the Contractor and their surety shall be liable for and shall pay the difference and any damages to the Owner.
- D. In exercising Owner's right to secure completion of the work under any of the provisions hereof, the Director shall have the right to exercise Owner's sole discretion as to the manner, methods and reasonableness of costs of completing the work.
- E. The rights of the Owner to suspend or terminate as herein provided shall be cumulative and not exclusive and shall be in addition to any other remedy provided by law.
- F. The Contractor in the event of such suspension or termination may be declared ineligible for Owner contracts for a minimal period of twelve (12) months. Further, no contract will be awarded to any Contractor who lists in their bid form any subcontractor whose prior performance has contributed, as determined by the Owner, to a breach of a contract. In order to be considered for state-awarded contracts after this period, the Contractor/subcontractor will be required to forward acceptance reports to the Owner regarding successful completion of non-state projects during the intervening twelve (12) months from the date of default. No contracts will be awarded to a subcontractor/Contractor until the ability to perform responsibly in the private sector has been proven to the Owner.

ARTICLE 7.3 -- FOR CONVENIENCE

- A. The Owner may terminate or suspend the Contract or any portion of the Work without cause at any time, and at the Owner's convenience. Notification of a termination or suspension shall be in writing

and shall be given to the Contractor and their surety. If the Contract is suspended, the notice will contain the anticipated duration of the suspension or the conditions under which work will be permitted to resume. If appropriate, the Contractor will be requested to demobilize and re-mobilize and will be reimbursed time and costs associated with the suspension.

B. Upon receipt of notification, the Contractor shall:

1. Cease operations when directed.
2. Take actions to protect the work and any stored materials.
3. Place no further subcontracts or orders for material, supplies, services or facilities except as may be necessary to complete the portion of the Contract that has not been terminated. No claim for payment of materials or supplies ordered after the termination date shall be considered.
4. Terminate all existing subcontracts, rentals, material, and equipment orders.

5. Settle all outstanding liabilities arising from termination with subcontractors and suppliers.

6. Transfer title and deliver to the Owner, work in progress, completed work, supplies and other material produced or acquire for the work terminated, and completed or partially completed plans, drawings information and other property that, if the Contract had been completed, would be required to be furnished to the Owner.

C. For termination without cause and at the Owner's convenience, in addition to payment for work completed prior to date of termination, the Contractor may be entitled to payment of other documented costs directly associated with the early termination of the contract. Payment for anticipated profit and unapplied overhead will not be allowed.

SECTION 007300 - SUPPLEMENTARY CONDITIONS

1.0 GENERAL:

- A. These Supplementary General Conditions clarify, add, delete, or otherwise modify standard terms and conditions of DIVISION 0, BIDDING AND CONTRACTING REQUIREMENTS.

2.0 CONTACTS:

Designer: Matt Swaback
Henderson Engineers
8345 Lenexa Drive, Suite 300
Lenexa, Kansas, 65101
Telephone: (913) 742-5742
Email: Matt.Swaback@hendersonengineers.com

Construction Representative: John Gentges
Division of Facilities Management, Design and Construction
301 West High Street, Room 730
Jefferson City, MO 65101
Telephone: (573) 526-5768
Email: John.Gentges@oa.mo.gov

Project Manager: Aaron Libbert
Division of Facilities Management, Design and Construction
301 West High Street, Room 730
Jefferson City, Missouri 65101
Telephone: 8167973442
Email: aaron.libbert@oa.mo.gov

Contract Specialist: April Howser
Division of Facilities Management, Design and Construction
301 West High Street, Room 730
Jefferson City, Missouri 65101
Telephone: 573-751-0053
Email: april.howser@oa.mo.gov

3.0 NOTICE: ALL BID MATERIALS ARE DUE AT THE TIME OF BID SUBMITTAL. THERE IS NO SECOND SUBMITTAL FOR THIS PROJECT.

4.0 FURNISHING CONSTRUCTION DOCUMENTS:

- A. The Owner will furnish the Contractor with approximately 3 complete sets of drawings and specifications at no charge.
- B. The Owner will furnish the Contractor with approximately 3 sets of explanatory or change drawings at no charge.
- C. The Contractor may make copies of the documents as needed with no additional cost to the Owner.

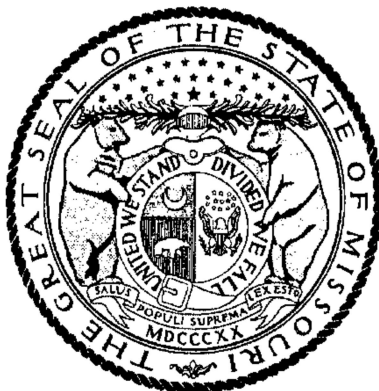
5.0 SAFETY REQUIREMENTS

Contractor and subcontractors at any tier shall comply with RSMo 292.675 and Article 1.3, E, of Section 007213, General Conditions.

Missouri

Division of Labor Standards

WAGE AND HOUR SECTION



MIKE KEHOE, Governor

Annual Wage Order No. 32

Section 054
LAFAYETTE COUNTY

In accordance with Section 290.262 RSMo 2000, within thirty (30) days after a certified copy of this Annual Wage Order has been filed with the Secretary of State as indicated below, any person who may be affected by this Annual Wage Order may object by filing an objection in triplicate with the Labor and Industrial Relations Commission, P.O. Box 599, Jefferson City, MO 65102-0599. Such objections must set forth in writing the specific grounds of objection. Each objection shall certify that a copy has been furnished to the Division of Labor Standards, P.O. Box 449, Jefferson City, MO 65102-0449 pursuant to 8 CSR 20-5.010(1). A certified copy of the Annual Wage Order has been filed with the Secretary of State of Missouri.

Original Signed by _____

Logan Hobbs, Director
Division of Labor Standards

Filed With Secretary of State: _____ **March 10, 2025**

Last Date Objections May Be Filed: **April 9, 2025**

Prepared by Missouri Department of Labor and Industrial Relations

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Asbestos Worker	\$25.56*
Boilermaker	\$25.56*
Bricklayer-Stone Mason	\$25.56*
Carpenter	\$65.96
Lather	
Linoleum Layer	
Millwright	
Pile Driver	
Cement Mason	\$25.56*
Plasterer	
Communication Technician	\$25.56*
Electrician (Inside Wireman)	\$74.67
Electrician Outside Lineman	\$25.56*
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Elevator Constructor	\$25.56*
Glazier	\$25.56*
Ironworker	\$78.77
Laborer	\$50.77
General Laborer	
First Semi-Skilled	
Second Semi-Skilled	
Mason	\$25.56*
Marble Mason	
Marble Finisher	
Terrazzo Worker	
Terrazzo Finisher	
Tile Setter	
Tile Finisher	
Operating Engineer	\$25.56*
Group I	
Group II	
Group III	
Group III-A	
Group IV	
Group V	
Painter	\$25.56*
Plumber	\$83.90
Pipe Fitter	
Roofer	\$25.56*
Sheet Metal Worker	\$25.56*
Sprinkler Fitter	\$25.56*
Truck Driver	\$25.56*
Truck Control Service Driver	
Group I	
Group II	
Group III	
Group IV	

*The Division of Labor Standards received fewer than 1,000 reportable hours for this occupational title. The public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center.

**The Prevailing Hourly Rate includes any applicable fringe benefit amounts for each occupational title as defined in RSMo Section 290.210.

Heavy Construction Rates for
LAFAYETTE County

Section 054

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Carpenter	\$25.56*
Millwright	
Pile Driver	
Electrician (Outside Lineman)	\$25.56*
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Laborer	\$49.46
General Laborer	
Skilled Laborer	
Operating Engineer	\$61.20
Group I	
Group II	
Group III	
Group IV	
Truck Driver	\$25.56*
Truck Control Service Driver	
Group I	
Group II	
Group III	
Group IV	

Use Heavy Construction Rates on Highway and Heavy construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(3).

Use Building Construction Rates on Building construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(2).

If a worker is performing work on a heavy construction project within an occupational title that is not listed on the Heavy Construction Rate Sheet, use the rate for that occupational title as shown on the Building Construction Rate Sheet.

*The Division of Labor Standards received fewer than 1,000 reportable hours for this occupational title. Public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center.

**The Prevailing Hourly Rate includes any applicable fringe benefit amounts for each occupational title.

OVERTIME and HOLIDAYS

OVERTIME

For all work performed on a Sunday or a holiday, not less than twice (2x) the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid to all workers employed by or on behalf of any public body engaged in the construction of public works, exclusive of maintenance work.

For all overtime work performed, not less than one and one-half (1½) the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid to all workers employed by or on behalf of any public body engaged in the construction of public works, exclusive of maintenance work or contractual obligation. For purposes of this subdivision, "**overtime work**" shall include work that exceeds ten hours in one day and work in excess of forty hours in one calendar week; and

A thirty-minute lunch period on each calendar day shall be allowed for each worker on a public works project, provided that such time shall not be considered as time worked.

HOLIDAYS

January first;
The last Monday in May;
July fourth;
The first Monday in September;
November eleventh;
The fourth Thursday in November; and
December twenty-fifth;

If any holiday falls on a Sunday, the following Monday shall be considered a holiday.

SECTION 011000 – SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Project consists of bathroom renovations.
 - 1. Project Location: Higginsville Habilitation Center, 100 W. 1st Street, Higginsville, MO 64037.
 - 2. Owner: State of Missouri, Office of Administration, Division of Facilities Management, Design and Construction, Harry S Truman State Office Building, Post Office Box 809, 301 West High Street, Jefferson City, Missouri 65102.
- B. Contract Documents, dated December 6, 2024 were prepared for the Project by Henderson Engineers, 8345 Lenexa Drive, Suite 300, Lenexa KS 66214.
- C. The Work includes:
 - a. The Ragland Education Building, on the campus of the Higginsville Habilitation Center, consists of four client bathrooms that have not been renovated since the building's construction in 1965. The bathrooms are in poor condition and do not meet current ADA standard.
 - b. Provide renovation of the bathrooms. The scope includes upgrading all finishes, modifications necessary to meet current ADA standards, replacement of plumbing fixtures, lighting, receptacles, fire alarm devices, and plumbing piping that is in poor condition. The scope also includes asbestos inspection and sampling for suspect surfaces that will be disturbed as a result of demolition.
- D. The Work will be constructed under a single prime contract.

1.3 CONTRACTOR USE OF PREMISES

- A. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
 - 1. Owner Occupancy: Allow for Owner occupancy and use by the public.
 - 2. Driveways and Entrances: Keep driveways and entrances serving the premises clear and available to the Owner, the Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- B. Use of the Existing Building: Maintain the existing building in a weathertight condition throughout the construction period. Repair damage cause by construction operations. Take all precautions necessary to protect the building and its occupants during the construction period..

1.4 OCCUPANCY REQUIREMENTS

- A. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire construction period. Cooperate with the Owner during construction operations to minimize conflicts and facilitate owner usage. Perform the Work so as not to interfere with the Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

END OF SECTION 011000

SECTION 012100 – ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements governing allowances.
 - 1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.
 - 2. Weather allowances.
- C. Related Sections include the following:
 - 1. Division 1 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders for allowances.
 - 2. Division 1 Section "Unit Prices" for procedures for using unit prices.

1.3 WEATHER ALLOWANCE

- A. Included within the completion period for this project are a specified number of “bad weather” days (see Schedule of Allowances).
- B. The Contractor’s progress schedule shall clearly indicate the bad weather day allowance as an “activity” or “activities”. In the event weather conditions preclude performance of critical work activities for 50% or more of the Contractor’s scheduled workday, that day shall be declared unavailable for work due to weather (a “bad weather” day) and charged against the above allowance. Critical work activities will be determined by review of the Contractor’s current progress schedule.
- C. The Contractor’s Representative and the Construction Representative shall agree monthly on the number of “bad weather” days to be charged against the allowance. This determination will be documented in writing and be signed by the Contractor and the Construction Representatives. If there is a failure to agree on all or part of the “bad weather” days for a particular month, that disagreement shall be noted on this written document and signed by each party’s representative. Failure of the Contractor’s representative to sign the “bad weather” day documentation after it is presented, with or without the notes of disagreement, shall constitute agreement with the “bad weather” day determination contained in that document.

- D. There will be no modification to the time of contract performance due solely to the failure to deplete the “bad weather” day allowance.
- E. Once this allowance is depleted, a no cost Change Order time extension will be executed for “bad weather” days, as defined above, encountered during the remainder of the Project.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALLOWANCES

- A. Weather Allowance: Included within the completion period for this Project 5 “bad weather” days.

END OF SECTION 012100

SECTION 012600 – CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract Modifications.
- B. Related Sections include the following:
 - 1. Division 1, Section 012100 "Allowances" for procedural requirements for handling and processing Allowances.
 - 2. Division 1, Section 012200 "Unit Prices" for administrative requirements for using Unit Prices.
 - 3. Division 1, Section 013115 "Project Management Communications" for administrative requirements for communications.
 - 4. Division 0, Section 007213, Article 3.1 "Acceptable Substitutions" for administrative procedures for handling Requests for Substitutions made after Contract award.
 - 5. Division 0, Section 007213, Article 4.0 "Changes in the Work" for Change Order requirements.

1.3 REQUESTS FOR INFORMATION

- A. In the event that the Contractor or Subcontractor, at any tier, determines that some portion of the Drawings, Specifications, or other Contract Documents requires clarification or interpretation, the Contractor shall submit a "Request for Information" (RFI) in writing to the Designer. A RFI may only be submitted by the Contractor and shall only be submitted on the RFI forms provided by the Owner. The Contractor shall clearly and concisely set forth the issue for which clarification or interpretation is sought and why a response is needed. In the RFI, the Contractor shall set forth an interpretation or understanding of the requirement along with reasons why such an understanding was reached.
- B. Responses to RFI shall be issued within ten (10) working days of receipt of the Request from the Contractor unless the Designer determines that a longer time is necessary to provide an adequate response. If a longer time is determined necessary by the Designer, the Designer will, within five (5) working days of receipt of the request, notify the Contractor of the anticipated response time. If the Contractor submits a RFI on a time sensitive activity on the current project schedule, the Contractor shall not be entitled to any time extension due to the time it takes the Designer to respond to the request provided that the Designer responds within the ten (10) working days set forth above.

- C. Responses from the Designer will not change any requirement of the Contract Documents. In the event the Contractor believes that a response to a RFI will cause a change to the requirements of the Contract Document, the Contractor shall give written notice to the Designer requesting a Change Order for the work. Failure to give such written notice within ten (10) working days, shall waive the Contractor's right to seek additional time or cost under Article 4, "Changes in the Work" of the General Conditions.

1.4 MINOR CHANGES IN THE WORK

- A. Designer will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Amount or the Contract Time, on "Designer's Supplemental Instructions" (DSI).

1.5 PROPOSAL REQUESTS

- A. The Designer or Owner Representative will issue a detailed description of proposed Changes in the Work that may require adjustment to the Contract Amount or the Contract Time. The proposed Change Description will be issued using the "Request for Proposal" (RFP) form. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Proposal Requests issued by the Designer or Owner Representative are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
 - 2. Within ten (10) working days after receipt of Proposal Request, submit a proposal for the cost adjustments to the Contract Amount and the Contract Time necessary to execute the Change. The Contractor shall submit his proposal on the appropriate Change Order Detailed Breakdown form. Subcontractors may use the appropriate Change Order Detailed Breakdown form or submit their proposal on their letterhead provided the same level of detail is included. All proposals shall include:
 - a. A detailed breakdown of costs per Article 4.1 of the General Conditions.
 - b. If requesting additional time per Article 4.2 of the General Conditions, include an updated Contractor's Construction Schedule that indicates the effect of the Change including, but not limited to, changes in activity duration, start and finish times, and activity relationship.

1.6 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, the Designer or Owner Representative will issue a Change Order for signatures of Owner and Contractor on the "Change Order" form.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 013100 – COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Projects including, but not limited to, the following:
 - 1. Coordination Drawings.
 - 2. Administrative and supervisory personnel.
 - 3. Project meetings.
- B. Each Contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific Contractor.
- C. Related Sections include the following:
 - 1. Division 1, Section 013200 "Schedules" for preparing and submitting Contractor's Construction Schedule.
 - 2. Articles 1.8.B and 1.8.C of Section 007213 "General Conditions" for coordinating meetings onsite.
 - 3. Article 5.4.H of Section 007213 "General Conditions" for coordinating Closeout of the Contract.

1.3 COORDINATION

- 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, which depend on each other for proper installation, connection, and operation.
- B. Coordination: Each Contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each Contractor shall coordinate its operations with 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 with other Contractors to ensure maximum accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.

4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components including mechanical and electrical.
- C. 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.
- D. 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 submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Startup and adjustment of systems.
 8. Project Closeout activities.
- E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.4 SUBMITTALS

- A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
- B. Key Personnel Names: Within fifteen (15) work days of starting construction operations, submit a list of key personnel assignments including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
 1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 PROJECT MEETINGS

- A. The Owner's Construction Representative will schedule a Pre-Construction Meeting prior to beginning of construction. The date, time, and exact place of this meeting will be determined after Contract Award and notification of all interested parties. The Contractor shall arrange to have the Job Superintendent and all prime Subcontractors present at the meeting. During the Pre-Construction Meeting, the construction procedures and information necessary for submitting payment requests will be discussed and materials distributed along with any other pertinent information.
 - 1. Minutes: Designer will record and distribute meeting minutes.
- B. Progress Meetings: The Owner's Construction Representative will conduct Monthly Progress Meetings as stated in Articles 1.8.B and 1.8.C of Section 007213 "General Conditions".
 - 1. Minutes: Designer will record and distribute to Contractor the meeting minutes.
- C. Preinstallation Conferences: Contractor shall conduct a preinstallation 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 Designer and Construction Representative 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 recommendations
 - 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. Contractor shall 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 parties who should have been present.
 - 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.
 - 6. Revise paragraph below if Project requires holding progress meetings at different intervals. Insert special intervals such as "every third Tuesday" to suit special circumstances.
 - 7. Project name
 - 8. Name and address of Contractor
 - 9. Name and address of Designer
 - 10. RFI number including RFIs that were dropped and not submitted
 - 11. RFI description
 - 12. Date the RFI was submitted
 - 13. Date Designer's response was received
 - 14. Identification of related DSI or Proposal Request, as appropriate

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013115 - PROJECT MANAGEMENT COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions, Bid Form, and other Division 1 Specification Sections apply to this Section.
- B. Division 1, Section 013300 - Submittals
- C. Division 1, Section 012600 – Contract Modification Procedures

1.2 SUMMARY

- A. Project Management Communications: The Contractor shall use the Internet web based project management communications tool, E-Builder® ASP software, and protocols included in that software during this project. The use of project management communications as herein described does not replace or change any contractual responsibilities of the participants.
 - 1. Project management communications is available through E-Builder® as provided by "e-Builder®" in the form and manner required by the Owner.
 - 2. The project communications database is on-line and fully functional. User registration, electronic and computer equipment, and Internet connections are the responsibility of each project participant. The sharing of user accounts is prohibited
- B. Support: E-Builder® will provide on-going support through on-line help files.
- C. Copyrights and Ownership: Nothing in this specification or the subsequent communications supersedes the parties' obligations and rights for copyright or document ownership as established by the Contract Documents. The use of CAD files, processes or design information distributed in this system is intended only for the project specified herein.
- D. Purpose: The intent of using E-Builder® is to improve project work efforts by promoting timely initial communications and responses. Secondly, to reduce the number of paper documents while providing improved record keeping by creation of electronic document files
- E. Authorized Users: Access to the web site will be by individuals who are authorized users.
 - 1. Individuals shall complete the E-Builder New Company/User Request Form located at the following web site: <https://oa.mo.gov/facilities/vendor-links/contractor-forms>.

Completed forms shall be emailed to the following email address: OA.FMDCE-BuilderSupport@oa.mo.gov.

2. Authorized users will be contacted directly and assigned a temporary user password.
 3. Individuals shall be responsible for the proper use of their passwords and access to data as agents of the company in which they are employed.
- F. Administrative Users: Administrative users have access and control of user licenses and all posted items. **DO NOT POST PRIVATE OR YOUR COMPANY CONFIDENTIAL ITEMS IN THE DATABASE!** Improper or abusive language toward any party or repeated posting of items intended to deceive or disrupt the work of the project will not be tolerated and will result in deletion of the offensive items and revocation of user license at the sole discretion of the Administrative User(s).
- G. Communications: The use of fax, email and courier communication for this project is discouraged in favor of using E-Builder® to send messages. Communication functions are as follows:
1. Document Integrity and Revisions:
 - a. Documents, comments, drawings and other records posted to the system shall remain for the project record. The authorship time and date shall be recorded for each document submitted to the system. Submitting a new document or record with a unique ID, authorship, and time stamp shall be the method used to make modifications or corrections.
 - b. The system shall make it easy to identify revised or superseded documents and their predecessors.
 - c. Server or Client side software enhancements during the life of the project shall not alter or restrict the content of data published by the system. System upgrades shall not affect access to older documents or software.
 2. Document Security:
 - a. The system shall provide a method for communication of documents. Documents shall allow security group assignment to respect the contractual parties communication except for Administrative Users. **DO NOT POST PRIVATE OR YOUR COMPANY CONFIDENTIAL ITEMS IN THE DATABASE!**
 3. Document Integration:
 - a. Documents of various types shall be logically related to one another and discoverable. For example, requests for information, daily field reports, supplemental sketches and photographs shall be capable of reference as related records.
 4. Reporting:
 - a. The system shall be capable of generating reports for work in progress, and logs for each document type. Summary reports generated by the system shall be available for team members.
 5. Notifications and Distribution:
 - a. Document distribution to project members shall be accomplished both within the extranet system and via email as appropriate. Project document distribution to parties outside of the project communication system shall be

accomplished by secure email of outgoing documents and attachments, readable by a standard email client.

6. Required Document Types:
 - a. RFI, Request for Information.
 - b. Submittals, including record numbering by drawing and specification section.
 - c. Transmittals, including record of documents and materials delivered in hard copy.
 - d. Meeting Minutes.
 - e. Application for Payments (Draft or Pencil).
 - f. Review Comments.
 - g. Field Reports.
 - h. Construction Photographs.
 - i. Drawings.
 - j. Supplemental Sketches.
 - k. Schedules.
 - l. Specifications.
 - m. Request for Proposals
 - n. Designer's Supplemental Instructions
 - o. Punch Lists

- H. Record Keeping: Except for paper documents, which require original signatures and large format documents (greater than 8½ x 11 inches), all other 8½ x 11 inches documents shall be submitted by transmission in electronic form to the E-Builder® web site by licensed users.

- a. The Owner and his representatives, the Designer and his consultants, and the Contractor and his Sub Contractors and suppliers at every tier shall respond to documents received in electronic form on the web site, and consider them as if received in paper document form.
 - b. The Owner and his representatives, the Designer and his consultants, and the Contractor and his Sub Contractors and suppliers at every tier reserves the right to and shall reply or respond by transmissions in electronic form on the web site to documents actually received in paper document form.
 - c. The Owner and his representatives, the Designer and his consultants, and the Contractor and his Sub Contractors and suppliers at every tier reserves the right to and shall copy any paper document into electronic form and make same available on the web site.

- I. Minimum Equipment and Internet Connection: In addition to other requirements specified in this Section, the Owner and his representatives, the Construction Manager and his representatives, the Architect and his consultants, and the Contractor and his sub-contractors and suppliers at every tier required to have a user license(s) shall be responsible for the following:

1. Providing suitable computer systems for each licensed user at the users normal work location¹ with high-speed Internet access, i.e. DSL, local cable company's Internet connection, or T1 connection.
2. Each of the above referenced computer systems shall have the following minimum system² and software requirements:
 - a. Desktop configuration (Laptop configurations are similar and should be equal to or exceed desktop system.)
 - 1) Operating System: Windows XP or newer
 - 2) Internet Browser: Internet Explorer 6.01SP2+ (Recommend IE7.0+)
 - 3) Minimum Recommend Connection Speed: 256K or above
 - 4) Processor Speed: 1 Gigahertz and above
 - 5) RAM: 512 mb
 - 6) Operating system and software shall be properly licensed.
 - 7) Internet Explorer version 7 (current version is a free distribution for download). This specification is not intended to restrict the host server or client computers provided that industry standard HTTP clients may access the published content.
 - 8) Adobe Acrobat Reader (current version is a free distribution for download).
 - 9) Users should have the standard Microsoft Office Suite (current version must be purchased) or the equivalent.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable.)

END OF SECTION 013115

¹ The normal work location is the place where the user is assigned for more than one-half of his time working on this project.

² The minimum system herein will not be sufficient for many tasks and may not be able to process all documents and files stored in the E-Builder® Documents area.

SECTION 013200 – SCHEDULE – BAR CHART

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes requirements for a Bar Chart Schedule for the project construction activities, schedule of submittals, and schedule for testing.

PART 2 - PRODUCTS – (Not Applicable)

PART 3 - EXECUTION

3.1 SUBMITTAL PROCEDURES

- A. The Contractor shall submit to the Designer, within ten (10) working days following the Notice to Proceed, a Progress Schedule including Schedule of Values showing the rate of progress the Contractor agrees to maintain and the order in which he proposed to carry out the various phases of Work. No payments shall be made to the Contractor until the Progress Schedule has been approved by the Owner.
 - 1. The Schedule of Values must have the following line items included with the value of the item as indicated below:
 - a. O&M's (Owner's Manual)
 - 1) \$1,000,000.00 (One million) and under – 2% of the total contract amount
 - 2) Over \$1,000,000.00 (One million) – 1% of the total contract amount
 - b. Close Out Documents
 - 1) \$1,000,000.00 (One million) and under – 2% of the total contract amount
 - 2) Over \$1,000,000.00 (One million) – 1% of the total contract amount
 - c. General Conditions
 - 1) No more than 10%
- B. The Contractor shall submit an updated Schedule for presentation at each Monthly Progress Meeting. The Schedule shall be updated by the Contractor as necessary to reflect the current Schedule and its relationship to the original Schedule. The updated Schedule shall reflect any changes in the logic, sequence, durations, or completion date.

Payments to the Contractor shall be suspended if the Progress Schedule is not adequately updated to reflect actual conditions.

- C. The Contractor shall submit Progress Schedules to Subcontractors to permit coordinating their Progress Schedules to the general construction Work. The Contractor shall coordinate preparation and processing of Schedules and reports with performance of other construction activities.

3.2 CONSTRUCTION PROGRESS SCHEDULE – BAR CHART SCHEDULE

- A. Bar-Chart Schedule: The Contractor shall prepare a comprehensive, fully developed, horizontal bar chart-type Contractor's Construction Schedule. The Contractor for general construction shall prepare the Construction Schedule for the entire Project. The Schedule shall show the percentage of work to be completed at any time, anticipated monthly payments by Owner, as well as significant dates (such as completion of excavation, concrete foundation work, underground lines, superstructure, rough-ins, enclosure, hanging of fixtures, etc.) which shall serve as check points to determine compliance with the approved Schedule. The Schedule shall also include an activity for the number of "bad" weather days specified in Section 012100 – Allowances.
 - 1. The Contractor shall provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week.
 - a. If practical, use the same Schedule of Values breakdown for schedule time bars.
 - 2. The Contractor shall provide a base activity time bar showing duration for each construction activity. Each bar is to indicate start and completion dates for the activity. The Contractor is to place a contrasting bar below each original schedule activity time for indicating actual progress and planned remaining duration for the activity.
 - 3. The Contractor shall prepare the Schedule on a minimal number of separate sheets to readily show the data for the entire construction period.
 - 4. Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on schedule with other construction activities. Include minor elements involved in the overall sequence of the Work. Show each activity in proper sequence. Indicate graphically the sequences necessary for completion of related portions of the Work.
 - 5. Coordinate the Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittal Schedule, progress reports, payment requests, and other required schedules and reports.
 - 6. Indicate the Intent to Award and the Contract Substantial Completion dates on the schedule.
- B. Phasing: Provide notations on the schedule to show how the sequence of the Work is affected by the following:
 - 1. Requirement for Phased completion
 - 2. Work by separate Contractors

3. Work by the Owner
 4. Pre-purchased materials
 5. Coordination with existing construction
 6. Limitations of continued occupancies
 7. Un-interruptible services
 8. Partial Occupancy prior to Substantial Completion
 9. Site restrictions
 10. Provisions for future construction
 11. Seasonal variations
 12. Environmental control
- C. Work Stages: Use crosshatched bars to indicate important stages of construction for each major portion of the Work. Such stages include, but are not necessarily limited to, the following:
1. Subcontract awards
 2. Submittals
 3. Purchases
 4. Mockups
 5. Fabrication
 6. Sample testing
 7. Deliveries
 8. Installation
 9. Testing
 10. Adjusting
 11. Curing
 12. Startup and placement into final use and operation
- D. Area Separations: Provide a separate time bar to identify each major area of construction for each major portion of the Work. For the purposes of this Article, a “major area” is a story of construction, a separate building, or a similar significant construction element.
1. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Permanent space enclosure
 - c. Completion of mechanical installation
 - d. Completion of the electrical portion of the Work
 - e. Substantial Completion

3.3 SCHEDULE OF SUBMITTALS

- A. Upon acceptance of the Construction Progress Schedule, prepare and submit a complete schedule of submittals. Coordinate the submittal schedule with Section 013300 SUBMITTALS, the approved Construction Progress Schedule, list of subcontracts, Schedule of Values and the list of products.
- B. Prepare the schedule in chronological order. Provide the following information
 - 1. Scheduled date for the first submittal
 - 2. Related Section number
 - 3. Submittal category
 - 4. Name of the Subcontractor
 - 5. Description of the part of the Work covered
 - 6. Scheduled date for resubmittal
 - 7. Scheduled date for the Designer's final release or approval
- C. Distribution: Following the Designer's response to the initial submittal schedule, print and distribute copies to the Designer, Owner, subcontractors, and other parties required to comply with submittal dates indicated.
 - 1. Post copies in the Project meeting room and temporary field office.
 - 2. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned part of the Work and are no longer involved in construction activities.
- D. Schedule Updating: Revise the schedule after each meeting or other activity where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each meeting.

3.4 SCHEDULE OF INSPECTIONS AND TESTS

- A. Prepare a schedule of inspections, tests, and similar services required by the Contract Documents. Submit the schedule with (15) days of the date established for commencement of the Contract Work. The Contractor is to notify the testing agency at least (5) working days in advance of the required tests unless otherwise specified.
- B. Form: This schedule shall be in tabular form and shall include, but not be limited to, the following:
 - 1. Specification Section number
 - 2. Description of the test
 - 3. Identification of applicable standards
 - 4. Identification of test methods
 - 5. Number of tests required
 - 6. Time schedule or time span for tests

7. Entity responsible for performing tests
 8. Requirements for taking samples
 9. Unique characteristics of each service
- C. Distribution: Distribute the schedule to the Owner, Architect, and each party involved in performance of portions of the Work where inspections and tests are required.

END OF SECTION 013200

SECTION 013300 – SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions, Bid Form, and other Division 1 Specification Sections apply to this Section.
- B. Division 1, Section 013115 “Project Management Communications” for administrative requirements for communications.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for submittals required for performance of the Work including the following:
 - 1. Shop Drawings
 - 2. Product Data
 - 3. Samples
 - 4. Quality Assurance Submittals
 - 5. Construction Photographs
 - 6. Operating and Maintenance Manuals
 - 7. Warranties
- B. Administrative Submittals: Refer to General and Supplementary Conditions other applicable Division 1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to, the following:
 - 1. Construction Progress Schedule including Schedule of Values
 - 2. Performance and Payment Bonds
 - 3. Insurance Certificates
 - 4. Applications for Payment
 - 5. Certified Payroll Reports
 - 6. Partial and Final Receipt of Payment and Release Forms
 - 7. Affidavit – Compliance with Prevailing Wage Law
 - 8. Record Drawings
 - 9. Notifications, Permits, etc.
- C. The Contractor is obliged and responsible to check all shop drawings and schedules to assure compliance with contract plans and specifications. The Contractor is responsible for the content of the shop drawings and coordination with other contract work. Shop drawings and schedules shall indicate, in detail, all parts of an Item or Work including erection and setting instructions and integration with the Work of other trades.

- D. The Contractor shall at all times make a copy, of all approved submittals, available on site to the Construction Representative.

1.3 SUBMITTAL PROCEDURES

- A. The Contractor shall comply with the General and Supplementary Conditions and other applicable sections of the Contract Documents. The Contractor shall submit, with such promptness as to cause no delay in his work or in that of any other contractors, all required submittals indicated in Part 3.1 of this section and elsewhere in the Contract Documents. Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.
 - a. The Designer reserves the right to withhold action on a submittal requiring coordination with other submittals until all related submittals are received.
- B. Each drawing and/or series of drawings submitted must be accompanied by a letter of transmittal giving a list of the titles and numbers of the drawings. Each series shall be numbered consecutively for ready reference and each drawing shall be marked with the following information:
 - 1. Date of Submission
 - 2. Name of Project
 - 3. Location
 - 4. Section Number of Specification
 - 5. State Project Number
 - 6. Name of Submitting Contractor
 - 7. Name of Subcontractor
 - 8. Indicate if Item is submitted as specified or as a substitution

1.4 SHOP DRAWINGS

- A. Comply with the General Conditions, Article 3.2.
- B. The Contractor shall submit newly prepared information drawn accurately to scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not a Shop Drawing.
- C. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates, and similar drawings including the following information:

1. Dimensions
2. Identification of products and materials included by sheet and detail number
3. Compliance with specified standards
4. Notation of coordination requirements
5. Notation of dimensions established by field measurement
6. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least 8½"x11" but no larger than 36"x48".

1.5 PRODUCT DATA

- A. The Contractor shall comply with the General Conditions, Article 3.2.
- B. The Contractor shall collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information, such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves.
 1. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products that are not required, mark copies to indicate the applicable information including the following information:
 - a. Manufacturer's printed recommendations
 - b. Compliance with Trade Association standards
 - c. Compliance with recognized Testing Agency standards
 - d. Application of Testing Agency labels and seals
 - e. Notation of dimensions verified by field measurement
 - f. Notation of coordination requirements
 2. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.

1.6 SAMPLES

- A. The Contractor shall comply with the General Conditions, Article 3.2.
- B. The Contractor shall submit full-size, fully fabricated samples, cured and finished as specified, and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.
 1. The Contractor shall mount or display samples in the manner to facilitate review of qualities indicated. Prepare samples to match the Designer's sample including the following:
 - a. Specification Section number and reference
 - b. Generic description of the Sample
 - c. Sample source

- d. Product name or name of the Manufacturer
 - e. Compliance with recognized standards
 - f. Availability and delivery time
- 2. The Contractor shall submit samples for review of size, kind, color, pattern, and texture. Submit samples for a final check of these characteristics with other elements and a comparison of these characteristics between the final submittal and the actual component as delivered and installed.
 - a. Where variation in color, pattern, texture, or other characteristic is inherent in the material or product represented, submit at least three (3) multiple units that show approximate limits of the variations.
 - b. Refer to other Specification Sections for requirements for samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.
 - c. Refer to other Sections for samples to be returned to the Contractor for incorporation in the Work. Such samples must be undamaged at time of use. On the transmittal, indicate special requests regarding disposition of sample submittals.
 - d. Samples not incorporated into the Work, or otherwise designated as the Owner's property, are the property of the Contractor and shall be removed from the site prior to Substantial Completion.
- 3. Field samples are full-size examples erected onsite to illustrate finishes, coatings, or finish materials and to establish the Project standard.
 - a. The Contractor shall comply with submittal requirements to the fullest extent possible. The Contractor shall process transmittal forms to provide a record of activity.

1.7 QUALITY ASSURANCE DOCUMENTS

- A. The Contractor shall comply with the General Conditions, Article 3.2
- B. The Contractor shall submit quality control submittals including design data, certifications, manufacturer's instructions, manufacturer's field reports, and other quality-control submittals as required under other Sections of the Specifications.
- C. Certifications: Where other Sections of the Specifications require certification that a product, material, or installation complies with specified requirements, submit a notarized certification from the Manufacturer certifying compliance with specified requirements.
 - 1. Signature: Certification shall be signed by an officer of the Manufacturer or other individual authorized to contractually bind the Company.
- D. Inspection and Test Reports: The Contractor shall submit the required inspection and test reports from independent testing agencies as specified in this Section and in other Sections of the Contract Documents.
- E. Construction Photographs: The Contractor shall submit record construction photographs as specified in this Section and in other Sections of the Contract Documents.

1. The Contractor shall submit digital photographs. The Construction Administrator shall determine the quantity and naming convention at the preconstruction meeting.
2. The Contractor shall identify each photograph with project name, location, number, date, time, and orientation.
3. The Contractor shall submit progress photographs monthly unless specified otherwise. Photographs shall be taken one (1) week prior to submitting.
4. The Contractor shall take four (4) site photographs from differing directions and a minimum of five (5) interior photographs indicating the relative progress of the Work.

1.8 OPERATING AND MAINTENANCE MANUALS AND WARRANTIES

- A. The Contractor shall submit all required manufacturer's operating instructions, maintenance/service manuals, and warranties in accordance with the General Conditions, Article 3.5, and Supplementary Conditions along with this and other Sections of the Contract Documents.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 REQUIRED SUBMITTALS

- A. Contractor shall submit the following information for materials and equipment to be provided under this contract.

SPEC SECTION	TITLE	CATEGORY
013200	Schedules	Construction Schedule
013200	Schedules	Schedule of Values
013200	Schedules	List of Subcontractors
013200	Schedules	Major Material Suppliers
0282113.13	Glovebag Asbestos Abatement	Certification
0282113.13	Glovebag Asbestos Abatement	Test Report
064023	Interior Architectural Woodwork	Certification
064023	Interior Architectural Woodwork	Product Data
064023	Interior Architectural Woodwork	Shop Drawings
064023	Interior Architectural Woodwork	Sample
078413	Penetration Firestopping	Product Data
078413	Penetration Firestopping	Certification
078443	Joint Firestopping	Product Data
078443	Joint Firestopping	Certification
079200	Joint Sealants	Sample

079200	Joint Sealants	Product Data
079200	Joint Sealants	Test Report
081113	Hollow Metal Doors and Frames	Shop Drawings
081113	Hollow Metal Doors and Frames	Product Data
083113	Access Doors and Frames	Shop Drawings
083113	Access Doors and Frames	Product Data
087100	Door Hardware	Product Data
087100	Door Hardware	Operation / Maintenance Manual
087100	Door Hardware	Warranty
092116	Gypsum Board Assemblies	Sample
092116	Gypsum Board Assemblies	Product Data
093000	Tiling	Shop Drawings
093000	Tiling	Sample
093000	Tiling	Product Data
096500	Resilient Flooring	Sample
096500	Resilient Flooring	Product Data
096500	Resilient Flooring	Shop Drawings
096500	Resilient Flooring	Operation / Maintenance Manual
096513	Resilient Base and Accessories	Product Data
096513	Resilient Base and Accessories	Sample
099100	Painting	Product Data
099100	Painting	Sample
102113	Toilet Compartments	Product Data
102113	Toilet Compartments	Shop Drawings
102113	Toilet Compartments	Sample
102113	Toilet Compartments	Operation / Maintenance Manual
102800	Toilet, Bath, and Laundry Accessories	Shop Drawings
102800	Toilet, Bath, and Laundry Accessories	Sample
102800	Toilet, Bath, and Laundry Accessories	Operation / Maintenance Manual
220500	Common Work Results for Plumbing	Product Data
220500	Common Work Results for Plumbing	Certification
220515	Basic Piping Material and Methods	Product Data
220515	Basic Piping Material and Methods	Certification
220523	General Duty Valves for Plumbing Piping	Product Data
220523	General Duty Valves for Plumbing Piping	Certification
220529	Hangers and Supports for Plumbing Piping	Product Data
220529	Hangers and Supports for Plumbing Piping	Certification
220523	Identification for Plumbing Piping & Equipment	Product Data
220700	Plumbing Insulation	Product Data
220700	Plumbing Insulation	Operation / Maintenance Manual
221100	Water Distribution Piping and Specialties	Certification

221100	Water Distribution Piping and Specialties	Test Report
221100	Water Distribution Piping and Specialties	Product Data
221100	Water Distribution Piping and Specialties	Operation / Maintenance Manual
221300	Sanitary Drainage & Vent Piping & Specialties	Product Data
221300	Sanitary Drainage & Vent Piping & Specialties	Test Report
224000	Plumbing Fixtures	Product Data
224000	Plumbing Fixtures	Certification
224000	Plumbing Fixtures	Warranty
224000	Plumbing Fixtures	Operation / Maintenance Manual
230500	Common Work Results for HVAC	Product Data
230510	Basic Piping Materials and Methods	Product Data
230510	Basic Piping Materials and Methods	Certification
230529	Hangers and Supports for HVAC Piping and Equipment	Product Data
230529	Hangers and Supports for HVAC Piping and Equipment	Certification
230529	Hangers and Supports for HVAC Piping and Equipment	Product Data
230553	Identification for HVAC Piping and Equipment	Product Data
230553	Identification for HVAC Piping and Equipment	Operation / Maintenance Manual
230593	Testing, Adjusting and Balancing for HVAC	Certification
230593	Testing, Adjusting and Balancing for HVAC	Test Report
230700	HVAC Insulation	Product Data
230913	Instrumentation & Control Devices for HVAC	Product Data
230913	Instrumentation & Control Devices for HVAC	Shop Drawings
230913	Instrumentation & Control Devices for HVAC	Operation / Maintenance Manual
230913	Instrumentation & Control Devices for HVAC	Warranty
232113	Hydronic Piping	Product Data
232113	Hydronic Piping	Test Report
233113	Metal Ducts	Product Data
233713	Diffusers, Registers and Grilles	Shop Drawings
233713	Diffusers, Registers and Grilles	Product Data
233713	Diffusers, Registers and Grilles	Operation / Maintenance Manual
238200	Terminal Heating and Cooling Units	Product Data
238200	Terminal Heating and Cooling Units	Certification
238200	Terminal Heating and Cooling Units	Operation / Maintenance Manual
238200	Terminal Heating and Cooling Units	Warranty
260500	Common Work Results for Electrical	Product Data
260502	Equipment Wiring Systems	Product Data

260502	Equipment Wiring Systems	Shop Drawings
260519	Low-Voltage Elec Power Cond and Cables	Product Data
260519	Low-Voltage Elec Power Cond and Cables	Test Report
260519	Low-Voltage Elec Power Cond and Cables	As-Builts
260519	Low-Voltage Elec Power Cond and Cables	Operation / Maintenance Manual
260526	Grounding and Bonding for Electrical Systems	Product Data
260526	Grounding and Bonding for Electrical Systems	Test Report
260526	Grounding and Bonding for Electrical Systems	As-Builts
260529	Hangers and Supports for Electrical Systems	Product Data
260533	Raceway and Boxes for Electrical Systems	Shop Drawings
260533	Raceway and Boxes for Electrical Systems	As-Builts
260553	Identification for Electrical Systems	Product Data
260923	Lighting Control Devices	Product Data
260923	Lighting Control Devices	Operation / Maintenance Manual
262726	Wiring Devices	Product Data
265100	Interior Lighting	Certification
265100	Interior Lighting	Product Data
265100	Interior Lighting	Operation / Maintenance Manual
265100	Interior Lighting	Warranty
284600	Fire Detection and Alarm	Certification
284600	Fire Detection and Alarm	Test Report
284600	Fire Detection and Alarm	Shop Drawings
284600	Fire Detection and Alarm	Product Data
284600	Fire Detection and Alarm	Operation / Maintenance Manual
284600	Fire Detection and Alarm	Warranty

END OF SECTION 013300

SECTION 013513.19 – SITE SECURITY AND HEALTH REQUIREMENTS (DMH)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes general Institution rules.
- B. This Section includes requirements for infection control in environments that Clients are housed in, dine in, or participate in program activities in or adjacent to the Scope of Work area:
 - 1. The Contractor shall have the applicable measures specified below in-place any time demolition or construction activities occur in occupied or non-occupied project work areas.
 - 2. The Contractor shall complete all specified cleaning procedures and receive clearance from the Construction Representative prior to removing any barriers and other precautionary measures – even for areas that the Clients do not occupy during construction.

1.3 SUBMITTALS

- A. List of required submittals:
 - 1. Materials Safety Data Sheets for all hazardous materials to be brought onsite.
 - 2. Schedule of proposed shutdowns, if applicable.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 GENERAL RULES OF THE INSTITUTION

- A. All workers and supervisors employed by the Contractor or any Subcontractors shall be made aware that the buildings and grounds are part of a Department of Mental Health facility and that:
 - 1. The Residents or Patients are to be treated with dignity.
 - 2. Construction activities shall not interfere with normal facility operation, except as otherwise arranged with and approved by the Facility Authorities.
 - 3. Access to the Facility, Residents, and Staff by Emergency Responders shall not be compromised at any time.
 - 4. Fire exits, alarm systems, and sprinkler systems shall remain fully operational at all times unless written approval is received from the Construction Representative

and the appropriate Facility Representative at least (24) hours in advance. The Contractor shall submit a written time schedule for any proposed shutdowns.

5. Smoking is not permitted in State-operated buildings. Smoking on grounds shall be in accordance with local Facility regulations and only as approved by Facility Management.
6. Intoxicating beverages or narcotics shall not be brought upon the premises nor shall Contractor's personnel be under the influence of these substances while on the premises.
7. Explosives or firearms and other weapons shall not be allowed onsite.
8. Keys shall not be left in unattended vehicles. Vehicles shall be locked when not in use.
9. The Residents shall not be photographed. Maintaining confidentiality of the Residents shall be required.

B. Because of the persistent risk that Residents or Patients may cause harm to themselves or others, extreme caution and special care must be taken in the interest of safety.

1. Materials, tools, and construction apparatus including ropes, ladders, and flammable liquids shall not be left unattended during working hours and shall be securely stored during non-working hours. Secure storage includes lockable cabinets, rooms, trailers, and rigid fenced areas. The location and use of exterior storage areas shall be approved by the Construction Representative and Facility Management prior to their use.
2. An inventory of tools, equipment, and materials intended to be left unsecured must be submitted to and approved by the Construction Representative in advance.
3. Any missing tools, equipment, or material must be immediately reported to the Construction Representative and Facility Management. Unattended or unsecured tools, equipment, or material that poses a potential risk may be confiscated by Facility Staff and returned after completion of the appropriate request documents by the Contractor.
4. Access to construction areas must be controlled at all times. Appropriate barriers must be erected to secure trenches, pits, wiring, etc.
5. Material Safety Data Sheets, or their equivalent, shall be provided to the Construction Representative for all hazardous materials to be brought onsite at least a day before their delivery.
6. Construction debris and trash must be securely stored in approved containers or removed from the site at least daily.

C. If the safety of Residents or Staff is jeopardized because Safety Guidelines are not properly observed, the Facility Representative will notify the Construction Representative, who may stop the Work until the situation is resolved. In such case, the Work will resume only after the unsafe conditions have been corrected and the Contractor is notified by the Construction Representative to resume the Work.

3.2 ACCESS TO THE SITE

- A. The Contractor shall coordinate with the Facility and Construction Representative to establish a schedule for working hours. Normal working hours for this Facility are 7:30AM to 4:00PM Monday through Friday. Working hour changes or overtime are to be requested and approved (48) hours in advance. The need for emergency overtime shall be reported to the Construction Representative as soon as it is evident that overtime is needed.
- B. The Contractor shall provide the name and phone number of the individual who is in charge onsite and who can be contacted in case of an emergency. This individual must maintain a current list of names and addresses of all project construction personnel and to furnish this list to the Construction Representative or Facility Representative upon request.
- C. All construction personnel shall be identified to the Facility Representative and, when the Facility Representative feels it is necessary, they will be issued identification cards.

3.3 HEALTH AND TRAFFIC CONTROLS

- A. Take all reasonable and necessary measures to reduce air and water pollution by any material or equipment used during construction. Keep volatile wastes in approved covered containers. Do not dispose of volatile wastes or oils in storm or sanitary drains.
- B. Keep project area in a neat, clean, orderly, and safe condition at all times. Immediately remove all waste materials. Do not allow trash or rubbish to accumulate. Provide approved onsite containers for collection of trash and rubbish and dispose of it at frequent intervals during progression of the Work.
- C. No burning will be permitted on the grounds.
- D. Conduct all construction-related activities and management of debris to ensure minimum interference with roadways, streets, walks, utilities, and adjacent facilities.
- E. Do not obstruct streets, driveways, walks, or use facilities without permission from the Facility Representative.
- F. No driver shall exceed the Facility speed limit of 5mph.

3.4 SPECIFICATION OF REQUIRED INFECTION CONTROL PRECAUTIONS BY CLASS

Class I is for inspection and non-invasive type activities. These include, but are not limited to, the removal of ceiling tiles for visual inspection (1) tile per 50SqFt, painting without sanding, wall covering, electrical trim work, minor plumbing, and activities which do not generate dust or require cutting of walls or access to ceilings other than for visual inspection.

OR

Class II is for work that generates minimal to a high level of dust, requires demolition, or removal of any fixed building components or assemblies. Work of this type includes, but is not limited to, installation of telephone and computer cabling, access to chase spaces, cutting of walls or ceiling where dust migration can be controlled, sanding of walls for painting or wall covering, removal of

floor coverings, ceiling tiles and casework, new wall construction, minor duct work, electrical or plumbing work above ceilings, and any activity that cannot be completed within a single work shift.

OR

Class III is for major demolition and construction projects. Work includes, but is not limited to, activities which require consecutive work shifts, heavy demolition, the removal of a complete cabling system, and new construction.

The Facility Contact or the DMH Capital Improvements Administrator will help you determine which Class applies to the particular project:

- A. Class I: Contractor shall perform the following precautionary measures during the project:
 - 1. Execute work by methods to minimize raising dust from construction operations.
 - 2. Immediately replace a ceiling tile displaced for visual inspection.
- B. Class I: Contractor shall perform the following measures upon completion of the project:
 - 1. No work is required.

OR

- A. Class II: Contractor shall perform the following precautionary measures during the project:
 - 1. Provide active means to prevent airborne dust from dispersing into the atmosphere.
 - 2. Water mist work surfaces to control dust while cutting.
 - 3. Seal unused doors with duct tape.
 - 4. Block off and seal air vents.
 - 5. Place dust mat at entrance and exit of work area.
 - 6. Remove or isolate HVAC system in areas where work is being performed.
- B. Class II: Contractor shall perform the following measures upon completion of the project:
 - 1. Wipe work surfaces with disinfectant.
 - 2. Contain construction waste before transport in tightly covered containers.
 - 3. Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area.
 - 4. Remove isolation of HVAC system in areas where work was performed.

OR

- A. Class III: Contractor shall perform the following precautionary measures during the project:
 - 1. Remove or isolate HVAC system in area where work is being done to prevent contamination of duct system including block off and seal air vents.
 - 2. Complete all critical barriers, i.e., drywall, plywood, and plastic to seal area from non-work area or implement control cube method (use cart with plastic covering

- and sealed connection to worksite with HEPA vacuum for vacuuming prior to exit) before construction begins.
 - 3. Maintain negative air pressure within worksite utilizing HEPA equipped air filtration units.
 - 4. Place dust mat at entrance and exit of work area.
 - 5. Contain construction waste before transport in tightly covered containers.
 - 6. Cover transport receptacles or carts. Tape covering unless solid lid.
- B. Class III: Contractor shall perform the following measures upon completion of the project:
- 1. Do not remove barriers from work area until completed project is inspected by the Construction Representative and a Representative of the Facility's Safety and Inspection Control Section.
 - 2. Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction.
 - 3. Vacuum work area with HEPA filtered vacuums.
 - 4. Wet mop area with disinfectant.
 - 5. Remove isolation of HVAC system in areas where work is being performed.

3.5 SECURITY CLEARANCES AND RESTRICTIONS

A. FMDC CONTRACTOR BACKGROUND AND ID BADGE PROCESS

- 1. All employees of an OA/FMDC contractor (or subcontractor performing work under an OA/FMDC contract) are required to submit a fingerprint check through the Missouri State Highway Patrol (MSHP) and the FBI enabling OA/FMDC to obtain state and national criminal background checks on the employees, unless stated otherwise in the Contractor's contract.
- 2. FMDC reserves the right to prohibit any employee of the Contractor from performing work in or on the premises of any facility owned, operated, or utilized by the State of Missouri for any reason.
- 3. The Contractor shall ensure all of its employees submit fingerprints to the Missouri State Highway Patrol and pay for the cost of such background checks. The Contractor shall submit to FMDC via email to FMDCSecurity@oa.mo.gov a list of the names of the Contractor's employees who will be fingerprinted and a signed OA/FMDC Authorization for Release of Information Confidentiality Oath for each employee. All employees of the Contractor approved by FMDC to work at a State facility must obtain a contractor ID badge from FMDC prior to beginning work on-site, unless the Director of FMDC, at the Director's discretion, waives the requirement for a contractor ID badge. The Contractor and its employees must comply with the process for background checks and contractor ID badges found on FMDC's website at: <https://oa.mo.gov/facilities/facilities-operations/security-information/fmdc-contractor-background-and-id-badge>
- 4. Fingerprints and Authorization for Release of Information Confidentiality Oath form are valid for one (1) year and must be renewed annually. Changing or adding locations

may result in additional required documentation. Certain employees may be required to be fingerprinted more frequently. OA/FMDC reserves the right to request additional background checks at any time for any reason.

5. The Contractor shall notify FMDC via email to FMDCSecurity@oa.mo.gov within 48 hours of anyone severing employment with their company.

END OF SECTION 013513.19

SECTION 015000 – CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes requirements for construction facilities and temporary controls including temporary utilities, support facilities, security, and protection.
- B. Temporary utilities include, but are not limited to, the following:
 - 1. Water service and distribution
 - 2. Temporary electric power and light
 - 3. Temporary heat
 - 4. Ventilation
 - 5. Telephone service
 - 6. Sanitary facilities, including drinking water
 - 7. Storm and sanitary sewer
- C. Support facilities include, but are not limited to, the following:
 - 1. Field offices and storage sheds
 - 2. Temporary roads and paving
 - 3. Dewatering facilities and drains
 - 4. Temporary enclosures
 - 5. Hoists and temporary elevator use
 - 6. Temporary project identification signs and bulletin boards
 - 7. Waste disposal services
 - 8. Rodent and pest control
 - 9. Construction aids and miscellaneous services and facilities
- D. Security and protection facilities include, but are not limited to, to following:
 - 1. Temporary fire protection
 - 2. Barricades, warning signs, and lights
 - 3. Sidewalk bridge or enclosure fence for the site
 - 4. Environmental protection

1.3 SUBMITTALS

- A. Temporary Utilities: Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.
- B. Implementation and Termination Schedule: Within (15) days of the date established for commencement of the Work, submit a schedule indicating implementation and termination of each temporary utility.

1.4 QUALITY ASSURANCE

- A. Regulations: Comply with industry standards and applicable laws and regulations including, but not limited to, the following:
 - 1. Building code requirements
 - 2. Health and safety regulations
 - 3. Utility company regulations
 - 4. Police, fire department, and rescue squad rules
 - 5. Environmental protection regulations
- B. Standards: Comply with NFPA 241 “Standard for Safeguarding Construction, Alterations, and Demolition Operations”. ANSI A10 Series standards for “Safety Requirements for Construction and Demolition”, and NECA Electrical Design Library “Temporary Electrical Facilities”.
 - 1. Electrical Service: Comply with NEMA, NECA, and UL standards and regulations for temporary electric service. Install service in compliance with NFPA 70 “National Electric Code”.
- C. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

1.5 PROJECT CONDITIONS

- A. Temporary Utilities: Prepare a schedule indicating dates for implementation and termination of each temporary utility. At the earliest feasible time, when acceptable to the Owner, change over from use of temporary service to use of permanent service.
- B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Relocate temporary services and facilities as the Work progresses. Do not overload facilities or permit them to interfere with progress. Take necessary fire-prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist onsite.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide new materials. If acceptable to the Designer, the Contractor may use undamaged, previously used materials in serviceable condition. Provide materials suitable for use intended.
- B. Lumber and Plywood: Comply with requirements in Division 6 Section "Rough Carpentry".
 - 1. For signs and directory boards, provide exterior-type, Grade B-B high-density concrete form overlay plywood of sized and thicknesses indicated.
 - 2. For fences and vision barriers, provide minimum 3/9" (9.5mm) thick exterior plywood.
 - 3. For safety barriers, sidewalk bridges, and similar uses, provide minimum 5/8" (16mm) thick exterior plywood.
- C. Paint: Comply with requirements of Division 9 Section "Painting".
 - 1. For sign panels and applying graphics, provide exterior-grade alkyd gloss enamel over exterior primer.
- D. Water: Provide potable water approved by local health authorities.
- E. Open-Mesh Fencing: Provide 0.120" (3mm) thick, galvanized 2" (50mm) chainlink fabric fencing 6' (2m) high with galvanized steel pipe posts, 1½" (38mm) ID for line posts and 2½" (64mm) ID for corner posts.

2.2 EQUIPMENT

- A. General: Provide new equipment. If acceptable to the Designer, the Contractor may use undamaged, previously used equipment in serviceable condition. Provide equipment suitable for use intended.
- B. Water Hoses: Provide ¾" (19mm), heavy-duty, abrasion-resistant, flexible rubber hoses 100' (30m) long, with pressure rating greater than the maximum pressure of the water distribution system. Provide adjustable shutoff nozzles at hose discharge.
- C. Electrical Outlets: Provide properly configured, NEMA-polarized outlets to prevent insertion of 110 to 120V plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button, and pilot light for connection of power tools and equipment.
- D. Electrical Power Cords: Provide grounded extension cords. Use hard-service cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage rating.

- E. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered-glass enclosures where exposed to breakage. Provide exterior fixture where exposed to moisture.
- F. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM, or another recognized trade association related to the type of fuel being consumed.
- G. Temporary Toilet Units: Provide self-contained, single-occupant toilet units of the chemical, aerated re-circulation, or combustion type. Provide units properly vented and fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.
- H. Fire Extinguishers: Provide hand-carried, portable, UL-rated, Class A fire extinguishers for temporary offices and similar spaces. In other locations, provide hand-carried, portable, UL-rated, Class ABC, dry-chemical extinguishers, or a combination of extinguishers of NFPA-recommended classes for the exposures.
 - 1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.
- B. Provide each Facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Engage the appropriate local utility company to install temporary service or connect to existing service. Where company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with company recommendations.
 - 1. Arrange with company and existing users for a time when service can be interrupted, if necessary, to make connections for temporary services.
 - 2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked-in services.
 - 3. Obtain easements to bring temporary utilities to the site where the Owner's easements cannot be used for that purpose.
 - 4. Use Charges: Cost or use charges for temporary facilities are not chargeable to the Owner or Designer. Neither the Owner nor Designer will accept cost or use charges as a basis of claims for Change Order.

- B. Temporary Water Service: The Owner will provide water for construction purposes from the existing building system. All required temporary extensions shall be provided and removed by the Contractor. Connection points and methods of connection shall be designated and approved by the Construction Representative.
- C. Temporary Electric Power Service: The Owner will provide electric power for construction lighting and power tools. Contractors using such services shall pay all costs of temporary services, circuits, outlet, extensions, etc.
- D. Temporary Lighting: When overhead floor or roof deck has been installed, provide temporary lighting with local switching.
 - 1. Install and operate temporary lighting that will fulfill security and protection requirements without operating the entire system. Provide temporary lighting that will provide adequate illumination for construction operations and traffic conditions.
- E. Temporary Heating and Cooling: The normal heating and/or cooling system of the building shall be maintained in operation during the construction. Should the Contractor find it necessary to interrupt the normal HVAC service to spaces, which have not been vacated for construction, such interruptions shall be pre-scheduled with the Construction Representative.
- F. Temporary Toilets: Install self-contained toilet units. Use of pit-type privies will not be permitted. Comply with regulations and health codes for the type, number, location, operation, and maintenance of fixtures and facilities. Install where facilities will best serve the Project's needs.
 - 1. Shield toilets to ensure privacy.
 - 2. Provide separate facilities for male and female personnel.
 - 3. Provide toilet tissue materials for each facility.
- G. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel involved in handling materials that require wash-up for a health and sanitary condition. Dispose of drainage properly. Supply cleaning compounds appropriate for each condition.
 - 1. Provide paper towels or similar disposable materials for each facility.
 - 2. Provide covered waste containers for used material.
 - 3. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.
- H. Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of storm water from heavy rains.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Locate field offices, storage sheds, and other temporary construction and support facilities for easy access.

1. Maintain support facilities until near Substantial Completion. Remove prior to Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to the Owner.
- B. Field Offices: Provide insulated, weathertight temporary offices of sufficient size to accommodate required office personnel at the Project site. Keep the office clean and orderly for use for small progress meetings. Furnish and equip office as follows:
 1. Furnish with a desk and chairs, a 4-drawer file cabinet, plan table, plan rack, and a 6-shelf bookcase.
 2. Equip with a water cooler and private toilet complete with water closet, lavatory, and medicine cabinet unit with a mirror.
- C. Storage Facilities: The Owner will provide storage onsite as designated by the Facility Representative or the Construction Representative. Areas for use by the Contractor for storage will be identified at the Pre-Bid Meeting.
- D. Construction Parking: Parking at the site will be provided in the areas designated at the Pre-Construction Meeting.
- E. Temporary Lifts and Hoists: Provide facilities for hoisting materials and employees. Truck cranes and similar devices used for hoisting materials are considered “tools and equipment” and not temporary facilities.
- F. Project Identification and Temporary Signs: Prepare project identification and other signs of size indicated. Install signs where indicated to inform the public and persons seeking entrance to the Project. Support on posts or framing of preservative-treated wood or steel. Do not permit installation of unauthorized signs.
 1. Project Identification Signs: Engage an experienced sign painter to apply graphics. Comply with details indicated.
 2. Temporary Signs: Prepare signs to provide directional information to construction personnel and visitors.
- G. Temporary Exterior Lighting: Install exterior yard and sign lights so signs are visible when Work is being performed.
- H. Collection and Disposal of Waste: Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than seven (7) days during normal weather or three (3) days when the temperature is expected to rise above 80°F (27°C). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material lawfully.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Except for use of permanent fire protection as soon as available, do not change over from use of temporary security and protection facilities to permanent facilities until Substantial Completion, or longer, as requested by the Designer.

- B. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of the types needed to protect against reasonable predictable and controllable fire losses. Comply with NFPA 10 “Standard for Portable Fire Extinguishers” and NFPA 241 “Standard for Safeguarding Construction, Alterations, and Demolition Operations”.
 - 1. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one (1) extinguisher on each floor at or near each usable stairwell.
 - 2. Store combustible materials in containers in fire-safe locations.
 - 3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for fighting fires. Prohibit smoking in hazardous fire-exposure areas.
 - 4. Provide supervision of welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
- C. Permanent Fire Protection: At the earliest feasible date in each area of the Project complete installation of the permanent fire-protection facility including connected services and place into operation and use. Instruct key personnel on use of facilities.
- D. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed, provide lighting including flashing red or amber lights.
- E. Enclosure Fence: Before excavation begins, install an enclosure fence with lockable entrance gates. Locate where indicated, or enclose the entire site or the portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs, and other animals from easily entering the site, except by the entrance gates.
 - 1. Provide open-mesh, chainlink fencing with posts set in a compacted mixture of gravel and earth.
 - 2. Provide plywood fence, 8’ (2.5m) high, framed with (4) 2”x4” (50mm x 100mm) rails, and preservative-treated wood posts spaced not more than 8’ (2.5m) apart.
- F. Security Enclosure and Lockup: Install substantial temporary enclosure of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
 - 1. Storage: Where materials and equipment must be stored and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.
- G. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and minimize the possibility that air, waterways, and subsoil might be contaminated or polluted or that other undesirable effects might result. Avoid use of tools and equipment

that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near the site.

3.5 OPERATION, TERMINATION AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.
- B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
 - 2. Protection: Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.
- C. Termination and Removal: Unless the Designer requests that it be maintained longer, remove each temporary facility when the need has ended, when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are the Contractor's property. The Owner reserves the right to take possession of project identification signs.
 - 2. At Substantial Completion, clean and renovate permanent facilities used during the construction period including, but not limited to, the following:
 - a. Replace air filters and clean inside of ductwork and housing.
 - b. Replace significantly worn parts and parts subject to unusual operating conditions.
 - c. Replace lamps burned out or noticeably dimmed by hours of use.

END OF SECTION 015000

SECTION 017400 – CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for cleaning during the Project.
- B. Environmental Requirements: Conduct cleaning and waste-disposal operations in compliance with local laws and ordinances. Comply fully with federal and local environmental and anti-pollution regulations.
 - 1. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
 - 2. Burning or burying of debris, rubbish, or other waste material on the premises is not permitted.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by the manufacturer or fabricator for the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 PROGRESS CLEANING

- A. General
 - 1. Retain all stored items in an orderly arrangement allowing maximum access, not impeding drainage or traffic, and providing the required protection of materials.
 - 2. Do not allow the accumulation of scrap, debris, waste material, and other items not required for construction of this Work.
 - 3. At least twice each month, and more often if necessary, completely remove all scrap, debris, and waste material from the jobsite.
 - 4. Provide adequate storage for all items awaiting removal from the jobsite, observing all requirements for fire protection and protection of the ecology.
- B. Site
 - 1. Daily, inspect the site and pick up all scrap, debris, and waste material. Remove all such items to the place designated for their storage.
 - 2. Weekly, inspect all arrangements of materials stored onsite. Re-stack, tidy, or otherwise service all material arrangements.

3. Maintain the site in a neat and orderly condition at all times.

C. Structures

1. Daily, inspect the structures and pick up all scrap, debris, and waste material. Remove all such items to the place designated for their storage.
2. Weekly, sweep all interior spaces clean. "Clean" for the purposes of this paragraph, shall be interpreted as meaning free from dust and other material capable of being removed by use of reasonable effort and handheld broom.
3. In preparation for installation of succeeding materials, clean the structures or pertinent portions thereof to the degree of cleanliness recommended by the manufacturer of the succeeding material, using all equipment and materials required to achieve the required cleanliness.
4. Following the installation of finish floor materials, clean the finish floor daily while work is being performed in the space in which finish materials have been installed. "Clean" for the purposes of this subparagraph, shall be interpreted as meaning free from all foreign material which, in the opinion of the Construction Representative, may be injurious to the finish of the finish floor material.

3.2 FINAL CLEANING

- A. General: Provide final cleaning operations when indicated. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit of Work to the condition expected from a commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
- B. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for the entire Project or a portion of the Project.
 1. Clean the Project Site, yard and grounds, in areas disturbed by construction activities including landscape development areas, of rubbish, waste material, litter, and foreign substances.
 2. Sweep paved areas broom clean. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 3. Remove petrochemical spills, stains, and other foreign deposits.
 4. Remove tools, construction equipment, machinery, and surplus material from the site.
 5. Remove snow and ice to provide safe access to the building.
 6. 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.
 7. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 8. Broom clean concrete floors in unoccupied spaces.
 9. Vacuum clean carpet and similar soft surfaces removing debris and excess nap. Shampoo, if required.
 10. Clean transparent material, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-

obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.

11. Remove labels that are not permanent labels.
 12. 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 already show evidence of repair or restoration.
 - a. Do not paint over “UL” and similar labels, including mechanical and electrical nameplates.
 13. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 14. Clean plumbing fixtures to a sanitary condition free of stains, including stains resulting from water exposure.
 15. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 16. Clean ducts, blowers, and coils if units were operated without filters during construction
 17. 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.
 18. Leave the Project clean and ready for occupancy.
- C. Removal of Protection: Remove temporary protection and facilities installed during construction to protect previously completed installations during the remainder of the construction period.
- D. Compliances: Comply with governing regulations and safety standards for cleaning operations. Remove waste materials from the site and dispose of lawfully.
1. Where extra materials of value remain after Final Acceptance by the Owner, they become the Owner’s property.

END OF SECTION 017400

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
- B. Attendance Record: For each training module, submit list of participants and length of instruction time.
- C. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Date of video recording.
 - 2. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.

3. At completion of training, submit complete training manual(s) for Owner's use in PDF electronic file format on compact disc.

1.5 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative experienced in operation and maintenance procedures and training.
- C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Coordination". Review methods and procedures related to demonstration and training including, but not limited to, the following:
 1. Inspect and discuss locations and other facilities required for instruction.
 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 3. Review required content of instruction.
 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

- a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
2. Documentation: Review the following items in detail:
- a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
- a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
- a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 007213 "General Conditions".
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 2. Owner will furnish an instructor to describe Owner's operational philosophy.
 3. Owner will furnish Contractor with names and positions of participants.
- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 1. Schedule training with Owner with at least seven days' advance notice.

- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- D. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Video: Provide minimum 640 x 480 video resolution converted to format file type acceptable to Owner, on electronic media.
 - 1. Electronic Media: Read-only format compact disc acceptable to Owner, with commercial-grade graphic label.
 - 2. File Hierarchy: Organize folder structure and file locations according to project manual table of contents. Provide complete screen-based menu.
 - 3. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in Project specifications.
 - 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following for each Contractor involved on the Project, arranged according to Project table of contents:
 - a. Name of Contractor/Installer.
 - b. Business address.
 - c. Business phone number.
 - d. Point of contact.
 - e. E-mail address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
 - 1. Film training session(s) in segments not to exceed 15 minutes.
 - a. Produce segments to present a single significant piece of equipment per segment.
 - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
 - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.

1. Furnish additional portable lighting as required.
- E. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.
- F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
- G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION 017900

SECTION 02 41 19 - SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- C. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.4 PREDEMOLITION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
1. Inspect and discuss condition of construction to be selectively demolished.
 2. Review structural load limitations of existing structure.
 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 5. Review areas where existing construction is to remain and requires protection.

1.5 SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.

- B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property , for environmental protection , for dust control and , for noise control. Indicate proposed locations and construction of barriers.
- C. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's on-site operations are uninterrupted.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Predemolition Photographs or Video: Submit before Work begins.
- E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- F. Minutes of predemolition conference.
- G. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.6 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: Hazardous materials are present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
 - 1. Hazardous material remediation is specified elsewhere in the Contract Documents.
 - 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.

- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or preconstruction videotapes.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - f. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
- C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 3. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 4. Provide for temporary enclosures, dust control, heating, and cooling.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes

to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

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

B. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

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

END OF SECTION 02 41 19

SECTION 02 82 13.13
GLOVEBAG ASBESTOS ABATEMENT

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PART 1 - GENERAL

1.1 SUMMARY OF THE WORK

1.1.1 CONTRACT DOCUMENTS AND RELATED REQUIREMENTS

- A. Drawings, general provisions of the contract, including general and supplementary conditions and other Division 01 specifications, shall apply to the work of this section. The contract documents show the work to be done under the contract and related requirements and conditions impacting the project. Related requirements and conditions include applicable codes and regulations, notices and permits, existing site conditions and restrictions on use of the site, requirements for partial owner occupancy during the work, coordination with other work and the phasing of the work. In the event the Asbestos Abatement Contractor (Contractor) discovers a conflict in the contract documents and/or requirements or codes, the conflict must be brought to the immediate attention of the Contracting Officer for resolution. Whenever there is a conflict or overlap in the requirements, the most stringent shall apply. Any actions taken by the Contractor without obtaining guidance from the Contracting Officer shall become the sole risk and responsibility of the Contractor. All cost incurred due to such action are also the responsibility of the Contractor.

1.1.2 EXTENT OF WORK

- A. Below is a brief description of the estimated quantities of asbestos containing materials to be abated by the glove bag method. These quantities are for informational purposes only and are based on the best information available at the time of the specification preparation. The Contractor shall satisfy himself as the actual quantities to be abated. Nothing in this section may be interpreted as limiting the extent of work otherwise required by this contract and related documents.
- B. Removal, clean-up and disposal of ACM piping and fittings and asbestos contaminated elements in an appropriate regulated area in the following approximate quantities:
Approximately 115 hard mudded fittings, observed in the wall cavity between the small (east) restrooms and in the mechanical room, next to the large(center) restrooms. Please see Appendix B for the ACM material drawing.

1.1.3 RELATED WORK

- A. Section 2.2.7 of this Work Plan; FIRESTOPPING.

1.1.4 TASKS

The work tasks are summarized as follows:

- A. Pre-abatement activities including pre-abatement meeting(s), inspection(s), notifications, permits, submittal approvals, work-site preparations, emergency procedures arrangements, and standard operating procedures for glove bag asbestos abatement work.

- B. Abatement activities include removal, clean-up and disposal of ACM waste, recordkeeping, security, monitoring, and inspections.
- C. Cleaning and decontamination activities including final visual inspection, air monitoring and certification of decontamination.

1.1.5 ABATEMENT CONTRACTOR USE OF PREMISES

- A. The Contractor and Contractor's personnel shall cooperate fully with the CO and IH Consultant to facilitate efficient use of buildings and areas within buildings. The Contractor shall perform the work in accordance with the project specifications, drawings, phasing plan and in compliance with any/all applicable Federal, State, and Local regulations and requirements.
- B. The Contractor shall use the existing facilities in the building strictly within the limits indicated in contract documents as well as the approved pre-abatement work plan. Asbestos abatement drawings of partially occupied buildings will show the limits of regulated areas; the placement of decontamination facilities; the temporary location of bagged waste ACM; the path of transport to outside the building; and the temporary waste storage area for each building/regulated area. Any variation from the arrangements shown on drawings shall be secured in writing by the owner's representative/CO through the pre-abatement plan of action. The following limitations of use shall apply to existing facilities shown on drawings:

1.2 VARIATIONS IN QUANTITY

- A. The quantities and locations of ACM as indicated on the drawings and the extent of work included in this section are estimates which are limited by the physical constraints imposed by occupancy of the buildings. Accordingly, minor variations (+/- 5%) in quantities of ACM within the regulated area are considered as having no impact on contract price and time requirements of this contract. Where additional work is required beyond the above variation, the Contractor shall provide unit prices for additional footage for newly discovered materials and those prices will be used for additional work under the contract.

1.3 STOP ASBESTOS REMOVAL

- A. If the Contracting Officer (CO) or their field representative presents a written **Stop Asbestos Removal Order**, the Abatement Contractor/Personnel shall immediately stop all asbestos removal and adequately wet any exposed ACM. The Contractor shall not resume any asbestos removal activity until authorized to do so by the CO. A stop asbestos removal order may be issued at any time the CO determines abatement conditions/activities are not within specification requirements. The work stoppage will continue until conditions have been corrected to the satisfaction of the CO. Standby time and costs for corrective actions will be borne by the Contractor, including the industrial hygienist's time. The occurrence of any of the following events shall be reported immediately by the Contractor in writing to the Contracting Officer and shall require the

Contractor to immediately stop asbestos removal activities and initiate fiber reduction activities:

1. ≥ 0.01 f/cc outside a regulated area or >0.05 f/cc inside a regulated area.
2. breach/break in regulated area critical barrier(s)/floor.
3. serious injury/death at the site.
4. fire/safety emergency at the site.
5. respiratory protection system failure.
6. power failure or loss of wetting agent; or
7. any visible emissions observed outside the regulated area.

1.4 DEFINITIONS

1.4.1 GENERAL

- A. The definitions and explanations here are neither complete nor exclusive of all terms used in the contract documents but are general for the work to the extent they are not stated more explicitly in another element of the contract documents. Drawings must be recognized as diagrammatic in nature and not completely descriptive of the requirements indicated therein.

1.4.2 GLOSSARY

Abatement - Procedures to control fiber release from asbestos-containing materials, typically during removal. Includes removal, encapsulation, enclosure, demolition and renovation activities related to asbestos.

ACE - Asbestos contaminated elements.

ACM - Asbestos containing material.

Aerosol - Solid or liquid particulate suspended in air.

Adequately wet - Sufficiently mixed or penetrated with liquid to prevent the release of particulates. If visible emissions are observed coming from the ACM, then that material has not been adequately wetted.

Aggressive method - Removal or disturbance of building material by sanding, abrading, grinding, or other method that breaks, crumbles, or disintegrates intact ACM.

Aggressive sampling - EPA AHERA defined clearance sampling method using air moving equipment such as fans and leaf blowers to aggressively disturb and maintain in the air residual fibers after abatement.

AHERA - Asbestos Hazard Emergency Response Act. Asbestos regulations for schools, issued in 1987.

Aircell - Pipe or duct insulation made of corrugated cardboard which contains asbestos.

Air monitoring - The process of measuring the fiber content of a known volume of air collected over a specified period of time. The NIOSH 7400 Method is used to determine the fiber levels in air.

Air sample filter - The filter used to collect fibers which are then counted. The filter is made of mixed cellulose ester membrane for PCM (Phase Contrast Microscopy) and polycarbonate for TEM (Transmission Electron Microscopy)

Amended water - Water to which a surfactant (wetting agent) has been added to increase the penetrating ability of the liquid.

Asbestos - Includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that have been chemically treated or altered. Asbestos also includes PACM, as defined below.

Asbestos-containing material (ACM) - Any material containing more than one percent asbestos.

Asbestos contaminated elements (ACE) - Building elements such as ceilings, walls, lights, or ductwork that are contaminated with asbestos.

Asbestos-containing waste material - Asbestos-containing material or asbestos contaminated objects requiring disposal.

Asbestos waste decontamination facility - A system consisting of drum/bag washing facilities and a temporary storage area for cleaned containers of asbestos waste. Used as the exit for waste and equipment leaving the regulated area. In an emergency, it may be used to evacuate personnel.

Authorized person - Any person authorized by the CO, the Contractor, or owner and required by work duties to be present in regulated areas.

Authorized visitor - Any person approved by the CO; the contractor; or owner having jurisdiction over the regulated area.

Barrier - Any surface that isolates the regulated area and inhibits fiber migration from the regulated area.

Containment Barrier - An airtight barrier consisting of walls, floors, and/or ceilings of sealed plastic sheeting which surrounds and seals the outer perimeter of the regulated area.

Critical Barrier - The barrier responsible for isolating the regulated area from adjacent spaces, typically constructed of plastic sheeting secured in place at openings such as doors, windows, or any other opening into the regulated area.

Primary Barrier - Barriers placed over critical barriers and exposed directly to abatement work.

Secondary Barrier - Any additional sheeting used to isolate and provide protection from debris during abatement work.

Breathing zone - The hemisphere forward of the shoulders with a radius of about 150 - 225 mm (6 - 9 inches) from the worker's nose.

Bridging encapsulant - An encapsulant that forms a layer on the surface of the ACM.

Building/facility owner - The legal entity, including a lessee, which exercises control over management and recordkeeping functions relating to a building and/or facility in which asbestos activities take place.

Bulk testing - The collection and analysis of suspect asbestos containing materials.

Certified Industrial Hygienist (CIH) - One certified in practice of industrial hygiene by the American Board of Industrial Hygiene. An industrial hygienist Certified in Comprehensive Practice by the American Board of Industrial Hygiene.

Class I asbestos work - Activities involving the removal of Thermal System Insulation (TSI) and surfacing ACM and Presumed Asbestos Containing Material (PACM).

Class II asbestos work - Activities involving the removal of ACM which is not thermal system insulation or surfacing material. This includes, but is not limited to, the removal

of asbestos-containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastic.

Clean room/Changing room - An uncontaminated room having facilities for the storage of employee's street clothing and uncontaminated materials and equipment.

Clearance sample - The final air sample taken after all asbestos work has been done and visually inspected. Performed by a 3rd party industrial hygiene consultant.

Closely resemble - The major workplace conditions which have contributed to the levels of historic asbestos exposure, are no more protective than conditions of the current workplace.

Competent person - In addition to the definition in 29 CFR 1926.32(f), one who is capable of identifying existing asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure, who has the authority to take prompt corrective measures to eliminate them, as specified in 29 CFR 1926.32(f); in addition, for Class I and II work who is specially trained in a training course which meets the criteria of EPA's Model Accreditation Plan (40 CFR 763) for supervisor.

Count - Refers to the fiber count or the average number of fibers greater than five microns in length per cubic centimeter of air.

Decontamination area/unit - An enclosed area adjacent to and connected to the regulated area and consisting of an equipment room, shower room, and clean room, which is used for the decontamination of workers, materials, and equipment that are contaminated with asbestos.

Demolition - The wrecking or taking out of any load-supporting structural member and any related razing, removing, or stripping of asbestos products.

Disposal bag - Typically 6 mil thick sift proof, dustproof, leak tight container used to package and transport asbestos waste from regulated areas to the approved landfill. Each bag/container must be labeled/marked in accordance with EPA, OSHA and DOT requirements.

Disturbance - Activities that disrupt the matrix of ACM or PACM, crumble or pulverize ACM or PACM, or generate visible debris from ACM or PACM. Disturbance includes cutting away small amounts of ACM or PACM, no greater than the amount that can be contained in one standard sized glove bag or waste bag to access a building component. In no event shall the amount of ACM or PACM so disturbed exceed that which can be contained in one glove bag or disposal bag which shall not exceed 60 inches in length or width.

Drum - A rigid, impermeable container made of cardboard fiber, plastic, or metal which can be sealed in order to be sift proof, dustproof, and leak tight.

Employee exposure - The exposure to airborne asbestos that would occur if the employee were not wearing respiratory protection equipment.

Encapsulant - A material that surrounds or embeds asbestos fibers in an adhesive matrix and prevents the release of fibers.

Encapsulation - Treating ACM with an encapsulant.

Enclosure - The construction of an airtight, impermeable, permanent barrier around ACM to control the release of asbestos fibers from the material and also eliminate access to the material.

Equipment room - A contaminated room located within the decontamination area that is supplied with impermeable bags or containers for the disposal of contaminated protective clothing and equipment.

Fiber - A particulate form of asbestos, 5 microns or longer, with a length to width ratio of at least 3 to 1.

Fibers per cubic centimeter (f/cc) - Abbreviation for fibers per cubic centimeter, used to describe the level of asbestos fibers in air.

Filter - Media used in respirators, vacuums, or other machines to remove particulate from air.

Firestopping - Material used to close the open parts of a structure to prevent a fire from spreading.

Friable asbestos containing material - Any material containing more than 1 percent asbestos as determined using the method specified in appendix A, Subpart F, 40 CFR 763, section 1, Polarized Light Microscopy, that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.

Glove bag - Not more than a 60 x 60-inch impervious plastic bag-like enclosure affixed around an asbestos-containing material, with glove-like appendages through which materials and tools may be handled.

High efficiency particulate air (HEPA) filter - A filter capable of trapping and retaining at least 99.97 percent of all mono-dispersed particles of 0.3 microns or greater in diameter.

HEPA vacuum - Vacuum collection equipment equipped with a HEPA filter system capable of collecting and retaining asbestos fibers.

Homogeneous area - An area of surfacing, thermal system insulation or miscellaneous ACM that is uniform in color, texture and date of application.

HVAC - Heating, Ventilation and Air Conditioning

Industrial hygienist - A professional qualified by education, training, and experience to anticipate, recognize, evaluate and develop controls for occupational health hazards. Meets definition requirements of the American Industrial Hygiene Association (AIHA).

Industrial hygienist technician - A person working under the direction of an IH or CIH who has special training, experience, certifications and licenses required for the industrial hygiene work assigned.

Intact - The ACM has not crumbled, been pulverized, or otherwise deteriorated so that the asbestos is no longer likely to be bound with its matrix.

Lockdown - Applying encapsulant, after a final visual inspection, on all abated surfaces at the conclusion of ACM removal prior to removal of critical barriers.

National Emission Standards for Hazardous Air Pollutants (NESHAP's) - EPA's rule to control emissions of asbestos to the environment.

Negative initial exposure assessment - A demonstration by the employer which complies with the criteria in 29 CFR 1926.1101 (f)(2)(iii), that employee exposure during an operation is expected to be consistently below the PEL's.

Negative pressure - Air pressure, which is lower than the surrounding area, created by exhausting air from a sealed regulated area through HEPA equipped filtration units. OSHA requires maintaining -0.02" water gauge inside the negative pressure enclosure.

Negative pressure respirator - A respirator in which the air pressure inside the facepiece is negative during inhalation relative to the air outside the respirator.

Non-friable ACM - Material that contains more than 1 percent asbestos but cannot be crumbled, pulverized, or reduced to powder by hand pressure.

Organic vapor cartridge - The type of cartridge used on air purifying respirators for organic vapor exposures.

Outside air - The air outside buildings and structures, including, but not limited to, the air under a bridge or in an open ferry dock.

Owner/operator - Any person who owns, leases, operates, controls, or supervises the facility being demolished or renovated or any person who owns, leases, operates, controls, or supervises the demolition or renovation operation, or both.

Penetrating encapsulant - Encapsulant that is absorbed into the ACM matrix without leaving a surface layer.

Personal sampling/monitoring - Representative air samples obtained in the breathing zone of the person using a cassette and battery-operated pump to determine asbestos exposure.

Permissible exposure limit (PEL) - The level of exposure OSHA allows for an 8-hour time weighted average. For asbestos fibers, the PEL is 0.1 fibers per cc.

Polarized light microscopy (PLM) - Light microscopy using dispersion staining techniques and refractive indices to identify and quantify the type(s) of asbestos present in a bulk sample.

Polyethylene sheeting - Strong plastic barrier material 4 to 6 mils thick, semi-transparent, sometimes flame retardant in compliance with NFPA 241.

Positive/negative fit check - A method of verifying the fit of a respirator by closing off the filters and breathing in or closing off the exhalation valve and breathing out while detecting leakage of the respirator.

Presumed ACM (PACM) - Thermal system insulation, surfacing, and flooring material installed in buildings prior to 1981. If the building owner has actual knowledge or should have known through the exercise of due diligence that other materials are ACM, they too must be treated as PACM. The designation of PACM may be rebutted pursuant to 29 CFR 1926.1101 (k)(5).

Professional IH - An IH who meets the definition requirements of AIHA; meets the definition requirements of OSHA as a "Competent Person" at 29 CFR 1926.1101 (b); has completed two specialized EPA approved courses on management and supervision of asbestos abatement projects; has formal training in respiratory protection and waste disposal; and has a minimum of four projects of similar complexity with this project of which at least three projects serving as the supervisory IH.

Project designer - A person who has successfully completed the training requirements for an asbestos abatement project designer as required by 40 CFR 763 Appendix C, Part I: (B)(5).

Protection factor - A value assigned by OSHA/NIOSH to indicate the assigned protection a respirator should provide if worn properly. The number indicates the reduction of exposure level from outside to inside the respirator.

Qualitative fit test (QLFT) - A fit test using a challenge material that can be sensed by the wearer if leakage in the respirator occurs.

Quantitative fit test (QNFT) - A fit test using a challenge material which is quantified outside and inside the respirator thus allowing the determination of the actual fit factor.

Regulated area - An area established by the employer to demarcate where Class I, II, III asbestos work is conducted, and any adjoining area where debris and waste from such asbestos work may accumulate; and a work area within which airborne concentrations of asbestos exceed, or there is a reasonable possibility they may exceed the PEL.

Regulated ACM (RACM) - Friable ACM; Category I nonfriable ACM that has become friable; Category I nonfriable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading or; Category II nonfriable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of the demolition or renovation operation.

Removal - All operations where ACM, PACM and/or RACM are taken out or stripped from structures or substrates, including demolition operations.

Renovation - Altering a facility or one or more facility components in any way, including the stripping or removal of asbestos from a facility component which does not involve demolition activity.

Repair - Overhauling, rebuilding, reconstructing, or reconditioning of structures or substrates, including encapsulation or other repair of ACM or PACM attached to structures or substrates.

Shower room - The portion of the PDF where personnel shower before leaving the regulated area. Also used for bag/drum decontamination in the EDF.

Standard operating procedures (SOP's) - Asbestos work procedures required to be submitted by the contractor before work begins.

Supplied air respirator (SAR) - A respirator that utilizes an air supply separate from the air in the regulated area.

Surfacing ACM - A material containing more than 1 percent asbestos that is sprayed, troweled on or otherwise applied to surfaces for acoustical, fireproofing and other purposes.

Surfactant - A chemical added to water to decrease water's surface tension thus making it more penetrating into ACM.

Thermal system ACM - A material containing more than 1 percent asbestos applied to pipes, fittings, boilers, breeching, tanks, ducts, or other structural components to prevent heat loss or gain.

Transmission electron microscopy (TEM) - A microscopy method that can identify and count asbestos fibers.

Visible emissions - Any emissions, which are visually detectable without the aid of instruments, coming from ACM/PACM/RACM or ACM waste material.

Waste generator - Any owner or operator whose act or process produces asbestos-containing waste material.

Waste/Equipment decontamination facility (W/EDF) - The area in which equipment is decontaminated before removal from the regulated area.

Waste shipment record - The shipping document, required to be originated and signed by the waste generator, used to track and substantiate the disposition of asbestos-containing waste material.

Wet cleaning - The process of thoroughly eliminating, by wet methods, any asbestos contamination from surfaces or objects.

1.4.3 REFERENCED STANDARDS ORGANIZATIONS

The following acronyms or abbreviations as referenced in contract/ specification documents are defined to mean the associated names. Names and addresses may be subject to change.

- A. VA Department of Veterans Affairs
810 Vermont Avenue, NW
Washington, DC 20420
- B. AIHA American Industrial Hygiene Association
2700 Prosperity Avenue, Suite 250
Fairfax, VA 22031
703-849-8888
- C. ANSI American National Standards Institute
1430 Broadway
New York, NY 10018
212-354-3300
- D. ASTM American Society for Testing and Materials
1916 Race St.
Philadelphia, PA 19103
215-299-5400
- E. CFR Code of Federal Regulations
Government Printing Office
Washington, DC 20420
- F. CGA Compressed Gas Association
1235 Jefferson Davis Highway
Arlington, VA 22202
703-979-0900
- G. CS Commercial Standard of the National Institute of Standards and Technology (NIST)
U. S. Department of Commerce
Government Printing Office
Washington, DC 20420
- H. EPA Environmental Protection Agency
401 M St., SW
Washington, DC 20460
202-382-3949
- I. MIL-STD Military Standards/Standardization Division
Office of the Assistant Secretary of Defense
Washington, DC 20420

- J. MSHA Mine Safety and Health Administration
Respiratory Protection Division
Ballston Tower #3
Department of Labor
Arlington, VA 22203
703-235-1452
- J. NIST National Institute for Standards and Technology
U. S. Department of Commerce
Gaithersburg, MD 20234
301-921-1000
- K. NEC National Electrical Code (by NFPA)
- M. NEMA National Electrical Manufacturer's Association
2101 L Street, NW
Washington, DC 20037
- N. NFPA National Fire Protection Association
1 Battery March Park
P.O. Box 9101
Quincy, MA 02269-9101
800-344-3555
- O. NIOSH National Institutes for Occupational Safety and Health
4676 Columbia Parkway
Cincinnati, OH 45226
513-533-8236
- P. OSHA Occupational Safety and Health Administration
U.S. Department of Labor
Government Printing Office
Washington, DC 20402
- Q. UL Underwriters Laboratory
333 Pfingsten Rd.
Northbrook, IL 60062
312-272-8800
- R. USA United States Army
Army Chemical Corps
Department of Defense
Washington, DC 20420

1.5 APPLICABLE CODES AND REGULATIONS

1.5.1 GENERAL APPLICABILITY OF CODES, REGULATIONS, AND STANDARDS

- A. All work under this contract shall be done in strict accordance with all applicable Federal, State, and local regulations, standards and codes governing asbestos abatement, and any other trade work done in conjunction with the abatement. All applicable codes, regulations and standards are adopted into this specification and will have the same force and effect as this specification.
- B. The most recent edition of any relevant regulation, standard, document or code shall be in effect. Where conflict among the requirements of these specifications exists, the most stringent requirement(s) shall be utilized.
- C. Copies of all standards, regulations, codes and other applicable documents, including this specification and those listed in Section 1.5 shall be available at the worksite in the clean change area of the worker decontamination system.

1.5.2 CONTRACTOR RESPONSIBILITY

- A. The Contractor shall assume full responsibility and liability for compliance with all applicable Federal, State and Local regulations related to all aspects of the abatement project. The contractor is responsible for providing and maintaining training, accreditation, medical exams, medical records, and personal protective equipment as required by applicable Federal, State and Local regulations. The contractor shall hold the owner and 3rd party consultants harmless for any failure to comply with any applicable work, packaging, transporting, disposal, safety, health, or environmental requirement on the part of himself, his employees, or his subcontractors.

1.5.3 FEDERAL REQUIREMENTS

Federal requirements which govern some aspect of asbestos abatement include, but are not limited to, the following regulations.

- A. Occupational Safety and Health Administration (**OSHA**)
 - 1. Title 29 CFR 1926.1101 - Construction Standard for Asbestos
 - 2. Title 29 CFR 1910.132 - Personal Protective Equipment
 - 3. Title 29 CFR 1910.134 - Respiratory Protection
 - 4. Title 29 CFR 1926 - Construction Industry Standards
 - 5. Title 29 CFR 1910.1020 - Access to Employee Exposure and Medical Records
 - 6. Title 29 CFR 1910.1200 - Hazard Communication
 - 7. Title 29 CFR 1910.151 - Medical and First Aid
- B. Environmental Protection Agency (**EPA**)
 - 1. 40 CFR 61 Subpart A and M (Revised Subpart B) - National Emission Standard for Hazardous Air Pollutants - Asbestos.

2. 40 CFR 763.80 - Asbestos Hazard Emergency Response Act (AHERA)

C. Department of Transportation (**DOT**)
Title 49 CFR 100 - 185 – Transportation

1.5.4 STATE REQUIREMENTS:

Missouri Department of Natural Resources (MDNR) State Regulations 10 CSR 10-6.241
– Asbestos Projects-Registration, Notification & Performance Requirements

1.5.5 LOCAL REQUIREMENTS

If local requirements are more stringent than federal or state standards, the local standards are to be followed.

1.5.6 STANDARDS

- A. Standards which govern asbestos abatement activities include, but are not limited to, the following:
 - 1. American National Standards Institute (ANSI)Z9.2-79 - Fundamentals Governing the Design and Operation of Local Exhaust Systems Z88.2 - Practices for Respiratory Protection.
 - 2. Underwriters Laboratories (UL)586-90 - UL Standard for Safety of HEPA filter Units, 7th Edition.
- B. Standards which govern encapsulation work include, but are not limited to, the following:
 - 1. American Society for Testing and Materials (ASTM)
- C. Standards which govern the fire and safety concerns in abatement work include, but are not limited to, the following:
 - 1. National Fire Protection Association (NFPA) 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations.
 - 2. NFPA 701 - Standard Methods for Fire Tests for Flame Resistant Textiles and Film.
 - 3. NFPA 101 - Life Safety Code

1.5.7 EPA GUIDANCE DOCUMENTS

- A. EPA guidance documents which discuss asbestos abatement work activities are listed below. These documents are made part of this section by reference. EPA publications can be ordered from (800) 424-9065.
- B. Guidance for Controlling ACM in Buildings (Purple Book) EPA 560/5-85-024
- C. Asbestos Waste Management Guidance EPA 530-SW-85-007.

D. A Guide to Respiratory Protection for the Asbestos Abatement Industry EPA-560-OPTS-86-001

E. Guide to Managing Asbestos in Place (Green Book) TS 799 20T July 1990

1.5.8 NOTICES

- A. State and Local agencies: Send written notification as required by state and local regulations including the local fire department prior to beginning any work on ACM as follows:
- B. Copies of notifications shall be submitted to the owner for the facility's records in the same time frame notification is given to EPA, State, and Local authorities.

1.5.9 PERMITS/LICENSES

The contractor shall apply for and have all required permits and licenses to perform asbestos abatement work as required by Federal, State, and Local regulations.

1.5.10 POSTING AND FILING OF REGULATIONS

Maintain two (2) copies of applicable federal, state, and local regulations. Post one copy of each at the regulated area where workers will have daily access to the regulations and keep another copy in the Contractor's office.

1.5.11 OWNER RESPONSIBILITIES

Prior to commencement of work:

- A. Notify occupants adjacent to regulated areas of project dates and requirements for relocation, if needed. Arrangements must be made prior to starting work for relocation of desks, files, equipment and personal possessions to avoid unauthorized access into the regulated area. **Note: Notification of adjacent personnel is required by OSHA in 29 CFR 1926.1101 (k) to prevent unnecessary or unauthorized access to the regulated area.**
- B. Submit to the Contractor results of background air sampling; including location of samples, person who collected the samples, equipment utilized and method of analysis.
- C. During abatement, submit to the Contractor results of bulk material analysis and air sampling data collected during the course of the abatement. This information shall not release the Contractor from any responsibility for OSHA compliance.

1.5.12 SITE SECURITY

- A. Regulated area access is to be restricted only to authorized, trained/accredited and protected personnel. These may include the Contractor's employees, employees of

Subcontractors, facility employees and representatives, State and local inspectors, and any other designated individuals. A list of authorized personnel shall be established prior to commencing the project and be posted in the clean room of the decontamination unit.

- B. Entry into the regulated area by unauthorized individuals shall be reported immediately to the Competent Person by anyone observing the entry. The Competent Person shall immediately notify the CO.
- C. A logbook shall be maintained in the clean room of the decontamination unit. Anyone who enters the regulated area must record their name, affiliation, time in, and time out for each entry.
- D. Access to the regulated area shall be through a single decontamination unit, if required. All other access (doors, windows, hallways, etc.) shall be sealed or locked to prevent entry to or exit from the regulated area. The only exceptions for this requirement are the waste/equipment load-out area which shall be sealed except during the removal of containerized asbestos waste from the regulated area, and emergency exits. Emergency exits shall not be locked from the inside, however, they shall be sealed with poly sheeting and taped until needed.
- E. The Contractor's Competent Person shall control site security during abatement operations to isolate work in progress and protect adjacent personnel. A 24-hour security system shall be provided at the entrance to the regulated area to assure that all entrants are logged in/out and that only authorized personnel are allowed entrance.
- F. The Abatement Contractor will have the owner's assistance in notifying adjacent personnel of the presence, location and quantity of ACM in the regulated area and enforcement of restricted access by facility employees.
- G. The regulated area shall be locked during non-working hours and secured by facility security.

1.5.13 EMERGENCY ACTION PLAN AND ARRANGEMENTS

- A. An Emergency Action Plan shall be developed by the Contractor prior to commencing abatement activities and shall be agreed to by the Contractor and the Owner. The Plan shall meet the requirements of 29 CFR 1910.38 (a);(b).
- B. Emergency procedures shall be in written form and prominently posted and available in the regulated area. Everyone, prior to entering the regulated area, must read and sign these procedures to acknowledge their understanding of the regulated area layout, location of emergency exits and emergency procedures.
- C. Emergency planning shall include written notification of police, fire, and emergency medical personnel of planned abatement activities; work schedule and layout of regulated area, particularly barriers that may affect response capabilities.

- D. Emergency planning shall include consideration of fire, explosion, hazardous atmospheres, electrical hazards, slips/trips and falls, confined spaces, and heat stress illness. Written procedures for response to emergency situations shall be developed and employee training in procedures shall be provided.
- E. Employees shall be trained in regulated area/site evacuation procedures in the event of workplace emergencies.
 - 1. For non-life-threatening situations - employees injured or otherwise incapacitated shall decontaminate following normal procedures with assistance from fellow workers, if necessary, before exiting the regulated area to obtain proper medical treatment.
 - 2. For life-threatening injury or illness, worker decontamination shall take least priority after measures to stabilize the injured worker, remove them from the regulated area, and secure proper medical treatment.
- E. Telephone numbers of all emergency response personnel shall be prominently posted in the clean room, along with the location of the nearest telephone.
- F. The Contractor shall provide verification of first aid/CPR training for personnel responsible for providing first aid/CPR. OSHA requires medical assistance within 3 minutes of a life-threatening injury/illness. Bloodborne Pathogen training shall also be verified for those personnel required to provide first aid/CPR.
- G. The Emergency Action Plan shall provide for a Contingency Plan if an incident occurs that may require the modification of the standard operating procedures during abatement. Such incidents include, but are not limited to, fire, accidents, and power failure. The Contractor shall detail procedures to be followed in the event of an incident assuring that work is stopped and wetting is continued until correction of the problem.

1.5.14 PRE-CONSTRUCTION MEETING

Prior to commencing the work, the Contractor shall meet with the VPCIH to present and review, as appropriate, the items following this paragraph. The Contractor's Competent Person(s) who will be on-site shall participate in the pre-start meeting. The pre-start meeting is to discuss and determine procedures to be used during the project. At this meeting, the Contractor shall provide:

- A. Proof of Contractor licensing.
- B. Proof the Competent Person is trained and accredited and approved for working in this State. Verification of the experience of the Competent Person shall also be presented.
- C. A list of all workers who will participate in the project, including experience and verification of training and accreditation.
- D. A list of and verification of training for all personnel who have current first-aid/CPR training. A minimum of one person per shift must have adequate training.
- E. Current medical written opinions for all personnel working on-site meeting the requirements of 29 CFR 1926.1101 (m).

- F. Current fit-tests for all personnel wearing respirators on-site meeting the requirements of 29 CFR 1926.1101 (h) and Appendix C.
- G. A copy of the Contractor's Standard Operating Procedures for Class I Glove bag Asbestos Abatement. In these procedures, the following information must be detailed, specific for this project.
 - 1. Regulated area preparation procedures.
 - 2. Notification requirements procedure of Contractor as required in 29 CFR 1926.1101 (d).
 - 3. If required, decontamination area set-up/layout and decontamination procedures for employees.
 - 4. Glove bag abatement methods/procedures and equipment to be used.
 - 5. Personal protective equipment to be used.
- H. At this meeting the Contractor shall provide all submittals as required.
- I. Procedures for handling, packaging and disposal of asbestos waste.
- J. Emergency Action Plan and Contingency Plan Procedures.

1.6 PROJECT COORDINATION

- A. The following are the minimum administrative and supervisory personnel necessary for coordination of the work.

1.6.1 PERSONNEL

- A. Administrative and supervisory personnel shall consist of a qualified Competent Person as defined by OSHA in the Construction Standards and the Asbestos Construction Standard, Contractor Professional Industrial Hygienist and Industrial Hygiene Technicians. These employees are the Contractor's representatives responsible for compliance with these specifications and all other applicable requirements.
- B. Non-supervisory personnel shall consist of an adequate number of qualified personnel to meet the schedule requirements of the project. Personnel shall meet the required qualifications. Personnel utilized on-site shall be pre-approved by the Owner's representative/CO. A request for approval shall be submitted for any person to be employed during the project giving the person's name; social security number; qualifications; accreditation card with picture; Certificate of Worker's Acknowledgment; and Affidavit of Medical Surveillance and Respiratory Protection and current Respirator Fit Test.
- C. Minimum qualifications for Contractor and assigned personnel are:
 - 1. The Contractor has conducted within the last three (3) years, three (3) projects of similar complexity and dollar value as this project; has not been cited and penalized for serious violations of asbestos regulations in the past three (3) years; has adequate liability/occurrence insurance for asbestos work; is licensed in applicable states; has adequate and qualified personnel available to complete the work; has comprehensive standard operating procedures for asbestos work; has adequate materials, equipment and supplies to perform the work.

2. The Competent Person has four (4) years of abatement experience of which two (2) years were as the Competent Person on the project; meets the OSHA definition of a Competent Person; has been the Competent Person on two (2) projects of similar size and complexity as this project; has completed EPA AHERA/OSHA/State/Local training requirements/accreditation(s) and refreshers; and has all required OSHA documentation related to medical and respiratory protection.
3. The Abatement Personnel shall have completed the EPA AHERA/OSHA abatement worker course; have training on the standard operating procedures of the Contractor; has one year of asbestos abatement experience; has applicable medical and respiratory protection documentation; has certificate of training/current refresher and State accreditation/license.

1.7 RESPIRATORY PROTECTION

1.7.1 GENERAL - RESPIRATORY PROTECTION PROGRAM

- A. The Contractor shall develop and implement a Respiratory Protection Program (RPP) which is in compliance with the January 8, 1998, OSHA requirements found at 29 CFR 1926.1101 and 29 CFR 1910.132;134.

ANSI Standard Z88.2-1992 provides excellent guidance for developing a respiratory protection program. All respirators used must be NIOSH approved for asbestos abatement activities. The written respiratory protection shall, at a minimum, contain the basic requirements found at 29 CFR 1910.134 (c)(1) (i - ix) - Respiratory Protection Program.

1.7.2 RESPIRATORY PROTECTION PROGRAM COORDINATOR

- A. The Respiratory Protection Program Coordinator (RPPC) must be identified and shall have two (2) years' experience coordinating the program. The RPPC must provide a signed statement attesting to the fact that the program meets the above requirements.

1.7.3 SELECTION AND USE OF RESPIRATORS

- A. The procedure for the selection and use of respirators must be submitted to the CO and IH as part of the Contractor's qualification. The procedure must be written clearly enough for workers to understand. A copy of the Respiratory Protection Program must be available in the clean room of the decontamination unit for reference by employees or authorized visitors.

1.7.4 MINIMUM RESPIRATORY PROTECTION

- A. Minimum respiratory protection shall be a full-face powered air purifying respirator when fiber levels are maintained consistently at or below 0.5 f/cc. A higher level of respiratory protection may be provided or required, depending on fiber levels. Respirator selection shall meet the requirements of 29 CFR 1926.1101 (h); Table 1, except as

indicated in this paragraph. Abatement personnel must have a respirator for their exclusive use.

1.7.5 MEDICAL WRITTEN OPINION

- A. No employee shall be allowed to wear a respirator unless a physician has determined they are capable of doing so and has issued a written opinion for that person.

1.7.6 RESPIRATOR FIT TEST

- A. All personnel wearing respirators shall have a current quantitative fit test which was conducted in accordance with 29 CFR 1910.134 (f) and Appendix A. Fit tests shall be done for PAPR's which have been put into a failure mode.

1.7.7 RESPIRATOR FIT CHECK

- A. The Competent Person shall assure that the positive/negative fit check is done each time the respirator is donned by an employee. Head coverings must cover respirator head straps. Any situation that prevents an effective facepiece to face seal as evidenced by failure of a fit check shall preclude that person from wearing a respirator until resolution of the problem.

1.7.8 MAINTENANCE AND CARE OF RESPIRATORS

- A. The Respiratory Protection Program Coordinator shall submit evidence and documentation showing compliance with 29 CFR 1910.134 (h) maintenance and care of respirators.

1.8 WORKER PROTECTION

1.8.1 TRAINING OF ABATEMENT PERSONNEL

- A. Prior to beginning any abatement activity, all personnel shall be trained in accordance with OSHA 29 CFR 1926.1101 (k)(9) and any additional State/Local requirements. Training must include, at a minimum, the elements listed at 29 CFR 1926.1101 (k)(9)(viii). Training shall have been conducted by a third party, EPA/State approved trainer meeting the requirements of EPA 40 CFR 763 Appendix C (AHERA MAP). Initial training certificates and current refresher and accreditation proof must be submitted for each person working at the site.

1.8.2 MEDICAL EXAMINATIONS

- A. Medical examinations meeting the requirements of 29 CFR 1926.1101 (m) shall be provided for all personnel working in the regulated area, regardless of exposure levels. The physician's written opinion as required by 29 CFR 1926.1101 (m)(4) shall be provided for each person and shall include in the opinion the person has been evaluated for working in a heat stress environment while wearing personal protective equipment and is able to perform the work.

1.8.3 PERSONAL PROTECTIVE EQUIPMENT

- A. Provide whole body clothing, head coverings, foot coverings and any other personal protective equipment as determined by conducting the hazard assessment required by OSHA at 29 CFR 1910.132 (d). The Competent Person shall ensure the integrity of personal protective equipment worn for the duration of the project. Duct tape shall be used to secure all suit sleeves to wrists and to secure foot coverings at the ankle.

1.8.4 REGULATED AREA ENTRY PROCEDURE

- A. Worker protection shall meet the most stringent requirement. The Competent Person shall ensure that each time workers enter the regulated area, they remove ALL street clothes in the clean room of the decontamination unit and put on new disposable coveralls, head coverings, a clean respirator, and then proceed through the shower room to the equipment room where they put on non-disposable required personal protective equipment.

1.8.5 DECONTAMINATION PROCEDURE – PAPR

The Competent Person shall require all personnel to adhere to the following decontamination procedures whenever they leave the regulated area.

- A. When exiting the regulated area, remove disposable coveralls, and ALL other clothes, disposable head coverings, and foot coverings or boots in the equipment room.
- B. Still wearing the respirator and completely naked, proceed to the shower. Showering is MANDATORY. Care must be taken to follow reasonable procedures in removing the respirator to avoid asbestos fibers while showering. The following procedure is required as a minimum:
 - 1. Thoroughly wet body including hair and face. If using a PAPR hold blower above head to keep filters dry.
 - 2. With respirator still in place, thoroughly decontaminate body, hair, respirator face piece, and all other parts of the respirator except the blower and battery pack on a PAPR. Pay particular attention to cleaning the seal between the face and respirator facepiece and under the respirator straps.
 - 3. Take a deep breath, hold it and/or exhale slowly, completely wetting hair, face, and respirator. While still holding breath, remove the respirator and hold it away from the face before starting to breathe.
- C. Carefully decontaminate the facepiece of the respirator inside and out. If using a PAPR, shut down using the following sequence: a) first cap inlets to filters; b) turn blower off to keep debris collected on the inlet side of the filter from dislodging and contaminating the outside of the unit; c) thoroughly decontaminate blower and hoses; d) carefully decontaminate battery pack with a wet rag being cautious of getting water in the battery pack thus preventing destruction. **THIS PROCEDURE IS NOT A SUBSTITUTE FOR RESPIRATOR CLEANING!**
- D. Shower and wash the body completely with soap and water. Rinse thoroughly.

- E. Rinse the shower room walls and floor to drain prior to exiting.
- F. Proceed from shower to clean room; dry off and change into street clothes or into new disposable work clothing.

1.8.6 REGULATED AREA REQUIREMENTS

- A. The Competent Person shall meet all requirements of 29 CFR 1926.1101 (o) and assure that all requirements for Class I glove bag regulated areas at 29 CFR 1926.1101 (e) are met. All personnel in the regulated area shall not be allowed to eat, drink, smoke, chew tobacco or gum, apply cosmetics, or in any way interfere with the fit of their respirator.

1.9 DECONTAMINATION FACILITIES

1.9.1 DESCRIPTION

- A. Provide each regulated area with separate personnel (PDF) and waste/equipment decontamination facilities (W/EDF). Ensure that the PDF is the only means of ingress and egress to the regulated area and that all equipment, bagged waste, and other material exit the regulated area only through the W/EDF.

1.9.2 GENERAL REQUIREMENTS

- A. All personnel entering or exiting a regulated area shall follow the requirements at 29 CFR 1926.1101 (j)(1) and these specifications. All equipment and materials must exit the regulated area through the W/EDF and be decontaminated in accordance with these specifications. Walls and ceilings of the PDF and W/EDF must be constructed of a minimum of 3 layers of 6 mil opaque fire-retardant polyethylene sheeting and be securely attached to existing building components and/or an adequate temporary framework. A minimum of 3 layers of 6 mil poly shall also be used to cover the floor under the PDF and W/EDF units. Construct doors so that they overlap and secure adjacent surfaces. Weigh sheets with layers of duct tape so that they close quickly after release. Put arrows on sheets so they show direction of travel and overlap. If the building adjacent area is occupied, construct a solid barrier on the occupied side(s) to protect the sheeting.

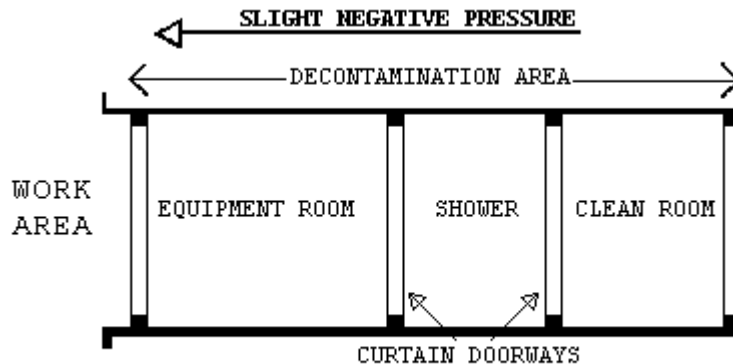
1.9.3 PERSONNEL DECONTAMINATION FACILITY (PDF)

- A. The Competent Person shall provide a PDF consisting of shower room which is contiguous to a clean room and equipment room. The PDF must be sized to accommodate the number of personnel scheduled for the project. The shower room, located in the center of the PDF, shall be fitted with as many portable showers as necessary to insure all employees can complete the entire decontamination procedure within 15 minutes. The PDF shall be constructed of opaque poly for privacy. The PDF shall be constructed to eliminate any parallel routes of egress without showering.
 - 1. Clean Room: The clean room must be physically and visually separated from the rest of the building to protect the privacy of personnel changing clothes. The clean room

shall be constructed of at least 2 layers of 6 mil fire retardant poly to provide an airtight room. Provide a minimum of 2 - 900 mm (3 foot) wide flapped doorways. One doorway shall be the entry from outside the PDF and the second doorway shall be to the shower room of the PDF. The floor of the clean room shall be maintained in a clean, dry condition. Shower overflow shall not be allowed into the clean room. An adequate supply of disposable towels shall be provided. Provide storage lockers per person. A portable fire extinguisher, Type ABC, shall be provided in accordance with OSHA and NFPA Standard 10. All persons entering the regulated area shall remove all street clothing in the clean room and dress in disposable protective clothing and respiratory protection. Any person entering the clean room does so either from the outside with street clothing on or is coming from the shower room completely naked and thoroughly washed. Females required to enter the regulated area shall be ensured of their privacy throughout the entry/exit process by posting guards at both entry points to the PDF so no male can enter or exit the PDF during her stay in the PDF.

2. Shower Room: The Competent Person shall assure that the shower room is a completely watertight compartment to be used for the movement of all personnel from the clean room to the equipment room and for the showering of all personnel going from the regulated area to the clean room. Each shower shall be constructed so water runs down the walls of the shower and into a drip pan. Install a freely draining smooth floor on top of the shower pan. The shower room shall be separated from the rest of the building and from the clean room and equipment room using airtight walls made from at least 3 layers of 6 mil fire retardant poly. The shower shall be equipped with a shower head and controls, hot and cold water, drainage, soap dish and continuous supply of soap, and shall be maintained in a sanitary condition throughout its use. The controls shall be arranged so an individual can shower without assistance. Provide a flexible hose shower head, hose bibs and all other items shown on Shower Schematic. Wastewater will be pumped to a drain after being filtered through a minimum of a 100-micron sock in the shower drain; a 20-micron filter; and a final 5 micron filter. Filters will be changed a minimum of daily or more often as needed. Filter changes must be made in the shower to prevent loss of contaminated water. Hose down all shower surfaces after each shift and clean any debris from the shower pan. Residue is to be disposed of as asbestos waste.
4. Equipment Room: The Competent Person shall provide an equipment room which shall be an airtight compartment for the storage of work equipment, reusable footwear and for use as a change station for personnel exiting the regulated area. The equipment room shall be separated from the regulated area by a minimum 3-foot-wide door made of 2 layers of 6 mil fire retardant poly. The equipment room shall be separated from the regulated area, the shower room and the rest of the building by airtight walls and ceiling constructed of a minimum of 3 layers of 6 mil fire retardant poly. Damp wipe all surfaces of the equipment room after each shift change. Provide an additional loose layer of 6 mil fire retardant poly per shift change and remove this layer after each shift. Provide a temporary electrical sub-panel equipped with GFCI in this room to accommodate any equipment required in the regulated area.

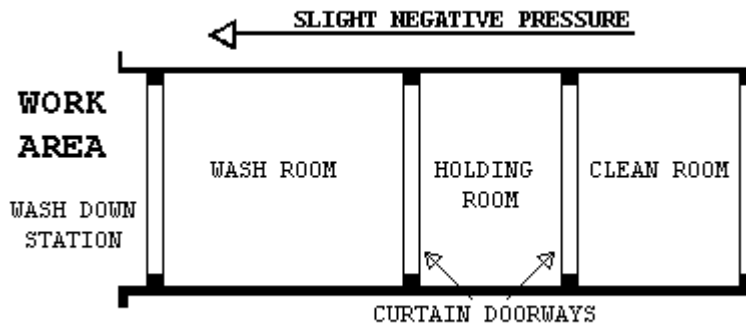
4. The PDF shall consist of the following: Clean room at the entrance followed by a shower room followed by an equipment room leading to the regulated area. Each doorway in the PDF is a minimum of 2 layers of 6 mil fire retardant poly.



1.9.4 WASTE/EQUIPMENT DECONTAMINATION FACILITY (W/EDF)

- A. The Competent Person shall provide a W/EDF consisting of a washroom, holding room, and clean room for removal of all waste, equipment and contaminated material from the regulated area. Personnel shall not enter or exit the W/EDF except in the event of an emergency. Clean debris and residue in the W/EDF daily. All surfaces in the W/EDF shall be wiped/hosed down after each shift and all debris shall be cleaned from the shower pan. The W/EDF shall consist of the following:
1. Wash Down Station: Provide an enclosed shower unit in the regulated area just outside the Washroom as equipment, bag and container cleaning station.
 2. Washroom: Provide a washroom for cleaning bagged or containerized asbestos containing waste materials passed from the regulated area. Construct the washroom using 50 x 100 mm (2" x 4") wood framing and 3 layers of 6 mil fire retardant poly. Locate the washroom so that packaged materials, after being wiped clean, can be passed to the Holding Room. The doorways in the washroom shall be constructed of 2 layers of 6 mil fire retardant poly.
 3. Holding Room: Provide a holding room as a drop location for bagged materials passed from the washroom. Construct the holding room using 50 x 100 mm (2" x 4") wood framing and 3 layers of 6 mil fire retardant poly. The holding room shall be located so that bagged material cannot be passed from the washroom to the clean room unless it goes through the holding room. Doorways in the holding room shall be constructed of 2 layers of 6 mil fire retardant poly.
 4. Clean Room: Provide a clean room to isolate the holding room from the building exterior. Construct the clean room using 2 x 4 wood framing and 2 layers of 6 mil fire retardant poly. The clean room shall be located to provide access to the holding room from the building exterior. Doorways to the clean room shall be constructed of two layers of 6 mil fire retardant poly.

5. The W/EDF shall be provided as follows: Washroom leading to a Holding Room followed by a Clean Room leading to outside the regulated area. See diagram.



1.9.5 WASTE/EQUIPMENT DECONTAMINATION PROCEDURES

- A. At washdown station in the regulated area, thoroughly wet clean contaminated equipment and/or sealed polyethylene bags and pass into Washroom after visual inspection. When passing anything into the Washroom, close all doorways of the W/EDF, other than the doorway between the washdown station and the Washroom. Keep all outside personnel clear of the W/EDF. Once inside the Washroom, wet clean the equipment and/or bags. After cleaning and inspection, pass items into the Holding Room. Close all doorways except the doorway between the Holding Room and the Clean Room. Workers from the Clean Room/Exterior shall enter the Holding Room and remove the decontaminated/cleaned equipment/bags for removal and disposal. These personnel will not be required to wear PPE. At no time shall personnel from the clean side be allowed to enter the Washroom.

PART 2 - PRODUCTS, MATERIALS AND EQUIPMENT

2.1 MATERIALS AND EQUIPMENT

2.1.1 GENERAL REQUIREMENTS (ALL ABATEMENT PROJECTS)

Prior to the start of work, the Contractor shall provide and maintain a sufficient quantity of materials and equipment to assure continuous and efficient work throughout the duration of the project. Work shall not start unless the following items have been delivered to the site and the Contractor has submitted verification to the Contracting Officer to this effect:

- A. All materials shall be delivered in their original package, container or bundle bearing the name of the manufacturer and the brand name (where applicable).
- B. Store all materials subject to damage off the ground, away from wet or damp surfaces and under cover sufficient enough to prevent damage or contamination. Flammable materials cannot be stored inside buildings. Replacement materials shall be stored outside of the regulated/work area until abatement is completed.

- C. The Contractor shall not block or hinder use of buildings by patients, staff, or visitors in partially occupied areas/spaces by placing materials/equipment in any unauthorized place.
- D. The Competent Person shall inspect for damaged, deteriorating or previously used materials. Such materials shall not be used and shall be removed from the worksite and disposed of properly.
- E. Poly sheeting put under the glove bag regulated area shall be a minimum of 6 mils in thickness.
- F. If required, the method of attaching polyethylene sheeting shall be agreed upon in advance by the Contractor and the CO and selected to minimize damage to equipment and surfaces.
- G. Polyethylene sheeting utilized for personnel decontamination facility shall be opaque white or black in color, 6 mil fire retardant poly.
- H. Installation and plumbing hardware, showers, hoses, drain pans, sump pumps and wastewater filtration system shall be provided by the Contractor.
- I. An adequate number of HEPA vacuums, scrapers, sprayers, nylon brushes, brooms, disposable mops, rags, sponges, staple guns, shovels, ladders and scaffolding of suitable height and length as well as meeting OSHA requirements shall be provided. Fall protection devices, water hose to reach all areas in the regulated area, airless spray equipment, and any other tools, materials or equipment required to conduct the abatement project shall also be provided. All electrically operated hand tools, equipment, electric cords shall be equipped with GFCI protection.
- J. Special protection for objects in the regulated area shall be detailed (e.g., plywood over carpeting or hardwood floors to prevent damage from scaffolds, water, and falling material).
- L. Disposal bags – 2 layers of 6 mil, for asbestos waste shall be pre-printed with labels, markings and address as required by OSHA, EPA and DOT regulations.
- M. The Contracting Officer (CO) shall be provided with a copy of the SDS as required for all hazardous chemicals under OSHA 29 CFR 1910.1200 - Hazard Communication. Chlorinated compounds shall not be used with any spray adhesive or other product. Appropriate encapsulant(s) shall be provided.
- N. OSHA DANGER demarcation signs, as many and as required by OSHA 29 CFR 1926.1101(k)(7) shall be provided and placed by the Competent Person. All other posters and notices required by Federal and State regulations shall be posted in the Clean Room.

- O. Adequate and appropriate PPE for the project and number of personnel/shifts shall be provided. All personal protective equipment issued must be based on a hazard assessment conducted under 29 CFR 1910.132(d).

2.2 CONTAINMENT BARRIERS AND COVERINGS IN THE REGULATED AREA

2.2.1 GENERAL

- A. Using critical barriers, seal off the perimeter to the regulated area to completely isolate the regulated area from adjacent spaces. All horizontal surfaces in the regulated area must be covered with 2 layers of 6 mil fire retardant poly to prevent contamination and to facilitate clean-up. Should adjacent areas become contaminated, immediately stop work and clean up the contamination at no additional cost to the Owner. Provide firestopping and identify all fire barrier penetrations due to abatement work as specified in Section 2.2.8; FIRESTOPPING.

2.2.2 PREPARATION PRIOR TO SEALING THE REGULATED AREA

- A. Place all tools, scaffolding, materials and equipment needed for working in the regulated area prior to erecting any plastic sheeting. Remove all uncontaminated removable furniture, equipment and/or supplies from the regulated area before commencing work, or completely cover with 2 layers of 6-mil fire retardant poly sheeting and secure with duct tape. Lock out and tag out any HVAC systems in the regulated area.

2.2.3 CONTROLLING ACCESS TO THE REGULATED AREA

- A. Access to the regulated area is allowed only through the personnel decontamination facility (PDF), if required. All other means of access shall be eliminated, and OSHA Danger demarcation signs posted as required by OSHA. If the regulated area is adjacent to or within view of an occupied area, provide a visual barrier of 6 mil opaque fire-retardant poly sheeting to prevent building occupant observation. If the adjacent area is accessible to the public, the barrier must be solid.

2.2.4 CRITICAL BARRIERS

- A. Separate any openings into the regulated area from adjacent areas using fire retardant poly at least 6 mils thick and duct tape. Individually seal with 2 layers of 6 mil poly and duct tape all HVAC openings into the regulated area. Individually seal all lighting fixtures, clocks, doors, windows, convectors, speakers, or any other objects in the regulated area. Heat must be shut off from any objects covered with poly.

2.2.5 SECONDARY BARRIERS

- A. A loose layer of 6 mil fire retardant poly shall be used as a drop cloth to protect the floor/horizontal surfaces from debris generated during the glove bag abatement. This layer shall be replaced as needed during the work.

2.2.6 EXTENSION OF THE REGULATED AREA

- A. If the enclosure of the regulated area is breached in any way that could allow contamination to occur, the affected area shall be included in the regulated area and constructed as per this section. If the affected area cannot be added to the regulated area, decontamination measures must be started immediately and continue until air monitoring indicates background levels are met.

2.2.7 FIRESTOPPING

- A. Through penetrations caused by cables, cable trays, pipes, sleeves must be fire stopped with a fire-rated firestop system providing an airtight seal.
- B. Firestop materials that are not equal to the wall or ceiling penetrated shall be brought to the attention of the CO. The Contractor shall list all areas of penetration, the type of sealant used, and whether the location is fire rated. Any discovery of penetrations during abatement shall be brought to the attention of the CO immediately. All walls, floors and ceilings are considered fire rated unless otherwise determined by the CO or Fire Marshall.
- C. Any visible openings whether caused by a penetration shall be reported by the Contractor to the CO for a sealant system determination. Firestops shall meet ASTM E814 and UL 1479 requirements for the opening size, penetrant, and fire rating needed.

2.3 MONITORING, INSPECTION AND TESTING

2.3.1 GENERAL

- A. Perform throughout abatement work monitoring, inspection and testing inside and around the regulated area in accordance with the OSHA requirements and these specifications. The IH Technician shall continuously inspect and monitor conditions inside the regulated area to ensure compliance with these specifications.
- B. The Owner or Owner's Representative/CO will employ an independent 3rd party industrial hygienist (IH) consultant to perform various services on behalf of the Owner. The IH will perform the necessary monitoring, inspection, testing, and other support services to ensure that facility patients, employees, and visitors will not be adversely affected by the abatement work, and that the abatement work proceeds in accordance with these specifications, that the abated areas or abated buildings have been successfully decontaminated. The work of the IH consultant in no way relieves the Contractor from their responsibility to perform the work in accordance with contract/specification requirements, to perform continuous inspection, monitoring and testing for the safety of their employees (including exposure assessments and monitoring in accordance with 29 CFR 1926.1101 (f); and to perform other such services as specified. The cost of the IH consultant and their services will be borne by the Owner except for any repeat of final inspection and testing that may be required due to unsatisfactory initial results. Any repeated final inspections and/or testing, if required, will be paid for by the Contractor.

- C. If fibers counted by the IH during abatement work, either inside or outside the regulated area, utilizing the NIOSH 7400 air monitoring method, exceed the specified respective limits, the Contractor shall stop work. The Contractor may request confirmation of the results by analysis of the samples by TEM. Request must be in writing and submitted to the CO. Cost for the confirmation of results will be borne by the Contractor for both the collection and analysis of samples and for the time delay that may/does result for this confirmation. An agreement between the Contractor and the IH shall be reached on the exact details of the confirmation effort, in writing, including such things as the number of samples, location, collection, quality control on-site, analytical laboratory, interpretation of results and any follow-up actions. This written agreement shall be co-signed and delivered to the CO.

2.3.2 SCOPE OF SERVICES OF THE 3RD PARTY IH CONSULTANT

- A. The purpose of the work of the 3rd party IH is to: Assure quality; resolve problems; and prevent the spread of contamination beyond the regulated area. In addition, their work includes performing the final inspection and testing to determine whether the regulated area or building has been adequately decontaminated. All perimeter air monitoring is to be done utilizing PCM/TEM per 29 CFR 1926.1101(g)(4)(ii)(B). The IH will perform the following tasks:
1. Task 1: Establish background levels before abatement begins by collecting background samples. Retain samples for possible TEM analysis.
 2. Task 2: Perform continuous air monitoring, inspection, and testing outside the regulated area during actual abatement work to detect any faults in the regulated area isolation and any adverse impact on the surroundings from regulated area activities.
 3. Task 3: Perform unannounced visits to spot check overall compliance of work with contract/specifications. These visits may include any inspection, monitoring, and testing inside and outside the regulated area and all aspects of the operation except personnel monitoring.
 4. Task 4: Provide support to the CO such as evaluation of submittals from the Contractor, resolution of unforeseen developments, etc.
 5. Task 5: Perform, in the presence of the CO, final inspection and testing of a decontaminated regulated area or building at the conclusion of the abatement and clean-up work to certify compliance with all regulations and project requirements/specifications.
 6. Task 6: Issue certificate of decontamination for each regulated area or building and project report.
- B. All data, inspection results and testing results generated by the IH will be available to the Contractor for information and consideration. The Contractor shall cooperate with and support the IH for efficient and smooth performance of their work.

- C. The monitoring and inspection results of the IH will be used by the CO to issue any Stop Removal orders to the Contractor during abatement work and to accept or reject a regulated area or building as decontaminated.

2.4 STANDARD OPERATING PROCEDURES

- A. The Contractor shall have established Standard Operating Procedures (SOP's) in printed form and loose-leaf folder consisting of simplified text, diagrams, sketches, and pictures that establish and explain clearly the ways and procedures to be followed during all phases of the work by the Contractor's personnel. The SOP's must be modified as needed to address specific requirements of the project. The SOPs shall be submitted for review and approval prior to the start of any abatement work. The minimum topics and areas to be covered by the SOP's are:
 - 1. Minimum Personnel Qualifications
 - 2. Contingency Plans and Arrangements
 - 3. Security and Safety Procedures
 - 4. Respiratory Protection/Personal Protective Equipment Program and Training
 - 5. Medical Surveillance Program and Recordkeeping
 - 6. Regulated Area Requirements for Glove bag Abatement
 - 7. Decontamination Facilities and Entry/Exit Procedures (PDF and W/EDF)
 - 8. Monitoring, Inspections, and Testing
 - 9. Removal Procedures for Piping ACM Using the Glove bag Method
 - 10. Disposal of ACM waste
 - 11. Regulated Area Decontamination/Clean-up
 - 12. Regulated Area Visual and Air Clearance
 - 13. Project Completion/Closeout

2.5 SUBMITTALS

2.5.1 PRE-CONSTRUCTION MEETING SUBMITTALS

Submit to the CO and IH a minimum of 14 days prior to the pre-start meeting the following for review and approval. Meeting this requirement is a prerequisite for the pre-start meeting for this project.

- A. Submit a detailed work schedule for the entire project reflecting contract documents and the phasing/schedule requirements from the CPM chart.
- B. Submit a staff organization chart showing all personnel who will be working on the project and their capacity/function. Provide their qualifications, training, accreditations, and licenses, as appropriate. Provide a copy of the "Certificate of Worker's Acknowledgment" and the "Affidavit of Medical Surveillance and Respiratory Protection" for each person.
- C. Submit Standard Operating Procedures developed specifically for this project, incorporating the requirements of the specifications, prepared, signed and dated by the Contractor.

- D. Submit the specifics of the materials and equipment to be used for this project with brand names, model numbers, performance characteristics, pictures/diagrams, and number available for the following:
1. HEPA vacuums, air monitoring pumps, calibration devices, and emergency power generating system.
 2. Wastewater filtration system, shower system, critical/floor barriers.
 3. Encapsulants, surfactants, handheld sprayers, airless sprayers, glove bags, fire extinguishers.
 4. Personal protective equipment.
 5. Fire safety equipment to be used in the regulated area.
- D. Submit the name, location, and phone number of the approved landfill; proof/verification the landfill is approved for ACM disposal; the landfill's requirements for ACM waste; the type of vehicle to be used for transportation; and name, address, and phone number of subcontractor, if used. Proof of asbestos training for transportation personnel shall be provided.
- F. Submit required notifications and arrangements made with regulatory agencies having regulatory jurisdiction and the specific contingency/emergency arrangements made with local health, fire, ambulance, hospital authorities and any other notifications/arrangements.
- G. Submit the name, location and verification of the laboratory and/or personnel to be used for analysis of air and/or bulk samples. Air monitoring must be done in accordance with OSHA 29 CFR 1926.1101(f) and Appendix A.
- H. Submit qualifications verification: Submit the following evidence of qualifications. Make sure that all references are current and verifiable by providing current phone numbers and documentation.
1. Asbestos Abatement Company: Project experience within the past 3 years; listing projects first most similar to this project:
Project Name; Type of Abatement; Duration; Cost; Reference Name/Phone Number; Final Clearance; Completion Date
 2. List of projects halted by owner, A/E, IH, regulatory agency in the last 3 years:
Project Name; Reason; Date; Reference Name/Number; Resolution
 3. List asbestos regulatory citations, penalties, damages paid, and legal actions taken against the company in the last 3 years. Provide copies and all information needed for verification.
- I. Submit information on personnel: Provide a resume; address each item completely; provide references; phone numbers; copies of certificates, accreditations, and licenses. Submit an affidavit signed by the Contractor stating that all personnel submitted below have medical records in accordance with OSHA 29 CFR 1926.1101(m) and 29 CFR 1910.20 and that the company has implemented a medical surveillance program and maintains recordkeeping in accordance with the above regulations. Submit the phone number and doctor/clinic/hospital used for medical evaluations.

1. Contractor: Name; years of abatement experience; list of projects similar to this one; certificates, licenses, accreditations for proof of AHERA/OSHA specialized asbestos training; professional affiliations; number of workers trained; samples of training materials; samples of SOP's developed; medical opinion; current respirator fit test.
 2. Competent Person(s)/Supervisor(s): Number; names; social security numbers; years of abatement experience as Competent Person /Supervisor; list of similar projects as Competent Person/Supervisor; as a worker; certificates, licenses, accreditations; proof of AHERA/OSHA specialized asbestos training; maximum number of personnel supervised on a project; medical opinion; current respirator fit test.
 3. Workers: Numbers; names; social security numbers; years of abatement experience; certificates, licenses, accreditations; training courses in asbestos abatement and respiratory protection; medical opinion; current respirator fit test.
- J. Submit copies of State license for asbestos abatement; copy of insurance policy, including exclusions with a letter from agent stating in plain English the coverage provided and the fact that asbestos abatement activities are covered by the policy; copy of SOP's incorporating the requirements of this specification; information on who provides your training, how often; who provides medical surveillance, how often; who does and how is air monitoring conducted; a list of references of independent laboratories/IH's familiar with your air monitoring and standard operating procedures; copies of monitoring results of the five referenced projects listed and analytical method(s) used.
- K. When rental equipment is to be used in regulated areas or used to transport asbestos waste, the contractor shall assure complete decontamination of the rental equipment before return to the rental agency.
1. Submit, before the start of work, the manufacturer's technical data and MSDS for encapsulants used on the project. Provide application instructions also.

2.5.2 SUBMITTALS DURING ABATEMENT

- A. The Competent Person shall maintain and submit a daily log at the regulated area documenting the dates and times of the following: purpose, attendees and summary of meetings; all personnel entering/exiting the regulated area; document and discuss the resolution of unusual events such as critical barrier breeching, equipment failures, emergencies, and any cause for stopping work; representative OSHA air monitoring and results/TWA's/EL's. Submit this daily log to CO and IH.
- B. The Contractor shall document and maintain the following during abatement and submit as appropriate to the CO and IH.
1. Inspection and approval of the regulated area preparation prior to start of work and daily during work.
 2. Removal of any poly critical/floor barriers.
 3. Visual inspection/testing by the IH prior to application of lockdown encapsulation.
 4. Packaging and removal of ACM waste from regulated area.
 5. Disposal of ACM waste materials; copies of Waste Shipment Records/landfill receipts to the CO on a weekly basis.

2.5.3 SUBMITTALS AT COMPLETION OF ABATEMENT

- A. The Contractor shall submit a project report consisting of the daily logbook requirements and documentation of events during the abatement project including Waste Shipment Records signed by the landfill's agent. The report shall include a certificate of completion, signed and dated by the Contractor, in accordance with Attachment #1. The CO will forward the abatement report to the Owner after completion of the project.

2.6 ENCAPSULANTS

2.6.1 TYPES OF ENCAPSULANTS

- A. The following four types of encapsulants must comply with performance requirements as stated in paragraph 2.6.2:
 - 1. Removal encapsulant - used as a wetting agent to remove ACM.
 - 2. Bridging encapsulant - provides a tough, durable coating on ACM.
 - 3. Penetrating encapsulant - penetrates/encapsulates ACM at least 13 mm (1/2").
 - 4. Lockdown encapsulant - seals microscopic fibers on surfaces after ACM removal.

2.6.2 PERFORMANCE REQUIREMENTS

Encapsulants shall meet the latest requirements of EPA; shall not contain toxic or hazardous substances; or solvents; and shall comply with the following performance requirements:

- A. **General Requirements for all Encapsulants:**

- 1. ASTM E84: Flame spread of 25; smoke emission of 50.
 - 2. University of Pittsburgh Protocol: Combustion Toxicity; zero mortality.
 - 3. ASTM C732: Accelerated Aging Test; Life Expectancy - 20 years.
 - 4. ASTM E96: Permeability - minimum of 0.4 perms.

- B. **Bridging/Penetrating Encapsulants:**

- 1. ASTM E736: Cohesion/Adhesion Test - 24 kPa (50 lbs./ft²).
 - 2. ASTM E119: Fire Resistance - 3 hours (Classified by UL for use on fibrous/cementitious fireproofing).
 - 3. ASTM D2794: Gardner Impact Test; Impact Resistance - minimum 11.5 kg-mm (43 in/lb.).
 - 4. ASTM D522: Mandrel Bend Test; Flexibility - no rupture or cracking.

- C. **Lockdown Encapsulants:**

- 1. ASTM E119: Fire resistance - 3 hours (tested with fireproofing over encapsulant applied directly to steel member).
 - 2. ASTM E736: Bond Strength - 48 kPa (100 lbs./ft²) (test compatibility with cementitious and fibrous fireproofing).
 - 3. In certain situations, encapsulants may have to be applied to hot pipes/equipment. The encapsulant must be able to withstand high temperatures without cracking or off gassing any noxious vapors during application.

2.7 CERTIFICATES OF COMPLIANCE

- A. The Contractor shall submit to the Contracting Officer (CO) and IH, certification from the manufacturer indicating compliance with performance requirements for encapsulants when applied according to manufacturer recommendations.

2.8 RECYCLABLE PROTECTIVE CLOTHING

- A. If recyclable clothing is provided, all requirements of EPA, DOT and OSHA shall be met.

PART 3 – EXECUTION

3.1 PRE-ABATEMENT ACTIVITIES

3.1.1 PRE-ABATEMENT MEETING

- A. The CO and IH, upon receipt, review, and substantial approval of all pre-abatement submittals and verification by the Contractor that all materials and equipment required for the project are on the site, will arrange for a pre-abatement meeting between the Contractor, Competent Person(s), the Owner's representative(s), CO and the 3rd party IH. The purpose of the meeting is to discuss any aspect of the submittals needing clarification or amplification and to discuss any aspect of the project execution and the sequence of the operation. The Contractor shall be prepared to provide any supplemental information/documentation to the CO and IH regarding any submittals, documentation, materials or equipment. Upon satisfactory resolution of any outstanding issues, the CO will issue a written order to proceed to the Contractor. No abatement work of any kind described in the following provisions shall be initiated prior to the Contracting Officer's written order to proceed.

3.1.2 PRE-ABATEMENT INSPECTIONS AND PREPARATIONS

Before any work begins on the construction of the regulated area, the Contractor will:

- A. Conduct a space-by-space inspection with the CO and prepare a written inventory of all existing damage in those spaces where asbestos abatement will occur. Still or video photography may be used to supplement the written damage inventory. Documents will be signed and certified as accurate by both parties.
- B. The CO, the Contractor, and IH must be aware of 10/95 A/E Quality Alert indicating the failure to identify asbestos as applicable to glove bag abatement in the areas listed. Make sure these areas are looked at/reviewed on the project: Lay-in ceilings concealing ACM; ACM behind walls/windows from previous renovations; inside chases/walls; transite piping/ductwork/sheets; behind radiators; below windowsills; water/sewer lines; electrical conduit coverings; steam line trench coverings.

- C. Ensure that all furniture, machinery, equipment, curtains, drapes, blinds, and other movable objects which the Contractor is required to remove from the regulated area have been cleaned and removed or properly protected from contamination.
- D. Shut down and seal with a minimum of 2 layers of 6 mil fire retardant poly all HVAC systems serving the regulated area. The regulated area critical barriers shall be completely isolated from any other air in the building. The IH will monitor the isolation provision.
- E. Shut down and lock out in accordance with 29 CFR 1910.147 all electrical circuits which pose a potential hazard. Electrical arrangements will be tailored to the particular regulated area and the systems involved. All electrical circuits affected will be turned off at the circuit box outside the regulated area, not just the wall switch. The goal is to eliminate the potential for electrical shock which is a major threat to life in the regulated area due to water use and possible energized circuits. Electrical lines used to power equipment in the regulated area shall conform to all electrical safety standards and shall be isolated by the use of a ground fault circuit interrupter (GFCI). All GFCI shall be tested prior to use. The CO or IH will monitor the electrical shutdown.

3.1.3 PRE-ABATEMENT CONSTRUCTION AND OPERATIONS

- A. Perform all preparatory work for the first regulated area in accordance with the approved work schedule and with this specification.
- B. Upon completion of all preparatory work, the Contractor will inspect the work and systems and will notify the CO and IH when the work is completed in accordance with this specification. The CO may inspect the regulated area and the systems with the IH and may require that upon satisfactory inspection, the Contractor's employees perform all major aspects of the approved SOP's, especially worker protection, respiratory systems, contingency plans, decontamination procedures, and monitoring to demonstrate satisfactory operation.
- C. The Contractor shall document the pre-abatement activities described above and deliver a copy to the CO.
- D. Upon satisfactory inspection of the installation of and operation of systems the CO will notify the Contractor in writing to proceed with the asbestos abatement work in accordance with this specification.

3.2 REGULATED AREA PREPARATIONS

3.2.1 OSHA DANGER SIGNS

- A. Post OSHA DANGER signs meeting the specifications of OSHA 29 CFR 1926.1101 at any location and approaches to the regulated area where airborne concentrations of asbestos may exceed ambient background levels. Signs shall be posted at a distance sufficiently far enough away from the regulated area to permit any personnel to read the

sign and take the necessary measures to avoid exposure. Additional signs will be posted following construction of the regulated area enclosure.

3.2.2 SHUT DOWN - LOCK OUT ELECTRICAL

- A. Shut down and lock out electric power to the regulated area. Provide temporary power and lighting. Ensure safe installation including GFCI of temporary power sources and equipment by compliance with all applicable electrical code requirements and OSHA requirements for temporary electrical systems. Electricity shall be provided by the Owner.

3.2.3 SHUT DOWN - LOCK OUT HVAC

- A. Shut down and lock out heating, cooling, and air conditioning system (**HVAC**) components that are in, supply or pass through the regulated area. Investigate the regulated area and agree on pre-abatement condition with the CO and IH. Seal all intake and exhaust vents in the regulated area with duct tape and 2 layers of 6-mil poly. Also, seal any seams in system components that pass through the regulated area. Remove all contaminated HVAC system filters and place in labeled 6-mil poly disposal bags for disposal as asbestos waste.

3.2.4 SANITARY FACILITIES

- A. The Contractor shall provide sanitary facilities for abatement personnel and maintain them in a clean and sanitary condition throughout the abatement project.

3.2.5 WATER FOR ABATEMENT

- A. The Owner will provide water for abatement purposes. The Contractor shall connect to the existing facility system. The service to the shower(s) shall be supplied with backflow prevention.

3.2.6 PRE-CLEANING MOVABLE OBJECTS

- A. Pre-clean all movable objects within the regulated area using a HEPA filtered vacuum and/or wet cleaning methods as appropriate. After cleaning, these objects shall be removed from the regulated area and carefully stored in an uncontaminated location.

3.2.7 PRE-CLEANING FIXED OBJECTS

- A. Pre-clean all fixed objects in the regulated area using HEPA filtered vacuums and/or wet cleaning techniques as appropriate. Careful attention must be paid to machinery behind grills or gratings where access may be difficult, but contamination may be significant. Also, pay particular attention to wall, floor and ceiling penetration behind fixed items. After precleaning, enclose fixed objects with 2 layers of 6-mil poly and seal securely in place with duct tape. Objects (e.g., permanent fixtures, shelves, electronic equipment, laboratory tables, sprinklers, alarm systems, closed circuit TV equipment and computer cables) which must remain in the regulated area and that require special ventilation or

enclosure requirements should be designated here along with specified means of protection. Contact the manufacturer for special protection requirements.

3.2.8 PRE-CLEANING SURFACES IN THE REGULATED AREA

- A. Pre-clean all surfaces in the regulated area using HEPA filtered vacuums and/or wet cleaning methods as appropriate. Do not use any methods that would raise dust such as dry sweeping or vacuuming with equipment not equipped with HEPA filters. Do not disturb asbestos-containing materials during this pre-cleaning phase.

3.3 CONTAINMENT BARRIERS AND COVERINGS FOR THE REGULATED AREA

3.3.1 GENERAL

- A. Seal off any openings at the perimeter of the regulated area with critical barriers to completely isolate the regulated area and to contain all airborne asbestos contamination created by the abatement activities. Should adjacent areas past the regulated area become contaminated due to improper work activities, the Contractor shall suspend work inside the regulated area, continue wetting, and clean the adjacent areas in accordance with procedures described in these specifications. Any and all costs associated with adjacent area cleanup shall be borne by the Contractor.

3.3.2 PREPARATION PRIOR TO SEALING OFF

- A. Place all materials, equipment and supplies necessary to isolate the regulated area inside the regulated area. Remove all movable material/equipment as described above and secure all unmovable material/equipment as described above. Properly secured material/equipment shall be considered to be outside the regulated area.

3.3.3 CONTROLLING ACCESS TO THE REGULATED AREA

- A. Access to the regulated area shall be permitted only through the PDF. All other means of access shall be closed off by proper sealing and DANGER signs posted on the clean side of the regulated area where it is adjacent to or within view of any occupiable area. An opaque visual barrier of 6 mil poly shall be provided so that the abatement work is not visible to any building occupants. If the area adjacent to the regulated area is accessible to the public, construct a solid barrier on the public side of the sheeting for protection and isolation of the project. The barrier shall be constructed with nominal 2" x 4" (50mm x 100mm) wood or metal studs 16" (400mm) on centers, securely anchored to prevent movement and covered with a minimum of 1/2" (12.5mm) plywood. Provide an appropriate number of OSHA DANGER signs for each visual and physical barrier. Any alternative method must be given written approval by the CO and IH.

3.3.4 CRITICAL BARRIERS

- A. The regulated area must be completely separated from the adjacent areas, and the outside by at least 2 layers of 6 mil fire retardant poly and duct tape/spray adhesive. Individually seal all supply and exhaust ventilation openings, lighting fixtures, clocks, doorways,

windows, convectors, speakers, and other openings into the regulated area with 2 layers of 6 mil fire retardant poly and taped securely in place with duct tape/spray adhesive. Critical barriers must remain in place until all work and clearances have been completed. Light fixtures shall not be operational during abatement. Auxiliary lighting shall be provided. If needed, provide plywood squares 6" x 6" x 3/8" (150mm x 150mm x 18mm) held in place with one 6d smooth masonry/galvanized nail driven through the center of the plywood square and duct tape on the poly so as to clamp the poly to the wall/surface. Locate plywood squares at each end, corner, and 4' (1200mm) maximum on centers.

3.3.5 EXTENSION OF THE REGULATED AREA

- A. If the regulated area barrier is breached in any manner that could allow the passage of asbestos fibers or debris, the Competent Person shall immediately stop work, continue wetting, and proceed to extend the regulated area to enclose the affected area as per procedures described in this specification. If the affected area cannot be enclosed, decontamination measures and cleanup shall start immediately. All personnel shall be isolated from the affected area until decontamination/cleanup is completed as verified by visual inspection and air monitoring. Air monitoring at completion must indicate background levels.

3.3.6 FLOOR BARRIERS:

- A. All floors within 10' of glove bag work shall be covered with 2 layers of 6 mil fire retardant poly.

3.4 REMOVAL OF PIPING ACM

3.4.1 WETTING MATERIALS

- A. Use amended water for the wetting of ACM prior to removal. The Competent Person shall assure the wetting of ACM meets the definition of "adequately wet" in the EPA NESHAP's regulation and OSHA's "wet methods" for the duration of the project. A removal encapsulant may be used instead of amended water with written approval of the CO.
- B. Amended Water: Provide water to which a surfactant has been added shall be used to wet the ACM and reduce the potential for fiber release during disturbance of ACM. The mixture must be equal to or greater than the wetting provided by water amended by a surfactant consisting of one ounce of 50% polyoxymethylene ester and 50% polyoxymethylene ether mixed with 5 gallons (19L) of water.
- C. Removal Encapsulant: Provide a penetrating encapsulant designed specifically for the removal of ACM. The material must, when used, result in adequate wetting of the ACM and retard fiber release during disturbance equal to or greater than the amended water described above in B.

3.4.2 SECONDARY BARRIER AND WALKWAYS

- A. Install as a drop cloth a 6-mil poly sheet at the beginning of each work shift where removal is to be done during that shift. Completely cover floors within 10 feet (3M) of the area where work is to be done. Secure the secondary barrier with duct tape to prevent debris from getting behind it. Remove the secondary barrier at the end of the shift or as work in the area is completed. Keep residue on the secondary barrier wet. When removing, fold inward to prevent spillage and place in a disposal bag.
- B. Install walkways using 6 mil poly between the regulated area and the decontamination facilities (PDF and W/EDF) to protect the floor from contamination and damage. Install the walkways at the beginning of each shift and remove them at the end of each shift.

3.4.3 WET REMOVAL OF ACM

- A. Using acceptable glove bag procedures, adequately and thoroughly wet the ACM to be removed prior to removal to reduce/prevent fiber release to the air. Adequate time must be allowed for the amended water to saturate the ACM. Abatement personnel must not disturb dry ACM. Use a fine spray of amended water or removal encapsulant. Saturate the material sufficiently to wet the substrate without causing excessive dripping. The material must be sprayed repeatedly/continuously during the removal process in order to maintain adequately wet conditions. Removal encapsulants must be applied in accordance with the manufacturer's written instructions. Perforate or carefully separate, using wet methods, an outer covering that is painted or jacketed in order to allow penetration and wetting of the material. Where necessary, carefully remove the covering while wetting to minimize fiber release. In no event shall dry removal occur except in the case of electrical hazards or a greater safety issue is possible!

3.5 GLOVEBAG REMOVAL PROCEDURES

3.5.1 GENERAL

- A. All applicable OSHA requirements and glove bag manufacturer's recommendations shall be met during glove bagging operations.
 - 1. Mix the surfactant with water in the garden sprayer, following the manufacturer's directions.
 - 2. Have each employee put on a HEPA filtered respirator approved for asbestos and check the fit using the positive/negative fit check.
 - 3. Have each employee put on a disposable full-body suit. Remember, the hood goes over the respirator straps.
 - 4. Check closely the integrity of the glove bag to be used. Check all seams, gloves, sleeves, and glove openings. OSHA requires the bottom of the bag to be seamless.
 - 5. Check the pipe where the work will be performed. If it is damaged (broken lagging, hanging, etc.), wrap the entire length of the pipe in poly sheeting and "candy stripe" it with duct tape.
 - 6. Attach glove bag with required tools per manufacturer's instructions.
 - 7. Using the smoke tube and aspirator bulb, test 10% of glove bags by placing the tube into the water porthole (two-inch opening to glove bag) and fill the bag with smoke

and squeeze it. If leaks are found, they should be taped closed using duct tape, and the bag should be retested with smoke.

8. Insert the wand from the water sprayer through the water porthole.
9. Insert the hose end from a HEPA vacuum into the upper portion of the glove bag.
10. Wet and remove the pipe insulation.
11. If the section of pipe is covered with an aluminum jacket, remove it first using the wire cutters to cut any bands and the tin snips to remove the aluminum. It is important to fold the sharp edges in to prevent cutting the bag when placing it in the bottom.
12. When the work is complete, spray the upper portion of the bag and clean-push all residue into the bottom of the bag with the other waste material. Be very thorough. Use adequate water.
13. Put all tools, after washing them off in the bag, in one of the sleeves of glove bag and turn it inside out, drawing it outside of the bag. Twist the sleeve tightly several times to seal it and tape it several tight turns with duct tape. Cut through the middle of the duct tape and remove the sleeve. Put the sleeve in the next glove bag or put it in a bucket of water to decontaminate the tools after cutting the sleeve open.
14. Turn on the HEPA vacuum and collapse the bag completely. Remove the vacuum nozzle, seal the hole with duct tape, twist the bag tightly several times in the middle, and tape it to keep the material in the bottom during removal of the glove bag from the pipe.
15. Slip a disposal bag over the glove bag (still attached to the pipe). Remove the tape securing the ends and slit open the top of the glove bag and carefully fold it down into the disposal bag. Double bag and gooseneck waste materials.

3.5.2 NEGATIVE PRESSURE GLOVEBAG PROCEDURE

1. In addition to the above requirements, the HEPA vacuum shall be run continuously during the glove bag procedure until completion at which time the glove bag will be collapsed by the HEPA vacuum prior to removal from the pipe/component.
2. The HEPA vacuum shall be attached and operated as needed to prevent collapse of the glove bag during the removal process.

3.6 LOCKDOWN ENCAPSULATION

3.6.1 GENERAL

- A. Lockdown encapsulation is an integral part of the ACM removal. At the conclusion of ACM removal and before removal of the primary barriers, all piping surfaces shall be encapsulated with a bridging encapsulant.

3.6.2 SEALING EXPOSED EDGES

- A. Seal edges of ACM exposed by removal work with two coats of encapsulant. Prior to sealing, permit the exposed edges to dry completely to permit penetration of the encapsulant.

3.7 DISPOSAL OF ACM WASTE MATERIALS

3.7.1 GENERAL

- A. Dispose of waste ACM and debris which is packaged in accordance with these specifications, OSHA, EPA and DOT. The landfill requirements for packaging must also be met. Disposal shall be done at the approved landfill. Disposal of non-friable ACM shall be done in accordance with applicable regulations.

3.7.2 PROCEDURES

- A. Asbestos waste shall be packaged and moved through the W/EDF into a covered transport container in accordance with procedures in this specification. Waste shall be double bagged prior to disposal. Wetted waste can be very heavy. Bags shall not be overfilled. Bags shall be securely sealed to prevent accidental opening and/or leakage. The top shall be tightly twisted and goosenecked prior to tightly sealing with at least three wraps of duct tape. Ensure that unauthorized persons do not have access to the waste material once it is outside the regulated area. All transport containers must be covered at all times when not in use. NESHAP's signs must be on containers during loading and unloading. Material shall not be transported in open vehicles. If drums are used for packaging, the drums shall be labeled properly and shall not be re-used.
- B. Waste Load Out: Waste load out shall be done in accordance with the procedures in W/EDF Decontamination Procedures. Bags shall be decontaminated on exterior surfaces by wet cleaning and/or HEPA vacuuming before being placed in the second bag.
- C. Asbestos waste with sharp edged components, i.e., nails, screws, lath, strapping, tin sheeting, jacketing, metal mesh, etc., which might tear poly bags shall be wrapped securely in burlap before packaging and, if needed, use a poly lined fiber drum as the second container, prior to disposal.

3.8 PROJECT DECONTAMINATION

3.8.1 GENERAL

- A. The entire work related to project decontamination shall be performed under the close supervision and monitoring of the 3rd party IH.
- B. If the asbestos abatement work is in an area which was contaminated prior to the start of abatement, the decontamination will be done by cleaning the primary barrier poly prior to its removal and cleaning of the regulated area surfaces after the primary barrier removal.
- C. If the asbestos abatement work is in an area which was uncontaminated prior to the start of abatement, the decontamination will be done by cleaning the primary barrier poly prior to its removal, thus preventing contamination of the building when the regulated area critical barriers are removed.

3.8.2 REGULATED AREA CLEARANCE

- A. Air testing and other requirements which must be met before release of the Contractor and re-occupancy of the regulated area space are specified in Final Testing Procedures.

3.8.3 WORK DESCRIPTION

- A. Decontamination includes the cleaning and clearance of the air in the regulated area and the decontamination and removal of the enclosures/facilities installed prior to the abatement work including primary/critical barriers, PDF and W/EDF facilities.

3.8.4 PRE-DECONTAMINATION CONDITIONS

- A. Before decontamination starts, all ACM waste from the regulated area shall be removed, all waste collected and removed, and the secondary barrier of poly removed and disposed of along with any gross debris generated by the work.
- B. At the start of decontamination, the following shall be in place:
 - 1. Critical barriers over all openings consisting of two layers of 6 mil poly which is the sole barrier between the regulated area and the rest of the building or outside.
 - 2. Decontamination facilities, if required for personnel and equipment in operating condition.

3.8.5 FIRST CLEANING

- A. Carry out a first cleaning of all surfaces of the regulated area including items of remaining poly sheeting, tools, scaffolding, ladders/staging by wet methods and/or HEPA vacuuming. Do not use dry dusting/sweeping methods. Use each surface of a cleaning cloth one-time only and then dispose of as contaminated waste. Continue this cleaning until there is no visible residue from abated surfaces or poly or other surfaces. If determined by the IH additional cleaning(s) may be needed.

3.8.6 PRE-CLEARANCE INSPECTION AND TESTING

- A. The 3rd party IH will perform a thorough and detailed visual inspection after the first cleaning to determine whether there is any visible residue in the regulated area. If the visual inspection is acceptable, the IH will perform pre-clearance sampling using aggressive clearance as detailed in 40 CFR 763 Subpart E (AHERA) Appendix A(III)(B)(7)(d). If the sampling results show values below 0.01 f/cc, then the Contractor shall notify the CO of the results with a brief report from the IH documenting the inspection and sampling results and a statement verifying that the regulated area is ready for lockdown encapsulation.

3.8.7 LOCKDOWN ENCAPSULATION OF ABATED SURFACES

- A. With the express written permission of the CO, perform lockdown encapsulation of all surfaces from which asbestos was abated in accordance with the procedures in this specification.

3.9 FINAL VISUAL INSPECTIONS AND AIR CLEARANCE TESTING

3.9.1 GENERAL

- A. Notify the CO 24 hours in advance for the performance of the final visual inspection and testing. The final visual inspection and testing will be performed by the IH after the final cleaning.

3.9.2 FINAL VISUAL INSPECTION

- A. Final visual inspection will include the entire regulated area, the PDF, all poly sheeting, seals over HVAC openings, doorways, windows, and any other openings. If any debris, residue, dust or any other suspect material is detected, the final cleaning shall be repeated at no cost to the Owner. When the regulated area is visually clean the final testing can be done.

3.9.3 FINAL AIR CLEARANCE TESTING

- A. After an acceptable final visual inspection by the IH, final clearance testing will be performed. Air samples will be collected and analyzed in accordance with procedures for PCM/TEM in this specification. If the release criteria are not met, the Contractor shall repeat the final cleaning and continue decontamination procedures. Additional inspection and testing will be done at the expense of the Contractor.
- B. If the results of the PCM/TEM are acceptable, remove the critical barriers. Any small quantities of residue material found upon removal of the poly shall be removed with a HEPA vacuum and localized isolation. If significant quantities are found as determined by the IH, then the entire area affected shall be cleaned as specified in the final cleaning.
- C. When release criteria are met, proceed to perform the abatement closeout and to issue the certificate of completion in accordance with these specifications.

3.9.4 FINAL AIR CLEARANCE PROCEDURES

- A. Contractor's Release Criteria: Work in a regulated area is complete when the regulated area is visually clean and airborne fiber levels have been reduced to or below 0.01 f/cc as measured with PCM/TEM methods.
- B. Air Monitoring and Final Clearance Sampling: To determine if the elevated airborne fiber counts encountered during abatement operations have been reduced to the specified level, the IH will secure samples and analyze them according to the following procedures:
 - 1. Fibers Counted: "Fibers" referred to in this section shall be either all fibers regardless of composition as counted in the NIOSH 7400 PCM method or asbestos fibers counted using the TEM method.
 - 2. Aggressive Sampling: All final air testing samples shall be collected using aggressive sampling techniques. Samples will be collected on 0.8μ MCE filters for PCM analysis and 0.45μ Polycarbonate filters for TEM analysis. Before pumps are started, initiate aggressive sampling as detailed in 40 CFR 763 Subpart E (AHERA)

Appendix A (III)(B)(7)(d). Air samples will be collected in areas subject to normal air circulation away from corners, obstructed locations, and locations near windows, doors, or vents. After air sampling pumps have been shut off, circulating fans shall be shut off.

3.9.5 CLEARANCE SAMPLING USING PCM

- A. The NIOSH 7400 method will be used for clearance sampling with a minimum collection volume of 1200 Liters of air. A minimum of 5 PCM clearance samples will be collected.

3.9.6 CLEARANCE SAMPLING USING TEM

- A. TEM clearance requires a minimum of 13 samples taken and analyzed, including five samples in the regulated area, five samples outside the regulated area and three field blanks using polycarbonate filters.

3.10 ABATEMENT CLOSEOUT AND CERTIFICATE OF COMPLIANCE

3.10.1 COMPLETION OF ABATEMENT WORK

After thorough decontamination, complete asbestos abatement work upon meeting the regulated area clearance criteria and fulfilling the following:

- A. Remove all equipment, materials, and debris from the project area.
- B. Package and dispose of all asbestos waste as required.
- C. Repair or replace all interior finishes damaged during the abatement work.
- D. Fulfill other project closeout requirements as specified elsewhere in this specification.

3.10.2 CERTIFICATE OF COMPLETION BY CONTRACTOR

- A. The Contractor shall complete and sign the "Certificate of Completion" in accordance with Attachment 1 at the completion of the abatement and decontamination of the regulated area.

3.10.3 WORK SHIFTS

- A. All work shall be done during administrative hours (8:00 AM to 4:30 PM) Monday - Friday excluding Federal Holidays. Any change in the work schedule must be approved in writing by the CO.

3.10.4 RE-INSULATION

- A. If required as part of the contract, replace all asbestos containing insulation with suitable non-asbestos material. Provide MSDS's for all replacement materials. Refer to Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.

END OF SECTION 028213.13

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wood blocking and nailers.

1.2 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) size or greater but less than 5 inches nominal (114 mm actual) size in least dimension.
- C. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 - 2. NHLA: National Hardwood Lumber Association.
 - 3. NLGA: National Lumber Grades Authority.
 - 4. PLIB; Pacific Lumber Inspection Bureau.
 - 5. SPIB: The Southern Pine Inspection Bureau.
 - 6. WWPA: Western Wood Products Association.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.

- 3. Dress lumber, S4S.
- B. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.

2.2 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
- B. Dimension Lumber Items: Standard, Stud, or No. 3 grade lumber of any species.
- C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.3 FASTENERS

- A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
- E. Wood Screws: ASME B18.6.1.
- F. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.
- G. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- H. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.
- I. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in

unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material (Interior): Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate blocking, nailers, and similar supports to comply with requirements for attaching other construction.
- C. Provide blocking as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- D. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- E. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 1. NES NER-272 for power-driven fasteners.
 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
 3. ICC-ES evaluation report for fastener.
- F. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

END OF SECTION 06 10 00

SECTION 06 40 23 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid-surface-material countertops.
 - 2. Wood furring, blocking, shims, and hanging strips for installing woodwork unless concealed within other construction before paneling installation.
- B. Related Requirements:
 - 1. Section 06 10 00 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
 - 2. Section 07 92 00 "Joint Sealant" for joint sealant at countertops.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 SUBMITTALS

- A. Product Data: For solid-surfacing material.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 - 1. Show details full size.
 - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 3. Show locations and sizes of cutouts and holes for faucets and other items installed in architectural woodwork.
 - 4. Apply AWI Quality Certification Program label to Shop Drawings.
- C. Samples:
 - 1. Solid-surfacing materials, 6 inches (150 mm) square.
- D. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.
 - 1. Register work with AWI Quality Certification Program.
- E. Minutes of preinstallation conference.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.
- B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.
- C. Low-Emitting Materials - Adhesives and Sealants: For field applications that are on the building interior, provide adhesives and sealants that comply with CDHP Standard Method v1.2-2017 and SCAQMD Rule 1168 effective date of October 6, 2017; do not contain methylene chloride and perchloroethylene; have maximum Total VOC of 500 microgram/cu m; and meet VOC content limits of authorities having jurisdiction. VOC content limits include but are not limited to following:
 - 1. Contact Adhesives: 80 g/L.
 - 2. Edge Glue Adhesive: 250 g/L.
 - 3. Multipurpose Construction Adhesives: 70 g/L.
 - 4. Special-Purpose Contact Adhesive: 250 g/L.
- D. Low-Emitting - Composite Wood: The composite wood product category includes particleboard, medium density fiberboard (both medium density and thin), hardwood plywood with veneer, composite or combination core, and wood structural panels or structural wood products. Exclude products covered in the flooring, ceiling, wall panels, or furniture categories from this category. These materials to meet one of the following:
 - 1. Certified as ultra-low-emitting formaldehyde (ULEF) product per EPA Toxic Substances Control Act, Formaldehyde Emission Standards for Composite Wood Products (TSCA, Title VI) (EPA TSCA Title VI) or California Air Resources Board (CARB) Airborne Toxic Control Measure (ATCM).
 - 2. Certified as no added formaldehyde resins (NAF) product per EPA TSCA Title VI or CARB ATCM.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver solid surface until painting and similar operations that could damage solid surface have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate

measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where woodwork is indicated to fit to other construction, establish dimensions for areas where woodwork are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, utilities and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 INTERIOR ARCHITECTURAL WOODWORK, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the ANSI / AWI Standards for grades of woodwork indicated for construction, finishes, installation, and other requirements.
1. Performance Duty Level: Duty Level 3 – Institutional.
 2. Grade: Custom.
 3. Provide labels and certificates from AWI certification program indicating that woodwork, including installation, complies with requirements of grades specified.
 4. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

2.2 SOLID-SURFACE-MATERIAL COUNTERTOPS

- A. Configuration: Provide countertops with the following front and backsplash style:
1. Front: Straight, slightly eased at top.
- B. Countertops: 1/2 inch thick, solid surface material with front edge built up with same material.
- C. Apron: 1/2 inch thick, solid surface material.
- D. Subtop Material at Sinks: Exterior-grade plywood.
- E. Fabrication: Fabricate tops in one piece with shop-applied edges unless otherwise indicated. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
1. Install integral sink bowls in countertops in the shop.

2.3 MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
 - 1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
 - 1. Composite Wood Products: Products shall be made using ultra-low-emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.
 - 2. Exterior Softwood Plywood: DOC PS 1 Grade C-C Plugged, touch sanded.
- C. Solid Surface Material : Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.
 - 1. Basis-of-Design Product: The design for solid surface is based on product per Finish and Material Index. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
 - a. Du Pont de Nemours, Inc.
 - b. Formica Corporation.
 - c. Wilsonart International.
 - 2. Type: Provide Standard Type unless Special Purpose Type is indicated.
 - 3. Integral Sink Bowls: Comply with ISSFA-2 and ANSI Z124.3, Type 5 or Type 6, without a precoated finish.
 - a. Basis-of-Design Product: The design for integral sink bowls is based on Corian; Accessible 8254 sink. Subject to compliance with requirements, provide the named product or a comparable product by manufacturer of solid surface provided.
 - 4. Colors and Patterns: Per Finish and Material Index.

2.4 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 08 71 00 "Door Hardware."
- B. Countertop Bracket (metal stud partitions): BHMA A156.
 - 1. Depth: As required by depth of countertop.
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Commercial Sourcing; ADA Vanity Bracket, Aluminum.
 - b. Hafele: 287.74.053 ADA Vanity Bracket, Aluminum.
 - c. Rakks: ADA-Compliant Vanity Support Bracket.

2.5 MISCELLANEOUS MATERIALS

- A. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesives: Do not use adhesives that contain urea formaldehyde.

2.6 FABRICATION

- A. Fabricate woodwork to dimensions, profiles, and details indicated. Provide front countertop overhang of 1 inch (25 mm) over base cabinets.
 - 1. Corners and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch (1.5 mm).
- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
- C. Shop-cut openings to maximum extent possible to receive plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 - 1. Seal edges of openings in countertops with a coat of varnish.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.
- B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Grade: Install woodwork to comply with same grade as item to be installed.

- B. Assemble woodwork and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Field Jointing Countertops: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
 - 1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches (150 mm) of front and back edges and at intervals not exceeding 24 inches (610 mm). Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.
- D. Install woodwork level, plumb, true, and straight with no distortions. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch (3 mm) in 96 inches (2,440 mm).
- E. Scribe and cut cabinets and countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- F. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 1. Install countertops with no more than 1/8 inch (3 mm) in 96 inch (2,440 mm) sag, bow, or other variation from a straight line.
 - 2. Seal junctures of tops and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust for uniform appearance.
- B. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 06 40 23

SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Penetrations in fire-resistance-rated walls.
- B. Related Sections:
 - 1. Section 07 84 43 "Joint Firestopping" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.
 - a. Illustrations of each assembly from qualified testing agency.
 - b. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- B. Minutes of preinstallation conference.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements" and employs installers and supervisors who are trained and approved by penetration firestopping manufacturer.
- B. Low-Emitting Materials - Adhesives and Sealants: For field applications that are on the building interior, provide adhesives and sealants that comply with CDHP Standard Method v1.2-2017 and SCAQMD Rule 1168 effective date of October 6, 2017; do not contain methylene chloride and perchloroethylene; have maximum Total VOC of 500 microgram/cu m; and meet VOC

content limits of authorities having jurisdiction. VOC content limits include but are not limited to following:

1. All Other Architectural Sealants: 50 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

C. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:

1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
 - b. Classification markings on penetration firestopping correspond to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek ETL SEMKO in its "Directory of Listed Building Products."
 - 3) FM Global in its "Building Materials Approval Guide."

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.6 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.
- C. Notify testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: For each opening, use single tested, listed system from single manufacturer.

2.2 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 - 1. Fire-resistance-rated walls include fire-barrier walls and fire partitions.
 - 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- D. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
 - 1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-wool-fiber or rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fire-rated form board.
 - d. Fillers for sealants.
 - 2. Temporary forming materials.
 - 3. Substrate primers.
 - 4. Collars.
 - 5. Steel sleeves.

2.3 FILL MATERIALS

- A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

- C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.
- D. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- F. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- G. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.4 MIXING

- A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.

- B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

- A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.
- C. Install fill materials for firestopping by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing and inspecting agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Engage a qualified testing agency to perform tests and inspections.
- B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.
- C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. Firestopping with No Penetrating Items:
 - 1. Basis of Design System: UL-Classified Systems: W-L- 0001-0999.
 - 2. Type of Fill Materials: As required to achieve rating.
- C. Firestopping for Metallic Pipes, Conduit, or Tubing:
 - 1. Basis of Design System: UL-Classified Systems: W-L- 1001-1999.
 - 2. Type of Fill Materials: As required to achieve rating.
- D. Firestopping for Nonmetallic Pipe, Conduit, or Tubing:
 - 1. Basis of Design System: UL-Classified Systems: W-L- 2001-2999.
 - 2. Type of Fill Materials: As required to achieve rating.
- E. Firestopping for Electrical Cables:
 - 1. Basis of Design System: UL-Classified Systems: W-L- 3001-3999.
 - 2. Type of Fill Materials: As required to achieve rating.
- F. Firestopping for Insulated Pipes:

1. Basis of Design System: UL-Classified Systems: W-L- 5001-5999. Retain one or more of six subparagraphs below if not retaining subparagraphs above.
2. Type of Fill Materials: As required to achieve rating.

G. Firestopping for Miscellaneous Electrical Penetrants:

1. Basis of Design System: UL-Classified Systems: W-L- 6001-6999.
2. Type of Fill Materials: As required to achieve rating.

H. Firestopping for Miscellaneous Mechanical Penetrants:

1. Basis of Design System: UL-Classified Systems: W-L- 7001-7999.
2. Type of Fill Materials: As required to achieve rating.

I. Firestopping for Groupings of Penetrants:

1. Basis of Design System: UL-Classified Systems: W-L-.
2. Type of Fill Materials: As required to achieve rating.

END OF SECTION 07 84 13

SECTION 07 84 43 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Joints in or between fire-resistance-rated constructions.
- B. Related Sections:
 - 1. Section 07 84 13 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.
 - a. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- B. Minutes of preinstallation conference.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing fire-resistive joint systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its fire-resistive joint system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- B. Low-Emitting Materials - Adhesives and Sealants: For field applications that are on the building interior, 75 percent of adhesives and sealants meet the VOC emissions evaluation and 100 percent meet the VOC content evaluations. Provide adhesives and sealants that comply with

CDHP Standard Method v1.2-2017 and SCAQMD Rule 1168 effective date of October 6, 2017; do not contain methylene chloride and perchloroethylene; have maximum Total VOC of 500 microgram/cu m; and meet VOC content limits of authorities having jurisdiction. VOC content limits include but are not limited to following:

1. All Other Architectural Sealants: 50 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

C. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:

1. Fire-resistive joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
2. Fire-resistive joint systems are identical to those tested per testing standard referenced in "Fire-Resistive Joint Systems" Article. Provide rated systems complying with the following requirements:
 - a. Fire-resistive joint system products bear classification marking of qualified testing agency.
 - b. Fire-resistive joint systems correspond to those indicated by reference to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek ETL SEMKO in its "Directory of Listed Building Products."

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure fire-resistive joint systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.6 COORDINATION

- A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.
- B. Coordinate sizing of joints to accommodate fire-resistive joint systems.
- C. Notify testing agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 FIRE-RESISTIVE JOINT SYSTEMS

- A. Where required, provide PVC-free, fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079:
 - 1. Joints include those installed in or between fire-resistance-rated walls.
 - 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.
- C. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- D. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.

- B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply fill materials so they contact and adhere to substrates formed by joints.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Identify fire-resistive joint systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge so labels will be visible to anyone seeking to remove or penetrate joint system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "WARNING - FIRE-RESISTIVE JOINT SYSTEM - DO NOT DISTURB. NOTIFY BUILDING MANAGEMENT OF ANY DAMAGE."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Where deficiencies are found or fire-resistive joint systems are damaged or removed due to testing, repair or replace fire-resistive joint systems so they comply with requirements.
- C. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.7 FIRE-RESISTIVE JOINT SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN.
- B. Where Intertek ETL SEMKO-listed systems are indicated, they refer to design numbers in Intertek ETL SEMKO's "Directory of Listed Building Products" under product category Expansion/Seismic Joints or Firestop Systems.
- C. Wall-to-Wall, Fire-Resistive Joint Systems:
 - 1. UL-Classified Systems: WW-D - 0000-0999.
 - 2. Assembly Rating: 1 hour.
 - 3. Nominal Joint Width: As indicated.
 - 4. Movement Capabilities: Class I - 25 percent compression or extension.
 - 5. L-Rating at Ambient: Less than 5 cfm per linear foot (0.00775 m³/s m) of joint at 0.30 inch (7.47 Pa) of water.
 - 6. L-Rating at 400 deg F (204 deg C): Less than 5 cfm per linear foot (0.00775 m³/s m) of joint at 0.30 inch (7.47 Pa) of water.
- D. Head-of-Wall, Fire-Resistive Joint Systems:
 - 1. UL-Classified Systems: HW-D - 0000-0999.
 - 2. Assembly Rating: 1 hour.
 - 3. Nominal Joint Width: As indicated.
 - 4. Movement Capabilities: Class I - 100 percent compression or extension.

5. L-Rating at Ambient: Less than 5 cfm per linear foot ($0.00775 \text{ m}^3/\text{s m}$) of joint at 0.30 inch (7.47 Pa) of water.
6. L-Rating at 400 deg F (204 deg C): Less than 5 cfm per linear foot ($0.00775 \text{ m}^3/\text{s m}$) of joint at 0.30 inch (7.47 Pa) of water.

E. Bottom-of-Wall, Fire-Resistive Joint Systems:

1. UL-Classified Systems: BW-D - 0000-0999.
2. Assembly Rating: 1 hour.
3. Nominal Joint Width: As indicated.
4. Movement Capabilities: Class I - 25 percent compression or extension.
5. L-Rating at Ambient: Less than 5 cfm per linear foot ($0.00775 \text{ m}^3/\text{s m}$) of joint at 0.30 inch (7.47 Pa) of water.
6. L-Rating at 400 deg F (204 deg C): Less than 5 cfm per linear foot ($0.00775 \text{ m}^3/\text{s m}$) of joint at 0.30 inch (7.47 Pa) of water.

F. Wall-to-Wall, Fire-Resistive Joint Systems Intended for Use as Corner Guards:

1. UL-Classified Systems: CG-D - 0000-0999.
2. Assembly Rating: 1 hour.
3. Nominal Joint Width: As indicated.
4. Movement Capabilities: Class I - 50 percent compression or extension.
5. L-Rating at Ambient: Less than 5 cfm per linear foot ($0.00775 \text{ m}^3/\text{s m}$) of joint at 0.30 inch (7.47 Pa) of water.
6. L-Rating at 400 deg F (204 deg C): Less than 5 cfm per linear foot ($0.00775 \text{ m}^3/\text{s m}$) of joint at 0.30 inch (7.47 Pa) of water.

END OF SECTION 07 84 43

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Latex joint sealants.
 - 2. Acoustical joint sealants.
- B. Related Sections:
 - 1. Section 09 21 16 "Gypsum Board Assemblies" for sealing perimeter joints.
 - 2. Section 09 30 00 "Tiling" for sealing tile joints.

1.2 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
 - 1. Joint-Sealant Schedule: Include the following information:
 - a. Joint-sealant application, joint location, and designation.
 - b. Joint-sealant manufacturer and product name.
 - c. Joint-sealant formulation.
 - d. Joint-sealant color.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- E. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- F. Field-Adhesion Test Reports: For each sealant application tested.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Low-Emitting Materials - Adhesives and Sealants: For field applications that are on the building interior, provide adhesives and sealants that comply with CDHP Standard Method v1.2-2017 and SCAQMD Rule 1168 effective date of October 6, 2017; do not contain methylene chloride and perchloroethylene; have maximum Total VOC of 500 microgram/cu m; and meet VOC content limits of authorities having jurisdiction. VOC content limits include but are not limited to following:
 - 1. All Other Architectural Sealants: 50 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- D. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.4 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.
 - 3. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
 - 4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 5. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
 - 6. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
 - 1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
 - 2. Conduct field tests for each kind of sealant and joint substrate.
 - 3. Notify Architect seven days in advance of dates and times when test joints will be erected.

4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
 - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.5 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
 2. When joint substrates are wet.
 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Silicone Sealants: 20 years from date of Substantial Completion.
 2. Urethane Sealants: 5 years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range of standard colors.

2.2 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type B (bicellular material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.3 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.
- D. Acoustical Outlet Backer: Flexible putty pad which provides high acoustical ratings at outlet boxes in acoustical-rated walls.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. ATS Acoustics; ATS Acoustics Putty Pads.
 - b. Kinetics Noise Control, Inc.; IsoBacker.
 - 2. Location: At all outlet boxes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, rust, laitance, release agents, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Remove laitance and form-release agents from concrete.
 - 3. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.

- B. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
 - 4. Where silicones sealants are to bond directly to urethane sealants; apply urethanes first, allow urethane sealant to cure per manufacturers recommendation, then prime and apply silicone sealant.
- F. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.
- G. Install acoustical outlet backers per manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed and cured sealant joints as follows:

- a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.
- C. Examine sealed outlets to ensure proper installation of acoustical outlet backer before concealing or enclosing areas.

3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage

or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

- A. Pourable, Traffic-Grade, Urethane Joint Sealant: Interior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Tile control and expansion joints.
 - c. Joints between different materials listed above.
 - d. Other joints as indicated.
 - 2. Single-Component, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type S, Grade P, Class 25, for Use T.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) BASF Building Systems; MasterSeal SL 1.
 - 2) Pecora Corporation; Urexpan NR-201.
 - 3) Sika Corporation. Construction Products Division; Sikaflex 1CSL.
 - 4) Tremco Incorporated; Vulkem 45SSL
 - 3. Multi-Component, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type M, Grade P, Class 25, for Use T.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) BASF Building Systems; MasterSeal SL 2.
 - 2) Pecora Corporation; NR-200.
 - 3) Sika Corporation. Construction Products Division; Sikaflex 2c SL.
 - 4) Tremco Incorporated; 45SSL.
- B. Mildew-Resistant Silicone Joint-Sealant: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Sealant Location:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - c. Other joints as indicated.
 - 2. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Corning Corporation; DOWSIL 786.
 - 2) Momentive Performance Materials, Inc.; Sanitary SCS1700.
 - 3) Pecora Corporation; 898NST.

- 4) Sika Corporation, Construction Products Division; SikaSil GP.
- 5) Tremco Incorporated; Tremsil 200 Sanitary.

C. Latex Joint Sealant: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

- a. Control and expansion joints on exposed interior surfaces of exterior walls.
- b. Tile control and expansion joints.
- c. Perimeter joints between interior wall surfaces and frames of interior doors.
- d. Penetration perimeter joints.
- e. Other joints as indicated.

2. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Momentive Performance Materials, Inc.; RCS20.
 - 2) Pecora Corporation; AC-20+.
 - 3) Tremco Incorporated; Tremflex 834.

D. Acoustical Joint Sealant: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Location:

- a. Acoustical joints where indicated.
- b. Penetration perimeter joints in vertical surfaces and horizontal nontraffic surfaces with acoustical joints.
- c. Other joints as indicated.

2. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) GE Advanced Materials Momentive, RCS20.
 - 2) Pecora Corporation; AC-20 FTR.
 - 3) Pecora Corporation; AIS-919.
 - 4) USG Corporation; SHEETROCK Acoustical Sealant.

END OF SECTION 07 92 00

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes hollow-metal work.
- B. Related Requirements:
 - 1. Section 08 71 00 "Door Hardware" for door hardware for hollow-metal doors.

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, and finishes.
 - 2. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, joints, field splices, and connections.

7. Details of accessories.

C. Samples:

1. For "Doors" and "Frames" subparagraphs below, prepare Samples approximately 8 by 10 inches (203 by 254 mm) to demonstrate compliance with requirements for quality of materials and construction:
 - a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
 - b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ceco Door Products; an Assa Abloy Group company.
 2. Curries Company; an Assa Abloy Group company.
 3. MPI Group, LLC (The).
 4. Steelcraft; an Ingersoll-Rand company.
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 INTERIOR DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. .
1. Physical Performance: Level B according to SDI A250.4.
 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.053 inch (16 gauge).
 - d. Edge Construction: Model 2, Seamless.
 - e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
 3. Frames:
 - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
 - b. Construction: Full profile welded.
 4. Exposed Finish: Prime.

2.3 FRAME ANCHORS

- A. Jamb Anchors:
1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
 2. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:
1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.4 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

2.5 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
1. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches (3.2 mm in 51 mm).
 2. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
 3. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 2. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 3. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - 1) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 2) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
 - 3) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.

- b. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
 - 4. Head Anchors: Two anchors per head for frames more than 42 inches (1067 mm) wide and mounted in metal-stud partitions.
 - 5. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

2.6 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - b. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - c. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
 - 4. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
 - 5. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:

- a. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
- b. Between Edges of Pairs of Doors: 1/8 inch (3.2 mm) to 1/4 inch (6.3 mm) plus or minus 1/32 inch (0.8 mm).
- c. At Bottom of Door to Top of Threshold or Finished Floor: 3/8 inch maximum, unless noted At Bottom of Door to Top of Threshold or Finished Floor: 3/8 inch maximum, unless noted otherwise.
- d. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in Section 09 91 00 "Painting."

END OF SECTION 08 11 13

SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Access doors and frames for walls and ceilings.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details materials, individual components and profiles, and finishes.
 - 2. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Detail fabrication and installation of access doors and frames for each type of substrate.
- C. Samples: For each door face material, at least 3 by 5 inches (75 by 125 mm) in size, in specified finish.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acudor Products, Inc.
 - 2. Babcock-Davis.
 - 3. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
 - 4. Karp Associates, Inc.
 - 5. Larsen's Manufacturing Company.
 - 6. Milcor Inc.
 - 7. Nystrom, Inc.
- B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

- C. Recycled Content of Steel Doors and Frames: Provide steel produced by electric-arc furnace process and has postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- D. Flush Access Doors with Exposed Flanges:
 - 1. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
 - 2. Locations: Wall and ceiling.
 - 3. Door Size: Per Drawings
 - 4. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage.
 - a. Finish: Factory finish.
 - 5. Frame Material: Same material, thickness, and finish as door.
 - 6. Hinges: Manufacturer's standard.
 - 7. Hardware: Lock.
- E. Hardware:
 - 1. Lock: Cylinder.
 - a. Lock Preparation: Prepare door panel to accept cylinder specified in Section 08 71 00 "Door Hardware."

2.2 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Frame Anchors: Same type as door face.
- D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.3 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.

1. Provide mounting holes in frames for attachment of units to metal or wood framing.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 1. For cylinder locks, furnish two keys per lock and key all locks alike.

2.4 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Steel and Metallic-Coated-Steel Finishes:
 1. Factory Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry-film thickness of 1 mil (0.025 mm) for topcoat.
 2. Color: Manufacturer's standard white.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08 31 13

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
 - 2. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Cylinders specified for doors in other sections.
- C. Related Sections:
 - 1. Division 08 Section "Hollow Metal Doors and Frames".
- D. Standards: All hardware specified herein shall comply with the following industry standards:
 - 1. ANSI/BHMA Certified Product Standards - A156 Series
 - 2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.2 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
 - 1. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 - b. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 - c. Content: Include the following information:

- 1) Type, style, function, size, label, hand, and finish of each door hardware item.
 - 2) Manufacturer of each item.
 - 3) Fastenings and other pertinent information.
 - 4) Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - 5) Explanation of abbreviations, symbols, and codes contained in schedule.
 - 6) Mounting locations for door hardware.
 - 7) Door and frame sizes and materials.
- d. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
2. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.
- B. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 00, General Conditions. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.
- C. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

1.3 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum 3 years documented experience installing both standard builders hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor in good standing by the manufacturers of the primary materials with a warehousing facility in Project's vicinity.

Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

1. Scheduling Responsibility: Preparation of door hardware and keying schedules.
- D. Automatic Operator Supplier Qualifications: Power operator products and accessories are required to be supplied and installed through current members of the manufacturer's "Power Operator Preferred Installer" program. Suppliers are to be factory trained, certified, and a direct purchaser of the specified power operators and be responsible for the installation and maintenance of the units and accessories indicated for the Project.
- E. Source Limitations: Obtain each type and variety of Door Hardware specified in this Section from a single source, qualified supplier unless otherwise indicated.
- F. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the model building code including, but not limited to, the following:
1. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1 as follows:
 - a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
 - b. Door Closers: Comply with the following maximum opening-force requirements indicated:
 - 1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
 - 2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.
 2. NFPA 101: Comply with the following for means of egress doors:
 - a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
 - b. Thresholds: Not more than 1/2 inch high.
 3. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 (neutral pressure at 40" above sill) or UL-10C.
 - a. Test Pressure: Positive pressure labeling.

- G. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- H. Keying Conference: Conduct conference. Keying conference to incorporate the following criteria into the final keying schedule document:
 - 1. Function of building, purpose of each area and degree of security required.
 - 2. Plans for existing and future key system expansion.
 - 3. Requirements for key control storage and software.
 - 4. Installation of permanent keys, cylinder cores and software.
 - 5. Address and requirements for delivery of keys.
- I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.5 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

1.6 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.

2. Faulty operation of the hardware.
 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
1. Ten years for mortise locks and latches.
 2. Five years for exit hardware.
 3. Twenty five years for manual surface door closers.

1.7 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Continuing Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous 1 year full maintenance including repair and replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
1. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
 - a. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- B. Substitutions: Requests for substitution and product approval for inclusive mechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 00, General Conditions. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.
1. Quantity: Provide the following hinge quantity, unless otherwise indicated:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
 4. Hinge Options: Comply with the following where indicated in the Hardware Sets or on Drawings:
 - a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the following applications:
 - 1) Out-swinging exterior doors.
 - 2) Out-swinging access controlled doors.
 - 3) Out-swinging lockable doors.
 5. Acceptable Manufacturers:
 - a. Bommer Industries (BO).
 - b. Hager Companies (HA).
 - c. Ives – Security Technologies (IV)
 - d. McKinney Products (MK).

2.3 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified automatic, self-latching, and manual flush bolts and surface bolts. Manual flush bolts to be furnished with top rod of sufficient length to allow bolt location approximately six feet from the

floor. Furnish dust proof strikes for bottom bolts. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

1. Acceptable Manufacturers:
 - a. Door Controls International (DC).
 - b. Ives (IV)
 - c. Rockwood Manufacturing (RO).
 - d. Trimco (TC).
- B. Door Push Plates and Pulls: ANS/BHMA A156.6 certified door pushes and pulls of type and design specified below or in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
 1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
 2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
 3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
 4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
 - a. Acceptable Manufacturers:
 - b. Burns (BU).
 - c. Ives (IV)
 - d. Rockwood Manufacturing (RO).
 - e. Trimco (TC).

2.4 CYLINDERS AND KEYING

- A. All locks and cylinders shall be master-keyed or grand-master keyed as directed by Owner. Owner will supply system expansion requirements.
- B. Keyway to be Schlage E or F keyway. Confirm with owner.
- C. Key Quantity: Provide the following minimum number of keys:
 1. Change Keys per Cylinder: Four (4)
 2. Master Keys (per Master Key Group): Two (2)
 3. Grand Master Keys (per Grand Master Key Group): Two (2)
 4. Construction Control Keys (where required): Two (2)
 5. Permanent Control Keys (where required): Two (2)
 6. Construction Keys (where required): Twenty (20)

2.5 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 4000, Operational Grade 1 certified mortise locksets furnished in the functions as specified in the Hardware Sets. Locksets to be manufactured with a corrosion resistant, stamped 12 gauge minimum formed steel case and be field-reversible for handing without disassembly of the lock body. Lockset trim (including knobs, levers, escutcheons, roses) to be the product of a single manufacturer. Furnish with standard 2 3/4" backset, 3/4" throw anti-friction stainless steel latchbolt, and a full 1" throw stainless steel bolt for deadbolt functions.
 - 1. Acceptable Manufacturers:
 - a. Schlage (SCH) – ND Series, Rhodes Lever
- B. Lock Trim Design: As specified in Hardware Sets.

2.6 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
 - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 - 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 - 3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
- B. Standards: Comply with the following:
 - 1. Strikes for Mortise Locks and Latches: BHMA A156.13.
 - 2. Strikes for Bored Locks and Latches: BHMA A156.2.
 - 3. Strikes for Auxiliary Deadlocks: BHMA A156.5.
 - 4. Dustproof Strikes: BHMA A156.16.

2.7 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
 - 1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.
 - 2. Standards: Closers to comply with UL-10C and UBC 7-2 for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
 - 3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.

4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.
 5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 - a. Where closers are indicated to have mechanical dead-stop, provide heavy duty arms and brackets with an integral positive stop.
 - b. Where closers are indicated to have mechanical hold open, provide heavy duty units with an additional built-in mechanical holder assembly designed to hold open against normal wind and traffic conditions. Holder to be manually selectable to on-off position.
 - c. Where closers are indicated to have a cushion-type stop, provide heavy duty arms and brackets with spring stop mechanism to cushion door when opened to maximum degree.
 - d. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics. Provide drop plates or other accessories as required for proper mounting.
 6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt or security type fasteners as specified in the door Hardware Sets.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
1. Acceptable Manufacturers:
 - a. LCN Closers (LC) – 4050/1450 Series.
 - b. Sargent Manufacturing (SA) – 281 Series.
 - c. Norton Door Controls (NO) – 7500/8000 Series.

2.8 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Metal Protection Plates: ANSI/BHMA A156.6 certified metal protection plates (kick, armor, or mop), beveled on four edges (B4E), fabricated from the following:
 - a. Stainless Steel: 300 series, .050-inch thick, with countersunk screw holes (CSK).
4. Fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets.
5. Metal Door Edging: Door protection edging fabricated from a minimum .050-inch thick metal sheet, formed into an angle or "U" cap shapes, surface or mortised mounted onto edge of door. Provide appropriate leg overlap to account for protection plates as required. Height to be as specified in the Hardware Sets.
6. Acceptable Manufacturers:
 - a. Burns (BU).
 - b. Ives (IV)
 - c. Rockwood Manufacturing (RO).
 - d. Trimco (TC).

2.9 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 1. Acceptable Manufacturers:
 - a. Burns (BU).
 - b. Ives (IV)
 - c. Rockwood Manufacturing (RO).
 - d. Trimco (TC).

2.10 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are 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.
 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and UBC 7-2, Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Acceptable Manufacturers:
 - 1. National Guard (NG).
 - 2. Pemko Manufacturing (PE).
 - 3. Zero (ZER)

2.11 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.12 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating 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.

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. and provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical door hardware.

3.8 DOOR HARDWARE SCHEDULE

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should 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 and functionality.

HARDWARE SET: 01

FOR USE ON DOOR #(S):

100/1 110A/1 111A/1

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1	652	IVE
1	EA	STOREROOM LOCK	ND80P6D RHO X VERIFY OWNER KEYWAY	626	SCH
1	EA	SURFACE CLOSER	1461 CUSH FC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

HARDWARE SET: 02

FOR USE ON DOOR #(S):

101/1 102/1

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1	652	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	L9040 06A 09-544 OS-OCC	626	SCH
1	EA	SURFACE CLOSER	1461 CUSH FC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

HARDWARE SET: 03

FOR USE ON DOOR #(S):

111/1

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1	652	IVE
1	EA	PASSAGE SET	ND10S RHO	626	SCH
1	EA	SURFACE CLOSER	1461 FC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

HARDWARE SET: 04

FOR USE ON DOOR #(S):

110/1

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1	652	IVE
1	EA	PASSAGE SET	ND10S RHO	626	SCH
1	EA	OH STOP	90S	630	GLY
1	EA	SURFACE CLOSER	1461 FC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

END OF SECTION 08 71 00

SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
 - 2. Tile backing panels.
 - 3. Non-load-bearing steel framing systems for interior gypsum board assemblies.
 - 4. Suspension systems for interior gypsum ceilings, soffits, and grid systems.
- B. Related Requirements:
 - 1. Section 07 92 00 "Joint Sealants" for sealants installed as part of gypsum board assemblies.

1.2 SUBMITTALS

- A. Product Data: For each component of wall assembly.
- B. Samples: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

1.3 QUALITY ASSURANCE

- A. Low-Emitting Materials - Adhesives and Sealants: For field applications that are on the building interior, provide adhesives and sealants that comply with CDHP Standard Method v1.2-2017 and SCAQMD Rule 1168 effective date of October 6, 2017; do not contain methylene chloride and perchloroethylene; have maximum Total VOC of 500 microgram/cu m; and meet VOC content limits of authorities having jurisdiction. VOC content limits include but are not limited to following:
 - 1. Gypsum Board and Panel Adhesives: 50 g/L.
 - 2. All Other Adhesives: 250 g/L.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store panel materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.
- B. Notify manufacturer of damaged materials received prior to installation.

- C. Deliver framing materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- D. Protect non-structural metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI's "Code of Standard Practice".

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or with gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, or mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide Basis of Design product or comparable product by one of the following:
 - 1. CertainTeed Corp.
 - 2. Georgia-Pacific Building Products.
 - 3. National Gypsum Company.
 - 4. USG Corporation.
- B. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

1. Basis of Design Product: USG Corporation; Sheetrock Brand EcoSmart Panels Mold Tough Firecode X.
2. Core: 5/8 inch (15.9 mm), Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; GlasRoc Tile Backer.
 - b. Georgia-Pacific Gypsum LLC; DensShield Tile Backer.
 - c. National Gypsum Company; Gold Bond eXP Tile Backer.
 - d. USG Corporation; USG DUROCK Brand Glass-Mat Tile Backerboard.
 2. Core: 5/8 inch (15.9 mm), Type X.
 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. Expansion (control) joint.

2.6 FRAMING SYSTEMS, GENERAL

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 90 percent.
- B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 1. Steel Sheet Components: Comply with AISI S220 requirements for metal unless otherwise indicated.
 2. Protective Coating: Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized unless otherwise indicated.

2.7 NON-STRUCTURAL FRAMING SYSTEMS

- A. Studs and Runners: ASTM C 645.

1. Embossed, High Strength Steel Studs and Tracks: Roll-formed and embossed with surface deformations to stiffen the framing members so that they are structurally comparable to conventional ASTM C 645 steel studs and tracks.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) ClarkDietrich; ProSTUD Drywall Framing.
 - 2) Marino Ware; Viperstud Drywall Framing.
 - b. Minimum Base-Steel Thickness: 0.0180 inch or as required by horizontal deflection performance requirements.
 - 1) Metal thickness for non-high-strength steel studs and runners is shown on Drawings. Provide structurally equivalent thickness of embossed, high-strength steel studs and runners per ICC ES AC86.
 - c. Depth: As indicated on Drawings.
- B. Slip-Type Head Joints: Where indicated, provide one of the following:
 1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
 2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
 3. Deflection Track: Steel sheet top runner 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.
- C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 1. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).
- D. Cold-Rolled Channel Bridging: Steel, 0.053-inch (1.34-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
 1. Depth: 1-1/2 inches (38 mm).
 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.
- E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 1. Depth: 7/8 inch (22.2 mm) unless otherwise indicated.
- F. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
 1. Depth: 3/4 inch (19 mm).

2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch (0.8 mm).
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

2.8 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- B. Hanger Attachments to Concrete:
 1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
 - a. Type: Postinstalled, chemical anchor or postinstalled, expansion anchor.
 2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
- D. Flat Hangers: Steel sheet, 1 by 3/16 inch (25 by 5 mm) by length indicated.
- E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch (1.34 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
 1. Depth: 1-1/2 inches (38 mm).
- F. Furring Channels (Furring Members):
 1. Cold-Rolled Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
 2. Embossed, High Strength Steel Studs and Tracks: Roll-formed and embossed with surface deformations to stiffen the framing members so that they are structurally comparable to conventional ASTM C 645 steel studs and tracks.
 - a. Minimum Base-Steel Thickness: 0.0150 inch.
 - b. Depth: 1-5/8 inches (41 mm).
 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
 - a. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).

4. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.
 - a. Configuration: hat shaped.
- G. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
 - b. Chicago Metallic Corporation; Drywall Grid System.
 - c. USG Corporation; Drywall Suspension System.

2.9 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 1. Interior Gypsum Board: Paper.
 2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
- D. Joint Compound for Tile Backing Panels:
 1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

2.10 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide the following:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
- D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
 1. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing according to ASTM E 488 conducted by a qualified testing agency.
 2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing according to ASTM E 1190 conducted by a qualified testing agency.
- E. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool; no urea-formaldehyde.
 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- F. Acoustical Joint Sealant: As specified in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates to which gypsum board assemblies attach or abut, with Installer present, and including welded hollow-metal frames, elevator hoistway door frames, cast-in anchors, and structural framing, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

- A. General: Install gypsum board wall assemblies to comply with requirements of fire-resistance-rated and STC-rated assemblies indicated, manufacturer's written installation instructions, and ASTM C 754 other than stud-spacing requirements.
 1. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
 2. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing in wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, grab bars, toilet accessories, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by wall assembly framing.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with wall assemblies; frame both sides of joints with furring and other support.

3.4 INSTALLING NON-STRUCTURAL FRAMED ASSEMBLIES

- A. Install non-structural framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 1. Single-Layer Application: 24 inches (610 mm) o.c. unless otherwise indicated.
 2. Tile Backing Panels: 16 inches (406 mm) o.c. unless otherwise indicated.
- B. Install studs so flanges within non-structural framing system point in same direction.
- C. Install tracks (runners) at floors and overhead supports. Extend non-structural 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 penetrating 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 runner 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.

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. Sound-Rated Partitions: Install non-structural framing to comply with sound-rated assembly indicated.
- D. Installation Tolerance: Install each non-structural framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
1. Hangers: 48 inches (1219 mm) o.c.
 2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.
 3. Furring Channels (Furring Members): 24 inches (610 mm) o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. 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. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.6 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.
 - 1. Completely fill space between framing over full area of ceiling at perforated gypsum board.

3.7 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Moisture- and Mold-Resistant Type X: Unless noted otherwise.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - 3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.8 APPLYING TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.9 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings and according to ASTM C 840. If not indicated, locate per following:
 - 1. Interior Partitions: 30 ft. maximum in either direction.
 - a. Isolate perimeter of gypsum panels from building structure.
 - b. Locate control joints where expansion or control joints occur in the base wall construction and/or building structure.
 - c. Tile Finish: 15 ft. maximum in either direction.

- d. Door Jambs and Openings Control Joints: Act as vertical control joints as follows:
 - 1) Partial height door jamb or opening with control joint installed at head of door or opening only where required to meet 30 ft. maximum.
- 2. Interior Ceilings:
 - a. Ceilings Without Perimeter Relief: 30 ft. maximum in either direction.
 - b. Isolate where wings of "L", "U" and "T" shaped ceiling areas are joined.
 - c. Locate to intersect column penetrations in ceiling plane.
- 3. Interior Partitions and Ceilings: Isolate partitions or ceilings of dissimilar construction meet and remain in the same plane.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners unless otherwise indicated.
 - 2. LC-Bead: Use at exposed panel edges.

3.10 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for tile.
 - 3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 09 91 00 "Painting."
- E. Glass-Matt, Water-Resistant Back Board: Finish according to manufacturer's written instruction.

3.11 FIRE WALL Marking.

- 1. Identify concealed fire-rated walls requiring protected openings or penetrations and located in accessible floor, floor-ceiling, or attic space with signs or stencils.
 - a. Locate identification within 15 feet of end of each wall and surface and at intervals not exceeding 30 feet measured horizontally.

- b. Lettering to be not less than 3-inch in height with 0.375-inch stroke of contrasting color and incorporating following wording:
 - 1) "X HOUR FIRE AND / OR SMOKE BARRIER - PROTECT ALL OPENINGS" "X" denotes required wall fire rating.

3.12 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, or mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 21 16

SECTION 09 30 00 - TILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Tile
 - 2. Crack isolation membrane.
- B. Related Sections:
 - 1. Section 07 92 00 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
 - 2. Section 09 21 16 "Gypsum Board Assemblies" for tile backing board.
 - 3. Section 09 65 13 "Resilient Base and Accessories" for metal edge strips.

1.2 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

- C. Samples:
 - 1. Full-size units of each type and composition of tile and for each color and finish required.
 - 2. Full-size units of each type of trim and accessory for each color and finish required.
- D. Minutes of preinstallation conference.
- E. Attic Stock: Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
 - 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
 - 2. Installer employs Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers.
- B. Low-Emitting Materials - Paints and Coatings: For field applications that are on the building interior, 75 percent of paints and coatings meet the VOC emissions evaluation and 100 percent meet the VOC content evaluations. Provide paints and coatings that comply with California Department of Public Health (CDPH) Standard Method v1.2-2017 and CARB 2007 SCM for Architectural Coatings; do not contain methylene chloride and perchloroethylene; have maximum Total VOC of 500 microgram/cu m; and meet VOC content limits of authorities having jurisdiction. VOC content limits include but are not limited to following:
 - 1. Waterproofing Membranes: 250 g/L.
 - 2. Tile and Stone Sealers: 100 g/L.
- C. Low-Emitting Materials - Adhesives and Sealants: For field applications that are on the building interior, provide adhesives and sealants that comply with CDHP Standard Method v1.2-2017 and SCAQMD Rule 1168 effective date of October 6, 2017; do not contain methylene chloride and perchloroethylene; have maximum Total VOC of 500 microgram/cu m; and meet VOC content limits of authorities having jurisdiction. VOC content limits include but are not limited to following:
 - 1. Ceramic Glass, Porcelain, & Stone Tile Adhesives: 65 g/L.

1.6 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 requirements in ANSI A137.1 for labeling tile packages.

- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store liquid materials in unopened containers and protected from freezing.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Dynamic Coefficient of Friction: For tile installed on walkway surfaces, provide products with dynamic coefficient of friction of greater than 0.42 per ANSI A137.1.

2.2 MANUFACTURERS

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.
 - 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
 - 1. Obtain setting and grouting materials from single manufacturer.
 - 2. Obtain crack isolation membrane, from manufacturer of setting and grouting materials.

2.3 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard grade requirements.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.4 TILE PRODUCTS

A. Tile: Per Finish and Material Index.

1. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base Cove: Cove, module size 6 by 12 inch.
 - b. Internal Corners: Field-buttet square corners. For coved base and cap, use angle pieces designed to fit with stretcher shapes.

2.5 CRACK ISOLATION MEMBRANE

A. Crack Isolation Membrane: ANSI A118.12 for high performance and ANSI A118.13.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Custom Building Products; RedGard Waterproofing and Crack Prevention Membrane.
 - b. Laticrete International, Inc.; Hydro Ban.
 - c. MAPEI Corporation; Mapelastic Waterstop.

2.6 SETTING MATERIALS

A. Improved Modified Dry-Set Mortar for Large and Heavy Tile (Thinset): ANSI A118.15HT(E).

1. Horizontal
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Custom Building Products; ProLite Premium Large Format Tile Mortar.
 - 2) MAPEI Corporation; Ultraflex LFT.
 - 3) Laticrete International, Inc.; LHT.
2. Vertical
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Custom Building Products; ProLite Premium Large Format Tile Mortar.
 - 2) MAPEI Corporation; Ultraflex LFT.
 - 3) Laticrete International, Inc.; LHT Plus.

2.7 GROUT MATERIALS

A. Water-Cleanable Epoxy Grout: ANSI A118.3 and ANSI A118.5.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Custom Building Products; CEG-IG 100% Solids Industrial Grade Epoxy Grout.

- b. MAPEI Corporation; Kerapoxy CQ.
- c. Laticrete International, Inc.; Spectralock Pro Premium

2.8 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds:
 - 1. Horizontal
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Custom Building Products; Tech Patch-MP.
 - 2) Laticrete International, Inc.; NXT Patch.
 - 3) MAPEI Corporation; Planipatch Plus.
 - 2. Vertical
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Custom Building Products; Silk Patching & Finishing Compound.
 - 2) MAPEI Corporation; Planitop 330 Fast.
- B. Self-Leveling, Hydraulic Cement Underlayment:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Custom Building Products; CustomTech TechLevel 150 with TechPrime A Acrylic Primer
 - b. Laticrete International, Inc.; NXT Level with NXT Primer.
 - c. MAPEI Corporation; Ultraplan 1 Plus with Primer T.
- C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.9 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions 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, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that concrete substrates for tile floors installed with thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
 - 3. 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.
 - 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.

3.3 TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 - 1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors composed of tiles 8 by 8 inches (200 by 200 mm) or larger.

- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. 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 plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - 2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Tile: 1/8 inch (3.2 mm).
- G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

3.4 CRACK ISOLATION MEMBRANE INSTALLATION

- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.
- B. Allow crack isolation membrane to cure before installing tile or setting materials over it.

3.5 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all tile surfaces so they are free of foreign matter.
 - 1. Remove latex-portland cement grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.6 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.7 INTERIOR TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
 - 1. Tile Installation: TCNA F125-Full; thinset mortar on crack isolation membrane.
 - a. Tile Type: Per Finish and Material Index.
 - b. Thinset Mortar: Improved modified dry-set for large and heavy tile mortar.
 - c. Grout: Water-cleanable epoxy grout.
- B. Interior Wall Installations, Wood or Metal Studs or Furring:
 - 1. Tile Installation: TCNA W245 or TCNA W248; thinset mortar on glass-mat, water-resistant gypsum backer board.
 - a. Tile Type: Per Finish and Material Index.
 - b. Thinset Mortar: Improved modified dry-set for large and heavy tile mortar.
 - c. Grout: Water-cleanable epoxy grout.

END OF SECTION 09 30 00

SECTION 09 65 00 - RESILIENT FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Polyurethane sheet flooring.
- B. Preinstallation Meetings
- C. Preinstallation Conference: Conduct conference at Project site.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of resilient flooring.
 - 1. Include flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
- C. Samples: For each exposed product and for each color, texture, pattern, and finish specified, in manufacturer's standard size, but not less than 6-by-9-inch (150-by-230-mm) sections.
 - 1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches (230 mm) long, of each color required.
- D. Welded-Seam Samples: For seamless-installation technique indicated and for each resilient flooring product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch (150-by-230-mm) Sample applied to a rigid backing and prepared by Installer for this Project.
- E. Maintenance Data: For each type of resilient flooring to include in maintenance manuals.
- F. Attic Stock: Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Resilient Sheet Flooring: Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, in roll form and in full roll width for each type, color, and pattern of flooring installed.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for resilient flooring installation and seaming method indicated.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by resilient flooring manufacturer for installation techniques required.
- B. Low-Emitting Materials - Adhesives and Sealants: For field applications that are on the building interior, provide adhesives and sealants that comply with CDHP Standard Method v1.2-2017 and SCAQMD Rule 1168 effective date of October 6, 2017; do not contain methylene chloride and perchloroethylene; have maximum Total VOC of 500 microgram/cu m; and meet VOC content limits of authorities having jurisdiction. VOC content limits include but are not limited to following:
 - 1. All Other Indoor Floor Covering Adhesives: 50 g/L.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).
 - 1. Store rolls upright.
 - 2. Store floor tiles on flat surfaces.
 - 3. Store cork flooring on flat surfaces.

1.5 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 64 deg F (18 deg C) or more than 79 deg F (26 deg C), in spaces to receive resilient flooring during the following periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Close spaces to traffic during resilient flooring installation.
- D. Close spaces to traffic for 72 hours after resilient flooring installation.
- E. Install resilient flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient flooring, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. FloorScore Compliance: Flooring shall comply with requirements of FloorScore certification.

2.2 UNBACKED POLYURETHANE FLOORING

- A. Basis-of-Design Product: Subject to compliance with requirements, provide per Finish and Material Index or comparable product.
- B. Thickness: 0.010 inch (2.5 mm).
- C. Wearing Surface: Smooth.
- D. Sheet Width: 6.6 feet (2.0 m).
- E. Seamless-Installation Method: Heat welded.
- F. Colors and Patterns: Per Finish and Material Index.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient flooring manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit resilient flooring and substrate conditions indicated.
- C. Seamless-Installation Accessories:
 - 1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
 - a. Colors: Match flooring.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer and manufacturer's representative present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient flooring.
 - 2. Verify compatibility of concrete moisture content and concrete curing compounds with adhesive to ensure compatibility.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to resilient flooring manufacturer's written instructions to ensure adhesion of resilient flooring.
- B. Concrete Substrates: Prepare according to ASTM F710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient flooring manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.
 - 4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. (304.8 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient flooring until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient flooring.

3.3 RESILIENT SHEET FLOORING INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient sheet flooring and with oversight by manufacturer's representative.
- B. Unroll resilient sheet flooring and allow it to stabilize before cutting and fitting.
- C. Lay out resilient sheet flooring as follows:
1. Maintain uniformity of flooring direction.
 2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches (152 mm) away from parallel joints in flooring substrates.
 3. Match edges of flooring for color shading at seams.
 4. Avoid cross seams.
 5. Eliminate deformations that result from hanging method used during drying process (stove bar marks).
- D. Scribe and cut resilient sheet flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend resilient sheet flooring into toe spaces, door reveals, closets, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on resilient sheet flooring as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Adhere resilient sheet flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- H. Seamless Installation:
1. Heat-Welded Seams: Comply with ASTM F1516. Rout joints and heat weld with welding bead to fuse sections permanently into a seamless flooring installation. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient flooring.
- B. Perform the following operations immediately after completing resilient flooring installation:
1. Remove adhesive and other blemishes from surfaces.
 2. Sweep and vacuum surfaces thoroughly.

- 3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient flooring until Substantial Completion.

END OF SECTION 09 65 00

SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Resilient base.
 - 2. Resilient molding accessories.
 - 3. Metal molding accessories.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches (300 mm) long.
- C. Attic Stock: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.3 QUALITY ASSURANCE

- A. Low-Emitting Materials - Adhesives and Sealants: For field applications that are on the building interior, provide adhesives and sealants that comply with CDHP Standard Method v1.2-2017 and SCAQMD Rule 1168 effective date of October 6, 2017; do not contain methylene chloride and perchloroethylene; have maximum Total VOC of 500 microgram/cu m; and meet VOC content limits of authorities having jurisdiction. VOC content limits include but are not limited to following:
 - 1. Cove Base Adhesives: 50 g/L.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.5 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product per Finish and Material Index or comparable product by one of the following:
 - 1. Allstate Rubber Corp.
 - 2. Burke Mercer Flooring Products, Division of Burke Industries Inc.
 - 3. Flexco.
 - 4. Johnsonite; A Tarkett Company.
 - 5. Roppe Corporation, USA.
- B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous), PVC-free.
 - 1. Style: To match existing.
- C. Thickness: 0.125 inch (3.2 mm).
- D. Height: Per Finish and Material Index.
- E. Lengths: Coils in manufacturer's standard length.
- F. Corners: Contractor's choice.
- G. Colors: Per Finish and Material Index.

2.2 RESILIENT MOLDING ACCESSORY

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product per Finish and Material Index or comparable product by one of the following:

1. Burke Mercer Flooring Products, Division of Burke Industries Inc.
2. Flexco.
3. Johnsonite; A Tarkett Company.
4. Roppe Corporation, USA.

- B. Description: Resilient flexible stop transition strip.
- C. Profile and Dimensions: As indicated.
- D. Locations: Provide resilient molding accessories in areas indicated.
- E. Colors and Patterns: Per Finish and Material Index.

2.3 METAL MOLDING ACCESSORIES

- A. Metal Edge Strips: Extruded profile of height shown, and in maximum available lengths to minimize running joints.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product per Finish and Material Index.
 2. Metal and Finish: Per Finish and Material Index.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are the same temperature as the space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing base.
- B. Apply base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. Preformed Corners: Install preformed corners before installing straight pieces.
- G. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
 - a. Miter or cope corners to minimize open joints.

3.4 ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing accessories.

- B. Molding Accessories: Butt to adjacent materials and tightly adhere resilient accessories secure metal accessories to substrates throughout length of each piece.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
- C. Protect products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 09 65 13

SECTION 09 91 00 - PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of paint and high-performance coating systems.

1.2 SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples: For each type of coating system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- C. Attic Stock: Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint and Coatings: 1 gal. of each material and color applied.

1.3 QUALITY ASSURANCE

- A. Low-Emitting Materials - Paints and Coatings: For field applications that are on the building interior, 75 percent of paints and coatings meet the VOC emissions evaluation and 100 percent meet the VOC content evaluations. Provide paints and coatings that comply with California Department of Public Health (CDPH) Standard Method v1.2-2017 and CARB 2007 SCM for Architectural Coatings; do not contain methylene chloride and perchloroethylene; have maximum Total VOC of 500 microgram/cu m; and meet VOC content limits of authorities having jurisdiction. VOC content limits include but are not limited to following:
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Industrial Maintenance and Rust-Preventive Coatings: 250 g/L.
 - 3. Nonflat Paints and Coatings: 100 g/L.
 - 4. Primers, Sealers, and Undercoaters: 100 g/L.
 - 5. Rust Preventative Coatings: 100 g/L.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
 - 1. Product name or title of material.
 - 2. Product description (generic classification or binder type).
 - 3. Manufacturer's stock number and date of manufacture.
 - 4. Contents by volume, for pigment and vehicle constituents.
 - 5. Thinning instructions.
 - 6. Application instructions.
 - 7. Color name and number.
 - 8. VOC content.
- B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.5 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products indicated in the High-Performance Coating and Paint Schedules at end of Part 3 of this Section.
- B. Interior High Performance Coatings and Paints:
 - 1. Manufacturers' Names: The following manufacturers are referred to in the High-Performance Coating Schedules by shortened versions of their names shown in parentheses:
 - a. Benjamin Moore & Co. (Moore).
 - b. PPG Paints (PPG).
 - c. Sherwin Williams; Industrial and Marine Coatings (S-W).

2.2 COATINGS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.
3. Provide products of same manufacturer for each coat in a coating system.

B. Colors: Per Finish and Material Index.

2.3 SOURCE QUALITY CONTROL

A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:

1. Contractor will engage the services of a qualified third-party testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 1. Gypsum Board: 12 percent.
 2. Plaster: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Plaster Substrates: Verify that plaster is fully cured.
- E. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

- F. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions applicable to substrates indicated and as specified.
- B. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
 - 1. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible coatings and encapsulants.
 - 1. Provide barrier coats over incompatible primers or remove and reprime substrate with compatible primers as required to produce coating systems indicated.
 - 2. Schedule cleaning and coating so dust and other contaminants from the cleaning process will not fall on wet, newly coated surfaces.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by coating manufacturer.
 - 1. Clean according to SSPC-SP 3, "Power Tool Cleaning".
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
 - 1. Remove any streaking and patch and blend scratches and chips in shop-applied primer.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.
- G. Gypsum Board Substrates: Do not begin coating application until finishing compound is dry and sanded smooth.
- H. Plaster Substrates: Do not begin coating application until plaster is fully cured and dry.
- I. Previously Coated Surfaces: Thoroughly clean previously coated surfaces indicated to be recoated or damaged during construction of all grease, dirt, dust or other foreign matter. Remove chalking, blistering, cracking, flaking and peeling or other deteriorated coatings. Roughen slick surfaces. Repair damaged areas such as, but not limited to, nail holes, cracks, chips, and spalls with suitable material to match adjacent undamaged areas. Feather edges and sand smooth all edges of chipped coating.

1. Rusty metal surfaces shall be cleaned as per SSPC requirements. Use solvent, mechanical, or chemical cleaning methods to provide surfaces suitable for coating.
 2. New, proposed coatings to be compatible with existing coatings. If existing surfaces are glossy, the gloss shall be reduced.
- J. Material Preparation: Mix and prepare coating materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying coating in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 3. Use only thinners approved by coating manufacturer and only within recommended limits.

3.3 APPLICATION

- A. Apply coatings according to manufacturer's written instructions and to recommendations in "MPI Manual."
1. Use applicators and techniques suited for coating and substrate indicated.
 2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 3. Coat front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 4. Do not coat over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 5. Spray doors and frames.
 6. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 7. Primers specified in coating schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Scheduling Coating: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for coating as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.

2. Omit primer over metal surfaces that have been shop primed and touchup coated.
 3. If undercoats, stains, or other conditions show through final coat of coating, apply additional coats until coating film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until coating has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of coating does not cause undercoat to lift or lose adhesion.
- E. Application Procedures: Apply coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being coated.
 2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- F. The term "exposed surfaces" includes:
1. Areas visible that call for coating including wood trims, stools, blocking or trims, and partitions and items built from gypsum drywall including coves, returns, and edges.
 2. Areas visible when permanent or built-in fixtures, convactor covers, covers for finned-tube radiation, grilles, and similar components are in place.
 3. Exposed mechanical (HVAC and plumbing) and electrical elements including, but not limited to, conduit, cables, work boxes, ATU equipment, air distribution hard and flexible ducts, grilles, diffusers, piping, and other items in areas called to be left exposed (including those that may be semi-exposed for directly underneath, but seen at adjacent angles of view.)
- G. Minimum Coating Thickness: Apply coating materials at a spreading rate to achieve manufacturer's recommended dry film thickness.
- H. Coating Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Coat the following work where exposed in occupied spaces:
 - a. Heat exchangers.
 - b. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - c. Other items as directed by Architect.
 2. Coat portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.
- I. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be coated or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or

unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

- J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- K. Stipple Enamel Finish: Roll and redistribute coating to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
- L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or recoat work not complying with requirements.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coating for dry film thickness.
 - 1. Contractor shall touch up and restore coated surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 INTERIOR PAINT SCHEDULE

- A. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
 - 1. Flat Acrylic Finish: Two finish coats over a primer.
 - a. Location: Overhead horizontal surfaces.
 - b. Primer: Factory-formulated latex-based primer for interior application.

- 1) Benjamin Moore; Ultra Spec 500 Interior Latex Primer N534.
 - 2) Kelly-Moore: 971 Acryplex Low VOC Interior PVA Primer/Sealer.
 - 3) PPG; Speedhide Zero VOC Interior Latex Sealer, 6-4900XI.
 - 4) Sherwin-Williams; ProMar 200 Zero VOC Primer B28 Series.
- c. Finish Coats: Factory-formulated flat acrylic-emulsion latex paint for interior application.
- 1) Benjamin Moore; Ultra Spec 500 Interior Flat Finish T535.
 - 2) Kelly-Moore: 1005 Premium Professional Low VOC Interior Flat.
 - 3) PPG; Speedhide Zero VOC Interior Latex Flat, 6-5110 Series.
 - 4) Sherwin-Williams; ProMar 200 Zero VOC Flat, B30-2600.
2. Low-Luster Acrylic-Enamel Finish: Two finish coats over a primer.
- a. Location: Exposed vertical surfaces.
- b. Primer: Factory-formulated latex-based primer for interior application.
- 1) Benjamin Moore; Ultra Spec 500 Interior Latex Primer N534.
 - 2) Kelly-Moore: 971 Acryplex Low VOC Interior PVA Primer/Sealer.
 - 3) PPG; Speedhide Zero VOC Interior Latex Sealer, 6-4900XI
 - 4) Sherwin-Williams; ProMar 200 Zero VOC Primer B28 Series.
- c. Finish Coats: Factory-formulated low-luster acrylic-latex interior enamel.
- 1) Benjamin Moore; Ultra Spec 500 Interior Eggshell T538.
 - 2) Kelly-Moore: 1010 Premium Professional Low VOC Interior Eggshell Enamel.
 - 3) PPG; Speedhide Zero VOC Interior Latex Eggshell, 6-5310 Series.
 - 4) Sherwin-Williams; ProMar 200 Zero VOC Eg-Shel, B20-2600.
- B. Plaster: Provide the following finish systems over new interior plaster surfaces:
1. Flat Acrylic Finish: Two finish coats over a primer.
- a. Location: Overhead horizontal surfaces.
- b. Primer: Factory-formulated latex-based primer for interior application.
- 1) Benjamin Moore; Ultra Spec 500 Interior Latex Primer N534.
 - 2) Kelly-Moore: 971 Acryplex Low VOC PVA Primer/Sealer.
 - 3) PPG; Speedhide Zero VOC Interior Latex Sealer, 6-4900XI.
 - 4) Sherwin-Williams; ProMar 200 Zero VOC Primer B28 Series.
- c. Finish Coats: Factory-formulated flat acrylic-emulsion latex paint for interior application.
- 1) Benjamin Moore; Ultra Spec 500 Interior Flat Finish T535.
 - 2) Kelly-Moore: 1005 Premium Professional Low VOC Interior Flat.
 - 3) PPG; Speedhide Zero VOC Interior Latex Flat, 6-5110 Series.
 - 4) Sherwin-Williams; ProMar 200 Zero VOC Flat, B30-2600.

2. Low-Luster Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Location: Exposed vertical surfaces.
 - b. Primer: Factory-formulated latex-based primer for interior application.
 - 1) Benjamin Moore; Ultra Spec 500 Interior Latex Primer N534.
 - 2) PPG; Speedhide Zero VOC Interior Latex Sealer, 6-4900XI.
 - 3) Sherwin-Williams; ProMar 200 Zero VOC Primer B28 Series.
 - c. Finish Coats: Factory-formulated low-luster acrylic-latex interior enamel.
 - 1) Benjamin Moore; Ultra Spec 500 Interior Eggshell T538.
 - 2) PPG; Speedhide Zero VOC Interior Latex Eggshell, 6-5310 Series.
 - 3) Sherwin-Williams; ProMar 200 Zero VOC Eg-Shel, B20-2600.

3.7 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Steel Substrates:

1. Semigloss, Water-Based, Light-Industrial Coating System:
 - a. Prime Coat: Rust-inhibitive primer, water based.
 - 1) Benjamin Moore: Moore Ultra Spec HP Acrylic Metal Primer HP04.
 - 2) PPG: Pitt-Tech Plus EP Int/Ext DTM Industrial Primer, 4020 .
 - 3) Sherwin-Williams; Pro-Cryl Universal Water Based Primer B66W310.
 - b. Intermediate Coat: Water-based, light-industrial coating, gloss matching topcoat.
 - 1) Benjamin Moore: Moore Ultra Spec HP D.T.M. Acrylic Semi-Gloss HP29.
 - 2) PPG: Pitt-Tech Plus EP Int/Ext Semigloss DTM Industrial Enamel, 90-1610 Series.
 - 3) Sherwin-Williams: Pro Industrial Acrylic Semi-Gloss, B66-650 Series.
 - c. Topcoat: Water-based, light-industrial coating,
 - 1) Benjamin Moore: Moore Ultra Spec HP D.T.M. Acrylic Semi-Gloss HP29.
 - 2) PPG: Pitt-Tech Plus EP Int.Ext Semi-Gloss DTM Industrial Enamel Series, 90-1610 Series.
 - 3) Sherwin-Williams: Pro Industrial Acrylic Semi-Gloss, B66-650 Series.

B. Galvanized-Metal Substrates:

1. Semigloss, Water-Based, Light-Industrial Coating System:
 - a. Prime Coat: Waterborne galvanized-metal primer.
 - 1) Benjamin Moore: Moore Ultra Spec HP Acrylic Metal Primer HP04.
 - 2) PPG: Pitt-Tech Plus EP Int/Ext DTM Industrial Primer, 4020.
 - 3) Sherwin-Williams; Pro-Cryl Universal Water Based Primer B66W310.

- b. Intermediate Coat: Water-based, light-industrial coating, gloss matching topcoat.
 - 1) Benjamin Moore: Moore Ultra Spec HP D.T.M. Acrylic Semi-Gloss HP29.
 - 2) PPG: Pitt-Tech Plus EP Int/Ext Semigloss DTM Industrial Enamel, 90-1610 Series.
 - 3) Sherwin-Williams: Pro Industrial Acrylic Semi-Gloss, B66-650 Series.
- c. Topcoat: Water-based, light-industrial coating,
 - 1) Benjamin Moore: Moore Ultra Spec HP D.T.M. Acrylic Semi-Gloss HP29.
 - 2) PPG: Pitt-Tech Plus EP Int/Ext Semigloss DTM Industrial Enamel, 90-1610 Series.
 - 3) Sherwin-Williams: Pro Industrial Acrylic Semi-Gloss, B66-650 Series.

END OF SECTION 09 91 00

SECTION 10 21 13 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Phenolic-core toilet compartments configured as toilet enclosures and urinal screens.
- B. Related Sections:
 - 1. Section 06 10 00 "Rough Carpentry" for overhead support of floor-and-ceiling-anchored compartments.
 - 2. Section 10 28 00 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of cutouts for compartment-mounted toilet accessories.
 - 2. Show locations of reinforcements for compartment-mounted grab bars.
 - 3. Show locations of centerlines of toilet fixtures.
 - 4. Show overhead support or bracing locations.
- C. Samples: For the following products, in manufacturer's standard sizes unless otherwise indicated:
 - 1. Each type of material, color, and finish required for units, prepared on 6-inch- (152-mm-) square Samples of same thickness and material indicated for Work.
 - 2. Each type of hardware and accessory.
- D. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.3 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire Test: Pass NFPA 286 as determined by a qualified testing agency in testing identical products.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

2.2 MATERIALS

- A. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- B. Stainless-Steel Castings: ASTM A 743/A 743M.
- C. Zamac: ASTM B 86, commercial zinc-alloy die castings.

2.3 PHENOLIC-CORE UNITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated Finiah and Material Index or comparable product by one of the following:
 - 1. Ampco, Inc.
 - 2. Bobrick Washroom Equipment, Inc.
 - 3. Bradley Corporation; Mills Partitions.
 - 4. ASI Global Products Corp.
 - 5. Sanymetal; a Crane Plumbing company.
- B. Toilet-Enclosure Style: Floor and ceiling anchored.
- C. Urinal-Screen Style: Wall hung.
- D. Door, Panel, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges and routed no-sightline edges at doors and pilasters. Provide minimum 3/4-inch- (19-mm-) thick doors and pilasters and minimum 1/2-inch- (13-mm-) thick panels.
- E. Pilaster Shoes and Sleeves (Caps): Fabricated from stainless-steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.
- F. Brackets (Fittings):
 - 1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

G. Phenolic-Panel Finish: One color and pattern in each room.

1. Through Color: Per Finish and Material Index.

2.4 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

1. Material: Stainless steel with satin brushed finish.
2. Hinges: Manufacturer's standard that swings to a closed or partially open position.
3. Occupancy Indicator Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.5 FABRICATION

A. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

B. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

- a. Pilasters and Panels: 1/2 inch (13 mm).
 - b. Panels and Walls: 1 inch (25 mm).
- B. Floor-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels when doors are in closed position.

3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 10 21 13

SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Public-use washroom accessories.
 - 2. Custodial accessories.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Manufacturer's warranty.
 - 5. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - a. Identify locations using room designations indicated.
 - b. Identify products using designations indicated.
- B. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.
 - 1. Approved full-size Samples will be returned and may be used in the Work.
- C. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

1.4 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.
- B. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- C. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- D. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Toilet Tissue (Jumbo-Roll Twin Dispenser) Dispenser: Owner furnished and Contractor installed.
 - 1. Product: Tork Bath Tissue Jumbo Roll Twin Dispenser 56TR.
 - a. Description: Roll-in-reserve dispenser with hinged front secured with tumbler lockset.
 - b. Mounting: Surface mounted.
 - c. Operation: Noncontrol delivery with standard spindle.
 - d. Capacity: Jumbo tissue rolls.
 - e. Material and Finish: Plastic, Smoke.
- B. Paper Towel (Roll) Dispenser: Owner furnished and Contractor installed.
 - 1. Product: Tork Matic #5510282.
 - a. Description: Lever-actuated mechanism permits controlled delivery of paper rolls in preset lengths per stroke.
 - b. Mounting: Surface mounted.
 - c. Capacity: 8-inch- (203-mm-) wide, 800-foot- (244-m-) long roll
 - d. Material and Finish: ABS Plastic, Black.
 - e. Lockset: Tumbler type.
- C. Liquid-Soap Dispenser, Surface-Mounted: Owner furnished and Contractor installed.
 - 1. Product: Waxie Clean Touch Manual Dispenser #386314.
 - a. Description: Designed for dispensing soap in liquid or lotion form.
 - b. Mounting: Vertically oriented, surface mounted.
 - c. Capacity: 40 oz.
 - d. Lockset: Tumbler type.
 - e. Refill Indicator: Window type.

D. Grab Bar:

1. Product: Bobrick B-6806.
 - a. Mounting: Flanges with concealed fasteners.
 - b. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
 - c. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
 - d. Outside Diameter: 1-1/2 inches (38 mm).
 - e. Configuration and Length: As indicated on Drawings.

E. Sanitary-Napkin Disposal Unit, Surface-Mounted:

1. Product: Bobrick B-270.
 - a. Mounting: Surface mounted.
 - b. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
 - c. Receptacle: Removable.
 - d. Material and Finish: Stainless steel, No. 4 finish (satin).

F. Mirror Unit, Channel Frame:

1. Product: Bobrick B-165 2436.
2. Frame: Stainless-steel channel.
 - a. Corners: Mitered and mechanically interlocked.
3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
 - b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
4. Size: 24 x 36 inches.

2.3 CUSTODIAL ACCESSORIES

A. Mop and Broom Holder:

1. Product: Bobrick Stainless Steel Mop and Broom Holder B-223.
2. Description: Unit with holders.
3. Length: 24 inches (610 mm).
4. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

2.4 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 10 28 00

SECTION 220010 – GENERAL PLUMBING REQUIREMENTS

PART 1 - GENERAL REQUIREMENTS

1.1 DESCRIPTION OF WORK

- A. This Division requires the furnishing and installing of complete functioning systems, and each element thereof, as specified or indicated on the Drawings and Specifications or reasonably inferred; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation, and utilities.
- B. Division 22 of the Specifications and Drawings numbered with prefixes P, MP and EP, or MEP generally describe these systems, but the scope of the Plumbing work includes all such work indicated in the Contract Documents: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing and Electrical Drawings and Specifications; and Addenda.
- C. The Drawings have been prepared diagrammatically intended to convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, piping, etc. without showing all the exact details as to elevations, offsets, control lines, and other installation requirements. The Contractor shall use the Drawings as a guide when laying out the work and shall verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers requirements, will ensure a complete, coordinated, satisfactory and properly operating system.

1.2 QUALITY ASSURANCE

- A. All work under this division shall be executed in a thorough professional manner by competent and experienced workmen licensed to perform the Work specified.
- B. All work shall be installed in strict conformance with manufacturer's requirements, recommendations, and installation instructions. Equipment and materials shall be installed in a neat and professional manner and shall be aligned, leveled, and adjusted for satisfactory operation.
- C. Material and equipment shall be new, shall be of the best quality and design, shall be current model of the manufacturer, shall be free from defects and imperfections and shall have markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Material and equipment of the same type shall be made by the same manufacturer whenever practicable.
- D. Unless specified otherwise, manufactured items shall have been installed and used, without modification, renovation, or repair for not less than one year prior to date of bidding for this project.

1.3 CODES, REFERENCES AND STANDARDS

- A. Execute Work in accordance with the National Fire Protection Association and all Local, State, and National codes, ordinances and regulations in force governing the particular

class of Work involved. Obtain timely inspections by the constituted authorities, and upon final completion of the Work obtain and deliver to the Owner executed final certificates of acceptance from the Authority Having Jurisdiction.

- B. Any conflict between these Specifications and accompanying Drawings and the applicable Local, State and Federal codes, ordinances and regulations shall be reported to the Architect in sufficient time, prior to the opening of Bids, to prepare the Supplementary Drawings and Specification Addenda required to resolve the conflict.
- C. The governing codes are minimum requirements. Where these Drawings and Specifications exceed the code requirements, these Drawings and Specification shall prevail.
- D. All material, manufacturing methods, handling, dimensions, method or installation and test procedure shall conform to but not be limited to the following industry standards and codes:

IBC	International Building Code
IMC	International Mechanical Code
IPC	International Plumbing Code
IECC	International Energy Conservation Code
ADA	American Disabilities Act
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
AHRI	Airc Conditioning, Heating and Refrigeration Institute
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineering
ASTM	American Society of Testing Materials
AWS	American Welding Society
AWWA	American Water Works Association
CISPI	Cast Iron Soil Pipe Institute
ETL	Electrical Testing Laboratories
HI	Hydraulic Institute
MSS	Manufacturer's Standardization Society of the Valve and Fitting Industry
NBFU	National Board of Fire Underwriters
NEC	National Electrical Code
NFPA	National Fire Protection Association
NEMA	National Electrical Manufacturers' Association
OSHA	Occupational Safety and Health Act
PDI	Plumbing and Drainage Institute
UL	Underwriter's Laboratories

- E. Contractor shall comply with rules and regulations of public utilities and municipal departments affected by connections of services.
- F. All Plumbing work shall be performed in compliance with applicable safety regulations, including OSHA regulations. Safety lights, guards, shoring and warning signs required for the performance of the Plumbing work shall be provided by the Contractor.

1.4 DEFINITIONS

- A. General:

1. **Furnish:** When ‘furnish’, ‘install’, ‘perform’, or ‘provide’ is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, “provide” is implied.
2. **Install:** The term “install” is used to describe operations at the project site including the actual “unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.”
3. **Provide:** The term “provide” means “to furnish and install, complete and ready for the intended use.” When ‘furnish’, ‘install’, ‘perform’, or ‘provide’ is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, “provide” is implied.
4. **Furnished by Owner or Furnished by Others:** The item will be furnished by the Owner or Others. It is to be installed and connected under the requirements of this Division, complete and ready for operation, including items incidental to the Work, including services necessary for proper installation and operation. The installation shall be included under the guarantee required by this Division.
5. **Engineer:** Where referenced in this Division, “Engineer” is the Engineer of Record and the Design Professional for the Work under this Division, and is a Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the “Architect”.
6. **AHJ:** The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
7. **NRTL:** Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other listed Manufacturers and models that meet the specified criteria.
8. **Substitution:** Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.
 - a. **Substitutions for Cause:** Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - b. **Substitutions for Convenience:** Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
9. **Value Engineering:** A systematic method to improve the “value” of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.

- B. The terms "approved equal", "equivalent", or "equal" are used synonymously and shall mean "accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified". The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.
- C. The following definitions apply to excavation operations:
 - 1. Additional Excavation: Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
 - 2. Bedding: as used in this Section refers to the compacted sand or pea gravel installed in the bottom of a pipe trench to immediately support a pipe and cover a pipe.
 - 3. Subbase: as used in this Section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.
 - 4. Subgrade: as used in this Section refers to the compacted soil immediately below the slab or pavement system.
 - 5. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Architect.
 - 6. Drainage Fill: as used in this Section refers to gravel installed to assist in the removal of underslab groundwater.
 - 7. Building Fill: as used in this section refers to borrowed fill material of rock 1" and larger used to fill foundation excavations.

1.5 COORDINATION

- A. The Contractor shall visit the site and ascertain the conditions to be encountered while installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provision for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, incorrect or faulty installation of Work under this Division or for additional compensation for Work covered by this Division.
- B. The Contractor shall refer to Drawings of the other disciplines and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. The Contractor shall make offsets required to clear equipment, beams and other structural members; and to facilitate concealing piping and ductwork in the manner anticipated in the design.
- C. The Contractor shall confirm and coordinate the final location and routing of all mechanical, electrical, plumbing, fire protection, control and audio-visual systems with all architectural features, structural components, and other trades. The Contractor shall locate equipment, components, ductwork, piping, conduit, and related accessories to maintain the desired ceiling heights as indicated on the architectural drawings. The Contractor shall inform the Architect of any areas where conflicts may prevent the indicated ceiling height from being maintained. The Contractor shall not proceed with any installation in such areas until the architect has given written approval to proceed or has provided modified contract drawings or written instructions to resolve the apparent conflict.

- D. The Contractor shall provide materials with trim which will fit properly the types of ceiling, wall, or floor finishes actually installed.
- E. The Contractor shall maintain a foreman on the jobsite at all times to coordinate his work with other contractors and subcontractors so that various components of the Plumbing systems will be installed at the proper time, will fit the available space, and will allow proper service access to the equipment. Carry on the Work in such a manner that the Work of the other contractors and trades will not be handicapped, hindered, or delayed at any time.
- F. Work of this Division shall progress according to the "Construction Schedule" as established by the Prime Contractor and his subcontractors and as approved by the Architect. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of schedule dates.

1.6 MEASUREMENTS AND LAYOUTS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Figured dimensions shall be taken in preference to scale dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing the Contract Documents. The Contractor will be held responsible for errors which could have been avoided by proper checking and inspection.

1.7 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to the requirements of individual Sections. Additionally, prepare coordination drawings as required scope of 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 trade.
 - 1. Information shall be project specific and drawn accurately to a scale large enough to resolve conflicts. Do not base coordination drawings on standard dimensional data.
 - 2. Prepare floorplans, sections, elevations, and details as needed to adequately describe relationship of various systems and components.
 - 3. Clearly indicate functional and spatial relationships of components of all systems specified in the Contract Documents, including but not limited to: architectural, structural, civil, mechanical, electrical, fire protection, and specialty systems.
 - 4. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - 5. Show location and size of access doors required for access to concealed equipment, fittings, controls, terminations, and cabling.
 - 6. Indicate required installation sequence to minimize conflicts between entities.
 - 7. 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 Contract Administrator indicating

proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

8. The details of the coordination are the responsibility of the Contractor and, where indicated on the Drawings, minor adjustments in raceway routing, device placement, device type, or equipment arrangement are not to be considered changes to the Contract.
- B. Equipment Room Coordination Drawings: In accordance with the submittal procedures outlined within these Specifications, provide dimensioned layouts of electrical equipment locations within electrical rooms/closets, mechanical rooms, generator rooms, and fire pump rooms with equipment drawn to scale and identified therein.
1. Clearly identify all required working clearances and access provisions required for installation and maintenance.
 2. Equipment layouts should be arranged accounting for considerations for required door openings and the clearances required by the equipment manufacturer.
 3. Indicate path to allow for the future removal of each large piece of equipment (up to and including generators and unit sub-station transformers) without removal of non-related equipment or architectural elements.
 4. Include work provided by others routed through the equipment rooms.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 2. BIM File Incorporation: Develop and incorporate coordination drawing files into Building Information Model established for Project.
 - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Contract Administrator.
 3. Where the Engineer's digital data files are provided to the Contractor for use in preparing coordination digital data files, the Engineer makes no representations as to the accuracy or completeness of digital data files as they relate to the Drawings or Specifications.
 4. Submit coordination drawings in accordance with the submittal procedures outlined within these Specifications.

1.8 SUBMITTALS

- A. Refer to Division 01 and General Conditions for submittal requirements in addition to requirements specified herein.

1.9 SUBSTITUTIONS

- A. Refer to Division 01 and General Conditions for substitutions in addition to requirements specified herein.

- B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.
- C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.

1.10 OPERATION AND MAINTENANCE MANUALS

- A. Refer to Division 01 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.

1.11 SPARE PARTS

- A. Provide to the Owner the spare parts specified in the individual sections in Division 22 of this specification.

1.12 RECORD DRAWINGS

- A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.

1.13 PAINTING

- A. Exposed ferrous surfaces, including pipe, pipe hangers, equipment stands and supports and exposed insulated piping shall be painted by the Plumbing Contractor using materials and methods as specified under Division 9 of the Specifications; colors shall be as selected by the Architect.
- B. Factory finishes, shop priming and special finishes are specified in the individual equipment specification sections.
- C. Where factory finishes are provided and no additional field painting is specified, marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish.

1.14 DELIVERY, STORAGE AND HANDLING

- A. Refer to Division 01 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.

1.15 GUARANTEES AND WARRANTIES

- A. Refer to Division 01 and General Conditions for Guarantees and Warranties in addition to requirements specified herein.

1.16 TEMPORARY FACILITIES

- A. Refer to Division 01 and General Conditions for Temporary Facilities requirements in addition to requirements specified herein.

1.17 PROJECT CONDITIONS

- A. Conditions Affecting Work In Existing Buildings:
1. The Drawings describe the general nature of remodeling to the existing building. However, the Contractor shall visit the Site prior to submitting His bid to determine the nature and extent of work involved.
 2. Work in the existing building shall be scheduled with the Owner.
 3. Certain demolition work must be performed prior to the remodeling. The Plumbing Contractor shall perform the demolition which involves Plumbing and Plumbing systems, fixtures, equipment, piping, equipment supports or foundations and materials.
 4. Plumbing Contractor shall remove articles which are not required for the new Work. Unless otherwise indicated, each item removed by the Plumbing Contractor during this demolition shall become his property and shall be removed by the Plumbing Contractor from the premises and dispose of them in accordance with applicable federal, state and local regulations.
 5. Plumbing Contractor shall relocate and reconnect Plumbing facilities that must be relocated in order to accomplish the remodeling shown in the Drawings or indicated in the Specifications. Where Plumbing equipment or materials are removed, the Plumbing Contractor shall cap unused piping beyond the floor line or wall line to facilitate restoration of finish.
 6. General Contractor shall install finish material.
 7. Obtain permission from the Architect for channeling of floors or walls not specifically noted on the Drawings.
 8. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
 9. Locate, identify, and protect Plumbing services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.
- B. Conditions Affecting Excavations: The following project conditions apply:
1. Maintain and protect existing building services which transit the area affected by selective demolition.
 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
- C. Site Information: Subsurface conditions were investigated during the design of the Project. Reports of these investigations are available for information only; data in the reports are not intended as representations or warranties of accuracy or continuity of conditions. The Owner will not be responsible for interpretations or conclusions drawn from this information.

- D. Use of explosives is not permitted.
- E. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

PART 2 - PRODUCTS AND MATERIALS

2.1 SOIL MATERIALS

- A. Provide clean sand, pea gravel or flowable fill material (per the geotechnical engineer's or structural engineer's recommendations).
- B. Subbase Material: Where applicable, provide natural soils with 10% by volume of rocks less than 2" diameter or artificially crushed aggregate. Corrosive fill materials shall not be utilized. When CL clay, rock, or gravel is used, it shall not be larger than 2 inches in any dimension and be free of debris, waste, frozen materials, vegetable and other deleterious matter.
- C. Drainage Fill: Provide washed, evenly graded mixture of ¾" open graded aggregate stone or gravel, around drainage pipes to a level above pipe as detailed by Architect. Provide open graded aggregate, crushed stone, crushed or uncrushed gravel with 100 percent passing a 1-1/2-inch sieve, and not more than 5 percent passing a No. 4 sieve for drainage fill to subgrade or around equipment structures.
- D. Filter Fabric: Flat needle punched PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. (4,480 to 13,440 L/min. per sq. m) when tested according to ASTM D 4491.

PART 3 - EXECUTION

3.1 PERMITS

- A. Secure and pay for permits required in connection with the installation of the Plumbing Work. Arrange with the various utility companies for the installation and connection of required utilities for this facility and pay charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

3.2 EXISTING UTILITIES

- A. Schedule and coordinate with the Utility Company, Owner and with the Engineer connection to, or relocation of, or discontinuation of normal utility services from existing utility lines. Premium time required for any such work shall be included in the bid.
- B. Existing utilities damaged due to the operations of utility work for this project shall be repaired to the satisfaction of the Owner or Utility Company without additional cost.
- C. Utilities shall not be left disconnected at the end of a work day or over a weekend unless authorized by representatives of the Owner or Engineer.

- D. Repairs and restoration of utilities shall be made before workmen leave the project at the end of the workday in which the interruption takes place.
- E. Contractor shall include in his bid the cost of furnishing temporary facilities to provide services during interruption of normal utility service.

3.3 SELECTIVE DEMOLITION

- A. Refer to Division 01, Division 02 and General Conditions for Selective Demolition requirements in addition to the requirements specified herein.
- B. General: Demolish, remove, demount, and disconnect abandoned Plumbing materials and equipment indicated to be removed and not indicated to be salvaged or saved.
- C. Materials and Equipment To Be Salvaged: Remove, demount, and disconnect existing Plumbing materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.
- D. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.
- E. Plumbing Materials and Equipment: Demolish, remove, demount, and disconnect the following items:
 - 1. Inactive and obsolete piping, fittings and specialties, equipment, controls, fixtures and insulation.
 - a. Piping embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove exposed materials and materials above accessible ceilings. Drain and cap piping and ducts allowed to remain.
 - b. Perform cutting and patching required for demolition in accordance with Division 01, General Conditions and "Cutting and Patching" portion of this Section in Division 22.
- F. Provide schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.
 - 1. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 01 Section "Summary of Work."

3.4 EXCAVATION AND BACKFILLING

- A. Refer to Division 01, Division 02, and Division 31, Geotechnical Soils Report and General Conditions for Excavation and Backfilling in addition to the requirements specified herein.
- B. Perform excavation of every description, of whatever substance encountered and to the depth required in connection with the installation of the work under this Division. Excavation shall be in conformance with applicable Division and section of the General Specifications.

- C. Roads, alleys, streets and sidewalks damaged during this work shall be restored to the satisfaction of Authorities Having Jurisdiction.
- D. Trenches close to walks or columns shall not be excavated without prior consultation with the Architect.
- E. Erect barricades around excavations. Provide an adequate number of amber lights on or near the work and keep them burning from dusk to dawn. The Contractor shall be held responsible for any damage that any parties may sustain due to neglecting the necessary precautions when performing the work.
- F. Slope sides of excavations to comply with local, state and federal codes and ordinances. Shore and brace as required for stability of excavation.
- G. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local, state and federal codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.
 - 1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.
- H. Install sediment and erosion control measures in accordance with local codes and ordinances.
- I. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and trenches.
 - 1. Do not allow water to accumulate in excavations and trenches. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
 - 2. Establish and maintain temporary drainage ditches and other diversions outside excavation and trench limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches. In no case shall sewers be used as drains for such water.
- J. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
 - 1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
 - 2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.
- K. Excavation for Underground Tanks, Basins, and Plumbing Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
 - 1. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover

- exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.
2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.
- L. Trenching: Excavate trenches for Plumbing installations as follows:
1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearance on both sides of pipe and equipment.
 2. Excavate trenches to depth indicated or required for piping to establish indicated slope and invert elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
 3. Limit the length of open trench to that in which pipe can be installed, tested, and the trench backfilled within the same day.
 4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of pipe. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and pipe.
 5. Excavate trenches for piping and equipment with bottoms of trench to accurate elevations for support of pipe and equipment on undisturbed soil.
- M. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.
- N. Bedding:
1. Fill bottom of pipe trench and fill unevenness with compacted bedding material to ensure continuous bearing of the pipe barrel on the bearing surface. Additional bedding installation requirements are in the following piping specifications. Compact bedding as described below:
 2. Fill bottom of equipment trench and fill unevenness with compacted sand backfill to ensure continuous bearing of the equipment on the bearing surface. Compact bedding as described below.
- O. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.
1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
 2. Under building slabs, use drainage fill materials.
 3. Under piping and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
 4. For piping less than 30 inches below surface of roadways, provide 4-inch-thick concrete base slab support after installation and testing of piping and prior to backfilling and placement of roadway subbase. Coordinate with AHJ for colored concrete requirements.
 5. Other areas, use excavated or borrowed materials.

- P. Backfill excavations as promptly as work permits, but not until completion of the following:
1. Inspection, testing, approval, and locations of underground utilities have been recorded.
 2. Removal of concrete formwork.
 3. Removal of shoring and bracing, and backfilling of voids.
 4. Removal of trash and debris.
- Q. Drainage Fill: Where building fill is used in lieu of natural soils, provide drainage fill as subbase material. Provide filter fabric material to line the trench to support the bedding material and subbase materials to ensure that backfill materials will not segregate within the trench nor create voids and sags within the pipe trench.
- R. Placement and Compaction: Place subgrade backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- S. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
- T. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of piping and equipment by carrying material uniformly around them to approximately same elevation in each lift.
- U. Compaction: Place bedding backfill materials in maximum layers of not more than 6 inches loose depth for material compacted by hand-operated tampers. Place subbase backfill materials in maximum layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers. Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.
1. Use of pneumatic backhoe as compaction method is not allowed as an acceptable process for compaction of excavations or trenches.
 2. For vertical and/or diagonal pipe installations greater than 1/2" rise/lf, thoroughly support pipes from permanent concrete structures or undisturbed earth at no less than 10-foot intervals, while placing backfill materials, so that pipes are not deflected, crushed, broken, or otherwise damaged by the backfill placement or settlement.
 3. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

4. Place backfill and/or drainage fill materials evenly adjacent to structures, piping, and equipment to required elevations. Coordinate with Architect and/or Civil Engineer backfill requirements prior to installation. Prevent displacement of pipes and equipment by carrying material uniformly around them to approximately same elevation in each layer or lift.
 5. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 or ASTM D 698 and not less than the following percentages of relative density, determined in accordance with ASTM D 4253, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).
 - a. Areas Under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
 - b. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
 - c. Other Areas: Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.
- V. Subsidence: Where subsidence occurs at Plumbing installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.
- W. Additional Excavation: Where additional excavation may be required due to unsuitable bearing materials encountered, notify the architect immediately for resolution.

3.5 CUTTING AND PATCHING

- A. Cut walls, floors, ceilings, and other portions of the facility as required to install work under this Division.
- B. Obtain permission from the Architect prior to cutting. Do not cut or disturb structural members without prior approval from the Architect and Structural Engineer.
- C. For post-tension slabs, x-ray slab and closely coordinate all core drill locations with Architect and Structural Engineer prior to performing any work. Obtain approval from Architect and Structural Engineer for all core drills and penetrations at least four days prior to performing work.
- D. Penetrations shall be made as small as possible while maintaining required clearances between the building element penetrated and the system component.
- E. Patch around openings to match adjacent construction, including fire ratings, if applicable.

- F. Repair and refinish areas disturbed by work to the condition of adjoining surfaces in a manner satisfactory to the Architect.
- G. After the final waterproofing membrane has been installed, roofs may be cut only with written permission by the Architect.

3.6 CLEANING

- A. Refer to Division 01 and General Conditions for Cleaning requirements in addition to requirements specified herein.

END OF SECTION 220010

SECTION 220015 – COORDINATION

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- 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 furnished motors, starters, and disconnect switches furnished as an integral part of packaged plumbing equipment.
- B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for plumbing equipment are scheduled on the Drawings.
- C. System shall be complete and operational with power and control wiring provided to meet the design intent shown on the drawings and specified within the specification sections.

1.2 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.

1.3 QUALITY ASSURANCE

- A. Electrical components and materials shall be UL labeled.
- B. All electrical equipment provided and the wiring and installation of electrical equipment shall be in accordance with the requirements of this Section and Division 26.

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL

- A. The Contractors shall provide all motors, starters, disconnects, wire, conduit, etc. as specified in the Construction Documents. If, however, the Plumbing Contractor furnishes a piece of equipment requiring a different motor, starter, disconnect, wire size, etc. than what is shown and/or intended on the Construction Documents, the Plumbing Contractor shall coordinate the requirements with any other Contractor and shall be responsible for any additional cost incurred by any other Contractor that is associated with installing the different equipment and related accessories for proper working condition.
- B. Refer to Division 26, "Common Work Results for Electrical" for specification of motor connections

PART 3 - EXECUTION

3.1 CONTRACTOR COORDINATION

- A. Unless otherwise indicated, all motors, equipment, controls, etc. shall be furnished, set in place and wired in accordance with Table 1. Any items not listed but shown on the drawings shall be considered part of the Contract Documents and brought to the attention of the Architect.
- B. The General Contractor is the central authority governing the total responsibility of all trade contractors. Therefore, deviations and clarifications of this schedule are permitted provided the General Contractor assumes responsibility to coordinate the trade contractors different than as indicated herein. If deviations or clarifications to this schedule are implemented, submit a record copy to the Engineer.

END OF SECTION 220015

SECTION 220500 – COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes limited scope general construction materials and methods for application with Plumbing installations as follows:
 - 1. Access panels and doors in walls, ceilings, and floors for access to Plumbing materials and equipment.
 - 2. Sleeves for Plumbing penetrations.
 - 3. Miscellaneous metals for support of Plumbing materials and equipment.
 - 4. Wood grounds, nailers, blocking, fasteners, and anchorage for support of Plumbing materials and equipment.
 - 5. Joint sealers for sealing around Plumbing materials and equipment.
 - 6. Plenum insulation for enclosure of combustible items located within fire-rated return air plenums.
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 7 Section “Penetration Firestopping” for material and methods for firestopping systems.
 - 2. Division 22 Section "Basic piping Materials and Methods" for materials and methods for mechanical sleeve seals.
 - 3. Division 22 Section “Sanitary Drainage and Vent Piping and Specialties” for indirect drain piping and installation requirements.

1.2 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 22 Section “General Plumbing Requirements”.
 - 1. Product data for the following products:
 - a. Access panels and doors.
 - b. Through and membrane-penetration firestopping systems.
 - c. Joint sealers.
 - d. Plenum insulation.
 - 2. Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for Plumbing materials and equipment.
 - 3. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this Section.
 - 4. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.

- a. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 01 Section "Summary of Work."
- 5. Through and Membrane Penetration Firestopping Systems Product Schedule: Submit a schedule for each piping system penetration that includes UL listing, location, wall or floor rating and installation drawing for each penetration fire stop system.
 - a. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.3 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
 - 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- B. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.
 - 1. Provide UL Label on each fire-rated access door.
- C. Through and Membrane Penetration Systems Installer Qualifications: A firm experienced in installing penetration firestopping systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

PART 2 - PRODUCTS AND MATERIALS

2.1 ACCESS TO EQUIPMENT

- A. Manufacturer:
 - 1. Bar-Co., Inc.
 - 2. Elmdor Stoneman.
 - 3. JL Industries
 - 4. Jay R. Smith Mfg. Co.
 - 5. Karp Associates, Inc.
 - 6. Milcor
 - 7. Nystrom Building Products
 - 8. Wade

9. Zurn

B. Access Doors:

1. Provide access doors for all concealed equipment, except where above lay-in ceilings. Refer to Section "Identification for Plumbing Piping" for labeling of access doors.
2. Access doors shall be adequately sized for the devices served with a minimum size of 18 inches x 18 inches, furnished by the respective Contractor or Subcontractor and installed by the General Contractor.
3. Access doors must be of the proper construction for type of construction where installed.
4. The exact location of all access doors shall be verified with the Architect prior to installation.
5. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
6. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
 - a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1-inch-wide exposed perimeter flange and adjustable metal masonry anchors.
 - b. For installation in gypsum wallboard or plaster: perforated flanges with wallboard bead.
 - c. For installation in full-bed plaster applications: galvanized, expanded metal lath and exposed casing bead, welded to perimeter of frame.
7. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
 - a. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
8. Locking Devices: Flush, screwdriver-operated cam locks.
9. Locking Devices: Where indicated on the drawings or where access panels are installed in locations accessible to the public, provide 5-pin or 5-disc type cylinder locks, individually keyed; provide 2 keys.

2.2 PENETRATIONS

A. Sleeves:

1. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A-53 grade A or 12 gauge (0.1084 inches) welded galvanized steel formed to a true circle concentric to the pipe.

2. Sheet-Metal Sleeves: 10 gauge (0.1382 inches), galvanized steel, round tube closed with welded longitudinal joint.
- B. Frames for rectangular openings attached to forms and of a maximum dimension established by the Architect. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, provide 18 gauge (0.052 inches) welded galvanized steel. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, provide 10 gauge (0.1382 inches) welded galvanized steel. Notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.
- C. Box Frames: Frames for rectangular openings shall be of welded 12 gauge steel attached to forms and of a maximum dimension established by the Architect. Contractor shall notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.

2.3 MISCELLANEOUS METALS

- A. Steel plates, shapes, bars, and bar grating: ASTM A 36.
- B. Cold-Formed Steel Tubing: ASTM A 500.
- C. Hot-Rolled Steel Tubing: ASTM A 501.
- D. Steel Pipe: ASTM A 53, Schedule 40, welded.
- E. Fasteners: Zinc-coated, type, grade, and class as required.

2.4 MISCELLANEOUS LUMBER

- A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPB rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.
- B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 15/32 inches.

2.5 JOINT SEALERS

- A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
- B. Colors: As selected by the Architect from manufacturer's standard colors.
- C. Elastomeric Joint Sealers: Provide the following types:
 1. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer. Provide one of the following:
 - a. "Dow Corning 790," Dow Corning Corp.

- b. "Silglaze II SCS 2801," General Electric Co.
 - c. "Silpruf SCS 2000," General Electric Co.
 - d. "864," Pecora Corp.
 - e. "Rhodia 5C," Rhone-Poulenc, Inc.
 - f. "Spectrem 1," Tremco, Inc.
 - g. "Spectrem 2," Tremco, Inc.
 - h. "Dow Corning 795," Dow Corning Corp.
 - i. "Rhodia 7B," Rhone-Poulenc, Inc.
 - j. "Rhodia 7S," Rhone-Poulenc, Inc.
 - k. "Omniseal," Sonneborn Building Products Div.
- 2. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, metal or porcelain plumbing fixtures and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes. Provide one of the following:
 - a. "Dow Corning 786," Dow Corning Corp.
 - b. "Sanitary 1700," General Electric Co.
 - c. "898 Silicone Sanitary Sealant," Pecora Corp.
- D. Acrylic-Emulsion Sealants: One-part, nonsag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent. Provide one of the following:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Chem-Calk 600," Bostik Construction Products Div.
 - b. "AC-20," Pecora Corp.
 - c. "Sonolac," Sonneborn Building Products Div.
 - d. "Tremflex 834," Tremco, Inc.

2.6 ACOUSTICAL SEALANTS

- A. General: Penetrations by pipes through surfaces that are around and between noise critical spaces shall be sleeved, packed and sealed airtight with foam rod, non-hardening sealant and/or packing material as described herein.
- B. Foam Rod: Foam backer rod shall be closed cell polyethylene suitable for use as a backing for non-hardening sealant.
- C. Non-Hardening Sealant: Sealant for penetrations shall be non-hardening polysulphide type. Permanently flexible, approved firestop putty may be used in lieu of the sealant on foam rod in noise critical walls that are also fire rated.

- D. Packing Material: Mineral fiber; non-combustible; resistant to water, mildew and vermin. Expanding resilient foams manufactured for this purpose are an acceptable alternative only if the material density is at least 15 pcf (40 kg/m3).

2.7 PLENUM INSULATION

- A. General: Combustible materials including, but not limited to, plastic pipe and plastic-coated cables that do not meet the minimum combustibility requirements of the applicable building codes may be installed in fire-rated return air plenums when enclosed within high-temperature insulation blanket where approved by the authority having jurisdiction.
- B. Material: Light weight, high temperature inorganic fiber blanket enhanced for biosolubility and encapsulated with a scrim-reinforced foil.
- C. Certification: Plenum insulation shall have an encapsulated flame spread rating less than 25 and a smoke developed rating of less than 50. The product shall be UL 1887 (Modified) listed, certified by ASTM E-136 for Non-combustibility and ASTM E-84/UL 723 for Surface Burning Characteristics.
- D. Physical Properties: Plenum insulation shall be single ½” layer with a density of 6 to 8 pounds per cubic foot.
- E. Acceptable Manufacturers and Products:
 - 1. 3M Fire Barrier Plenum Wrap 5A+.
 - 2. ETS Schaefer Plenumshield Blanket.
 - 3. Knauf Earthwool 1000° Pipe Insulation with ECOSE Technology.
 - 4. Morgan Advanced Materials – Thermal Ceramics FireMaster PlenumWrap+.
 - 5. Owens Corning Pipe Insulation SSL II with ASJ Max Jacket.
 - 6. Unifrax FyreWrap 0.5 Plenum Insulation.

2.8 FIRESTOPPING

- A. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with UL 2079 or ASTM E 814, or other NRTL acceptable to AHJ. Manufactured by:
 - 1. 3M Corp., Fire Barrier Sealant
 - 2. Hilti
 - 3. Owens Corning, Firestopping Insulation.
 - 4. Pecora, AC-20 FTR
 - 5. RectorSeal
 - 6. Specified Technologies Inc.,
 - 7. United States Gypsum Company SHEETROCK Firecode Compound
 - 8. Tremco, Tremstop Fyre-Sil.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install plenum insulation, access doors and sealants in accordance with manufacturer's installation instructions.

3.2 INSTALLATION OF ACCESS DOORS

- A. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- B. Adjust hardware and panels after installation for proper operation.

3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor Plumbing materials and equipment.
- B. Field Welding: Comply with AWS "Structural Welding Code."

3.4 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor Plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.5 PREPARATION FOR JOINT SEALERS

- A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.
- B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

3.6 APPLICATION OF JOINT SEALERS

- A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
 - 1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
 - 2. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.

- B. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.7 PENETRATIONS:

- A. Construction in Existing Facilities:
 - 1. Saw cut or core drill existing walls and slabs to install sleeves and sleeve seals in existing facilities. Do not cut or drill any walls or slabs without first coordinating with, and receiving approval from, the Architect, Owner, or both. Seal sleeves and sleeve seals into concrete walls or slabs with a waterproof non-shrink grout acceptable to the Architect.
- B. Provide sleeves and/or box frames for openings in all concrete and masonry construction and fire or smoke partitions, for all mechanical work that passes through such construction; Coordinate with other trades and Divisions to dimension and lay out all such openings.
- C. The General Contractor will provide only those openings specifically indicated on the Architectural or Structural Drawings as being provided under the General Contractor's work.
- D. The cutting of new or existing construction shall not be permitted except by written approval of the Architect.
- E. Floor sleeves shall be fitted with means for attachment to forms and shall be of length to extend at least two inches above the floor level.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- I. Seal space outside of sleeves with approved joint compound for penetrations of gypsum board assemblies.
- J. All openings sleeved through underground exterior walls shall be sealed with mechanical sleeve seals as specified in Division 22 Section "Basic Piping Materials and Methods".

3.8 ACOUSTICAL PENETRATIONS

- A. General: There shall be no direct contact of piping with shaft walls, floor slabs and/or partition. All openings around pipes in the structure surrounding the plumbing equipment and surrounding noise-critical spaces shall be sealed, packed with caulking for the full depth of the penetration, as described herein. This includes all slab penetrations and penetrations of noise critical walls.
- B. Domestic Water, Sewer, Drain and Vent Piping

1. Where a pipe passes through a wall, ceiling or floor slab of a noise critical space, a steel sleeve shall be cast or grouted into the structure. The internal diameter of the sleeve shall be 2 inches larger than the external diameter of the pipe passing through it. After all of the piping is installed in that area, the Contractor shall check the clearance and correct it, if necessary, to within 1/2 inch. Pack the void full depth with packing material sealed at both ends, 1 inch deep, with non-hardening sealant backed by foam rod.

3.9 PLENUM INSULATION

- A. General: Plenum insulation shall be installed as a single layer encapsulation applied directly on the surface of combustible items within fire-rated return air plenums where permitted by the local authority having jurisdiction
- B. Overlap: Provide a minimum 1" perimeter and longitudinal overlap at all seams and joints. Seal all cut edges with aluminum foil tape. There shall be no exposed fiber.
- C. Secure Attachment: Securely attach insulation using stainless steel tie wire or banding at locations and intervals as recommended by the manufacturer. The entire installation shall comply with the manufacturer's written installation instructions.
- D. Approval: Plenum insulation shall not be installed where not allowed by local authority having jurisdiction. Do not install combustible material within fire-rated return air plenums where the use of plenum insulation is not approved.

END OF SECTION 220500

SECTION 220515 – BASIC PIPING MATERIALS AND METHODS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section specifies piping materials and installation methods common to more than one Section of Division 22 and includes joining materials, piping specialties and basic piping installation instructions.
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 22 Section "Common Work Results for Plumbing," for materials and methods for sleeve materials.

1.2 DEFINITIONS

- A. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content $\leq 0.25\%$ per Safe Drinking Water Act as amended January 4th 2011 Section 1417.

1.3 SUBMITTALS

- A. Refer to Division 1 and Division 22 Section "General Plumbing Requirements" for administrative and procedural requirements for submittals.
- B. Product Data: Submit product data on the following items:
 - 1. Escutcheons
 - 2. Dielectric Unions
 - 3. Dielectric Waterway Fittings
 - 4. Dielectric Flanges and Flange Kits
 - 5. Mechanical Sleeve Seals
 - 6. Wall Pipes
 - 7. Strainers
- C. Quality Control Submittals:
 - 1. Submit welders' certificates specified in Quality Assurance below.
- D. Submit certification that specialties and fittings for domestic water distribution comply with NSF 61 Annex G and / or NSF 372.
- E. Submit a schedule of dissimilar metal joints and dielectric waterway fittings, unions, flanges or flange kits. Include joint type materials, connection method and proposed dielectric waterway fittings, unions and flanges to isolate dissimilar metals. Include minimum and maximum torque requirements for flange connections to valves. Refer to the individual piping system specification sections in Division 22 for specifications for piping materials and fittings relative to that particular system and additional requirements.

- F. Submit certification that fittings and specialties are manufactured in plants located in the United States or certified that they comply with applicable ANSI and ASTM standards.

1.4 QUALITY ASSURANCE

- A. Welder's Qualifications: All welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.
- B. Welding procedures and testing shall comply with ANSI Standard B31.9 - Standard Code for Building Services Piping and The American Welding Society, Welding Handbook.
- C. Soldering and Brazing procedures shall conform to ANSI B9.1 Standard Safety Code for Plumbing Refrigeration.
- D. Pipe specialties and fittings shall be manufactured in plants located in the United States or certified to meet the specified ASTM and ANSI standards.
- E. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of specialties and fittings containing no more than 0.25% lead by weight for domestic water distribution.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide piping materials and specialties from one of the following:
 - 1. Pipe Escutcheons:
 - a. AWI Manufacturing.
 - b. Keeney Manufacturing Company
 - c. Wal-Rich Corp.
 - d. Jones Stephens Corp.
 - 2. Dielectric Waterway Fittings:
 - a. Grinnell Mechanical Products; Tyco Fire Products LP
 - b. Precision Plumbing Products, Inc.
 - 3. Dielectric Unions:
 - a. JOMAR International
 - b. Smith Cooper International
 - c. Watts Regulator Co.
 - d. Zurn Industries
 - 4. Dielectric Flanges and Flange Kits:
 - a. Advance Products & Systems
 - b. Calpico, Inc.
 - c. Pipeline Seal & Insulator, Inc.

- d. Tampa Rubber and Gasket Co., inc.
 - e. Watts Industries Inc.; Water Products Div.
 - f. Zurn Industries, Inc.; Wilkins Div.
- 5. Strainers – 2” and smaller:
 - a. Apollo
 - b. Hammond
 - c. Milwaukee
 - d. NIBCO
- 6. Mechanical Sleeve Seals:
 - a. Advance Products & Systems
 - b. Calpico, Inc.
 - c. GPT Industries/Link Seal
 - d. Metraflex Co.
 - e. Proco Products, Inc.
- 7. Wall Pipes
 - a. Josam Mfg. Co.
 - b. Smith (Jay R) Mfg. Co.
 - c. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
 - d. Watts Industries, Inc.
 - e. Zurn Industries, Inc.; Hydromechanics Div.

2.2 PIPE AND FITTINGS

- A. Refer to the individual piping system specification sections in Division 22 for specifications on piping and fittings relative to that particular system.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 22 Piping Sections for special joining materials not listed below.
- B. Welding Materials: AWS D10.12; Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.
- C. Brazing Materials: AWS A5.8; Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials appropriate for the materials being joined.
- D. Soldering Materials: ASTM B32; Refer to individual piping system specifications for solder appropriate for each respective system.

- E. Gaskets for Flanged Joints: ASME B16.21; Gasket material shall be full-faced for cast-iron flanges and raised-face for steel flanges. Select materials to suit the service of the piping system in which installed and which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.

2.4 PIPING SPECIALTIES

- A. Escutcheons: Chrome-plated, stamped steel, hinged, split-ring escutcheon, with set screw. Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated and of depth adequate to conceal protruding piping. Outside diameter shall completely cover the opening in floors, walls, or ceilings.
- B. Unions:
 - 1. Malleable-iron, Class 150 for low pressure service and class 300 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.
 - 2. Bronze, Class 125, with lead free cast bronze body meeting ASTM B584, for low pressure service and class 250 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; solder or female threaded ends.
- C. Dielectric Unions: Factory-fabricated with lead free cast bronze body meeting ASTM B584 and galvanized steel body with plastic dielectric gasket, class 125 for low pressure service and class 250 for high pressure service, and appropriate end connections for the pipe materials in which installed (screwed or soldered) to effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.
- D. Dielectric Waterway Fittings: Electroplated steel or brass nipple, with an inert and non-corrosive, thermoplastic lining.
- E. Dielectric Flanges and Flange Kits:
 - 1. Full faced gasket with same outside diameter and bolt hole arrangement as the flange. Pressure rating of 200psi for low pressure service and 400 psi for high pressure service at a continuous operating temperature of 180F.
 - 2. Steel washers, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves.
 - 3. Lead free cast bronze meeting ASTM B584, class 125 solder type or cast iron class 125 threaded type for low pressure service and bronze class 250 solder type or cast iron class 250 threaded type for high pressure service.
 - 4. For low pressure applications, cast iron strainers shall have 125 psi working pressure rating and cast bronze strainers shall have 150 psi working pressure rating. For high pressure applications, cast iron strainers shall have 250 psi working pressure rating and cast bronze strainers shall have 300 psi working pressure rating.
 - 5. Solder Ends, 2" and Smaller: Lead free cast bronze body meeting ASTM B584, screwed screen retainer with centered blowdown fitted with pipe plug.
 - 6. Flanged Ends, 2-1/2" and Larger: Cast-iron body, with FDA fused epoxy coating, bolted screen retainer with off-center blowdown fitted with pipe plug.

- F. Sleeves:
 - 1. Sleeve: Refer to Division 22 Section “Common Work Results for Plumbing” for sleeve materials.
- G. Mechanical Sleeve Seals: Modular Plumbing 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.

2.5 WALL PIPES

- A. Cast-iron sleeve with integral clamping flange with clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.6 WALL SLEEVES

- 1. Steel sleeve of schedule 40 pipe meeting ASTM A53B with 2” wide metal plate meeting ASTM A36 welded all around. Hot dip galvanized inside and out.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer’s installation instructions.

3.2 PREPARATION

- A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

3.3 INSTALLATIONS

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.
- B. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated otherwise.
- C. Install piping free of sags and bends and with ample space between piping to permit proper insulation applications.
- D. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.

- E. Install horizontal piping as high as possible allowing for specified slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- F. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
- G. Support piping from structure. Do not support piping from ceilings, equipment, ductwork, conduit and other non-structural elements.
- H. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4" ball valve, and short 3/4" threaded nipple and cap.
- I. Verify final equipment locations for roughing in.

3.4 PIPING PROTECTION

- A. Protect piping during construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

3.5 PENETRATIONS

- A. Plumbing penetrations occur when piping penetrate concrete slabs, concrete or masonry walls, or fire / smoke rated floor and wall assemblies.
- B. Provide escutcheons for exposed pipe penetrations of interior floors, walls, ceilings and under cabinets and millwork. Use deep pattern escutcheons where required.
- C. Above Grade Concrete or Masonry Penetrations
 - 1. Provide sleeves for pipes passing through above grade concrete or masonry walls, concrete floor or roof slabs. Sleeves are not required for core drilled holes in existing masonry walls, concrete floors or roofs. Provide sleeves as follows:
 - a. Provide schedule 40 galvanized steel pipe for sleeves smaller than 6 inches in diameter.
 - b. Provide galvanized sheet metal for sleeves 6 inches in diameter and larger, thickness shall be 10 gauge (0.1382 inches).
 - c. Provide welded galvanized sheet metal for rectangular sleeves with the following minimum metal thickness:
 - 1) For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 18 gauge (0.052 inches).
 - 2) For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 10 gauge (0.1382 inches).
 - d. Schedule 40 PVC pipe sleeves are acceptable for use in areas without return air plenums.

2. Extend pipe insulation for insulated pipe through floor, wall and roof penetrations, including fire rated walls and floors. The vapor barrier shall be maintained. Size sleeve for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.
 3. Seal elevated floor, exterior wall and roof penetrations watertight and weathertight with non-shrink, non-hardening commercial sealant. Pack with mineral wool and seal both ends with minimum of ½" of sealant.
- D. Underground, Exterior-Wall Penetrations: Provide galvanized steel wall sleeve. Wall sleeve is not required for existing concrete walls with core drilled penetrations. Size wall sleeves to allow for 1-inch or larger, if required by the mechanical sleeve seal manufacturer) annular clear space between pipe and sleeve. Provide mechanical sleeve seal.
1. Use type and number of sealing elements recommended by manufacturer for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
 2. Verify sleeve and mechanical sleeve seal installations for damage and faulty work. Verify watertight integrity of sleeves and mechanical sleeve seals installed below grade to seal against hydrostatic water pressure. If sleeve and or sleeve seal are not watertight, provide new wall sleeve and mechanical sleeve seal.
- E. Elevated Floor Penetrations of Waterproof Membrane:
1. Provide cast-iron wall pipes for sleeves, extend top of wall pipe minimum 1" above finish floor. Size wall pipe for minimum ½" annular space between pipe and wall pipe.
 2. Extend pipe insulation for insulated pipe through wall pipe. The vapor barrier shall be maintained. Size wall pipe for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.
 3. Pack with mineral wool and seal both ends with minimum of ½" of waterproof sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
 4. Secure waterproof membrane flashing between clamping flange and clamping ring. Comply with requirements for flashing specified in Division 7 Section "Sheet Metal Flashing and Trim."
 5. Extend bottom of wall pipe below floor slab as required and secure underdeck clamp to hold wall pipe rigidly in place.
- F. Interior Foundation Penetrations: Provide sleeves for horizontal pipe passing through or under foundation. Sleeves shall be cast iron soil pipe two nominal pipe sizes larger than the pipe served.
- G. Concrete Slab on Grade Penetrations:
1. Provide schedule 40 PVC pipe sleeves for vertical pressure pipe passing through concrete slab on grade. Sleeves shall be one nominal pipe size larger than the pipe served and two pipe sizes larger than pipe served for ductile iron pipes with restraining rods. Seal water-tight with silicone caulk.

2. Provide ½" thick cellular foam insulation around perimeter of non-pressure pipe passing thru concrete slab on grade. Insulation shall extend to 2" above and below the concrete slab.
- H. Interior Penetrations of Non-Fire-Rated Walls: Seal annular space between sleeve and pipe, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½" of sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
1. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.
- I. Exterior Wall Penetrations: Seal annular space between sleeve and pipe, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½" of waterproof sealant. Cover exterior sealant with grout, minimum ½" thick and paint grout to match exterior color, with color selection by the architect. Refer to Division 07 Section "Joint Sealants" for materials and installation.
1. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.
- J. Fire / Smoke Rated Floor and Wall Assemblies: Seal around penetrations of fire rated assemblies to maintain fire resistance rating of fire-rated assemblies. Coordinate fire ratings and locations with the architectural drawings. Install sealants in compliance with the manufacturer's UL listing. Refer to Division 22 Section "Common Work Results for Plumbing" for firestoppings and materials.
- K. Acoustical Barrier Penetrations: Where a pipe passes through a wall, ceiling or floor slab of a noise critical space, a steel sleeve shall be cast or grouted into the structure. Refer to Section "Basic Mechanical Materials and Methods" for noise critical spaces. The internal diameter of the sleeve shall be a minimum of 2 inches larger than the external diameter of the pipe. After the piping is installed, the Contractor shall check the clearance and correct it to within 1/2-inch. Contractor shall pack the void full depth with glass/mineral fiber insulation and seal at both ends, 1-inch deep, with sealant backed by foam rod.
1. Penetration of sound isolating ceilings by sprinkler pipes and heads shall be sleeved and sealed and shall have no rigid connections between them.

3.6 FITTINGS AND SPECIALTIES

- A. Use fittings for all changes in direction and all branch connections.
- B. Remake leaking joints using new materials.
- C. Install components with pressure rating equal to or greater than system operating pressure.
- D. Install strainers on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, mixing valve, backflow preventer and elsewhere as indicated.
- E. Install unions at the final connection to each piece of equipment adjacent to each isolation valve or valve assembly for connections 2" and smaller. Install unions where indicated elsewhere on the drawings.

- F. Install dielectric unions for piping 2" and smaller to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air, vacuum) for copper or brass connected to carbon steel, cast or ductile iron.
- G. Install dielectric unions for piping 2" and smaller to connect piping materials of dissimilar metals in wet piping systems (water) (except do not install dielectric unions in concealed spaces, instead, install dielectric waterway fittings) for copper or brass connected to carbon steel, cast or ductile iron.
- H. Install dielectric waterway fittings for piping 2" and smaller for copper or brass pipe connections to carbon steel equipment connections.
- I. Dielectric Flange Installation:
 - 1. Provide brass nipples between the equipment connection and dielectric flange for screwed connections. Provide an iron flange for the equipment side and a bronze flange for the copper or brass piping side of the joint.
 - 2. Provide a bronze flange for the copper or brass piping connection to a cast iron, ductile iron or steel flange.
 - 3. Provide full face gasket with pressure rating equal to system served.
 - 4. At each bolt provide, steel washers, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves.

3.7 JOINTS

- A. Steel Pipe Joints:
 - 1. Pipe 2" and Smaller: Thread pipe with tapered pipe threads in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint lubricant or sealant suitable for the service for which the pipe is intended on the male threads at each joint and tighten joint to leave not more than 3 threads exposed.
- B. Non-ferrous Pipe Joints:
 - 1. Brazed And Soldered Joints: For copper tube and fitting joints, braze joints in accordance with ANSI B31.9 - Standard Code for Building Services Piping and ANSI B9.1 - Standard Safety Code for Plumbing Refrigeration.
 - 2. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emory cloth, prior to making soldered or brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.
- C. Joints for other piping materials are specified within the respective piping system Sections.

3.8 PIPE FIELD QUALITY CONTROL

- A. Testing: Refer to individual piping system specification sections.

- B. Inspection Report Form: Refer to the inspection report form at the end of this section for inspection data to be completed for each piping system. Submit completed forms to the Owner and Engineer.

END OF SECTION 220515

PLUMBING & PLUMBING PIPING SYSTEMS
INSPECTION REPORT FORM

Project Name: _____
Project No: _____ Contractor Project No. _____
General Contractor: _____
Inspection Date: _____ Temperature: _____

System Inspected

Building: _____
Location/Description: _____
Service: _____

Inspection Results

Time of Inspection: _____
Approval to Insulate: Y N Approval to Cover in Wall: Y N
Approval to backfill Y N

Signatures

Witness: _____ Representing: _____
Witness: _____ Representing: _____
Witness: _____ Representing: _____

Remarks

Contractor Supervisor's signature: _____

SECTION 220523 – GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes general duty valves common to most plumbing water distribution piping systems.
 - 1. Special purpose valves are specified in individual piping system specifications.

1.2 DEFINITIONS

- A. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content $\leq 0.25\%$ per Safe Drinking Water Act as amended January 4th, 2011 Section 1417.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
 - 1. Product data, including body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.
- B. Submit certification that valves for domestic water distribution comply with NSF 61 Annex G and / or NSF 372.

1.4 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide products specified in this section from the same manufacturer where products are available and conform to the specification requirements.
- B. American Society of Mechanical Engineers (ASME) Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.
- C. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the MSS Standard Practices below:
 - 1. MSS SP 67 “Butterfly Valves”
 - 2. MSS SP 70 “Gray Iron Gate Valves, Flanged and Threaded Ends”
 - 3. MSS SP 71 “Gray Iron Swing Check Valves, Flanged and Threaded Ends”
 - 4. MSS SP 72 “Ball Valves with Flanged or Butt Welding Ends”
 - 5. MSS SP 80 “Bronze Gate, Angle and Check Valves”
 - 6. MSS SP 110 “Ball Valves, Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends”
 - 7. MSS SP 125 “Check Valves: Gray Iron and Ductile Iron, In-Line, Spring Loaded, Center-Guided”

- 8. MSS SP 139 “Copper Alloy Gate, Globe, Angle and Check Valves for Low Pressure/Low Temperature Plumbing Applications”
- D. Valves shall be manufactured in plants located in the United States or certified that they comply with applicable ANSI, ASTM and MSS standards.
- E. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of valves containing no more than 0.25% lead by weight compliance for valves for domestic water distribution.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products from one of the manufacturers listed in valve schedule.

2.2 VALVE FEATURES, GENERAL

- A. Valve Design: Rising stem or rising outside screw and yoke stems.
 - 1. Non-rising stem valves may be used where headroom prevents full extension of rising stems.
- B. Pressure and Temperature Ratings: As scheduled and required to suit system pressures and temperatures.
- C. Sizes: Same size as upstream pipe, unless otherwise indicated.
- D. Operators: Provide the following special operator features:
 - 1. Handwheels, fastened to valve stem, for valves other than quarter turn.
 - 2. Lever handles, on quarter-turn valves 6-inch and smaller.
- E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- F. End Connections: As indicated in the valve specifications.
 - 1. Threads: Comply with ANSI B1.20.1.
 - 2. Flanges: Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze valves.
 - 3. Solder-Joint: Comply with ANSI B16.18.
 - a. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F for gate, globe, and check valves; below 421 deg F for ball valves.

2.3 GATE VALVES

- A. Gate Valves, 2-Inch and Smaller: Meeting MSS SP-80; Class 125, 200-psi CWP, body, solid wedge and bonnet of ASTM B 584 lead free cast bronze; brass packing gland and

stem of ASTM B283 naval brass; with solder ends, non-asbestos composition packing, and malleable iron handwheel.

2.4 BALL VALVES

- A. Ball Valves, 2 Inch and Smaller: Meeting MSS SP 110, Class150, 600-psi CWP; two-piece construction; with ASTM B 584 cast lead free bronze full port, blowout-proof stem and stainless steel ball, with replaceable "Teflon" or "TFE" seats and seals, solder ends and vinyl-covered steel handle.

2.5 CHECK VALVES

- A. Swing Check Valves, 2-Inch and Smaller: Meeting MSS SP-80; Class 125, 200-psi CWP, body and cap of ASTM B 584 cast lead free bronze; with horizontal swing, Y-pattern, disc and disc holder of ASTM B 283 alloy C46400 naval brass; solder ends. Provide valves capable of being reground while the valve remains in the line.
- B. Wafer Check Valves: Meeting MSS SP 125, Class 125, 200-psi CWP, lead free cast-iron body, with FDA epoxy coating, replaceable bronze seat, and non-slam design lapped and balanced twin bronze flappers and stainless steel trim and torsion spring. Provide valves designed to open and close at approximately one foot differential pressure.
- C. Lift Check Valves, 2-Inch and Smaller: Meeting MSS SP-139; 250-psi CWP, body, disc holder and cap of ASTM B 584 cast lead free bronze; horizontal or angle pattern, lift-type valve, with stainless steel spring, renewable "Teflon" disc and solder ends. Provide valves capable of being refitted and ground while the valve remains in the line.

PART 3 - EXECUTION

3.1 INSTALLATIONS

- A. Install valves in accordance with manufacturer's installation instructions.
- B. Locate valves for easy access and provide separate support where necessary. Provide access doors and fire rated access doors as required.
- C. Install valves and unions for each fixture and item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.
- D. Install three-valve bypass around each pressure reducing valve using throttling-type valves.
- E. Install valves in horizontal piping with stem at or above the center of the pipe.
- F. Install valves in a position to allow full stem movement.
- G. Installation of Check Valves: Install for proper direction of flow as follows:
 - 1. Swing Check Valves: Horizontal position with hinge pin level.
 - 2. Wafer Check Valves: Horizontal or vertical position, between flanges.
 - 3. Lift Check Valve: With stem upright and plumb.

3.2 VALVE ENDS SELECTION

A. Select valves with the following ends or types of pipe/tube connections:

1. Copper Tube Size, 2-Inch and Smaller: Solder ends.

3.3 VALVE PRESSURE/TEMPERATURE CLASSIFICATION SCHEDULES

A. Domestic Hot and Cold Water Service

<u>VALVE TYPE</u>	<u>2" AND SMALLER</u>	<u>2-1/2" AND LARGER</u>
Ball	150	200
Butterfly	N/A	200
Gate	125	125
Check	125	125

B. Domestic High Pressure Hot and Cold Water Service

<u>VALVE TYPE</u>	<u>2" AND SMALLER</u>	<u>2-1/2" AND LARGER</u>
Ball	150	N/A
Gate	N/A	250
Check	N/A	250

3.4 VALVE SCHEDULE

A. Gate Valves - 2 inch and smaller:

<u>MANUFACTURER</u>	<u>SOLDER NRS</u>
Apollo	102S-LF
Hammond	UP-668
Milwaukee	UP668
NIBCO	S-113-LF

B. Ball Valves – 2 inch and smaller:

<u>MANUFACTURER</u>	<u>SOLDER ENDS</u>
Apollo (Conbraco)	70-LF-200
Hammond	UP8511
Milwaukee	UPBA-150
NIBCO	N/A

C. Ball Valves (full port) – 2 inch and smaller:

<u>MANUFACTURER</u>	<u>SOLDER ENDS</u>	<u>THREADED ENDS</u>
Apollo (Conbraco)	77C-LF-200	77C-LF-100
Hammond	UP8311A	UP8301A
Milwaukee	UPBA-450	UPBA-400

NIBCO	S-585-80-LF	T-585-80-LF

D. Ball Valves (full port – SS Ball) – 2 inch and smaller:

<u>MANUFACTURER</u>	<u>SOLDER ENDS</u>	<u>THREADED ENDS</u>
Apollo (Conbraco)	77C-LF-240	77C-LF-140
Hammond	UP8313A	UP8303A
Milwaukee	UPBA-450S	UPBA-400S
NIBCO	S-585-66-LF	T-585-66-LF

E. Globe Valves – 2 inch and smaller:

<u>MANUFACTURER</u>	<u>SOLDER ENDS</u>
Apollo	120S-LF
Hammond	UP-418
Milwaukee	UP1502
NIBCO	S113

F. Swing Check Valves – 2 inch and smaller:

<u>MANUFACTURER</u>	<u>SOLDER ENDS</u>	<u>THREADED ENDS</u>
Apollo	161S-LF	161T-LF
Milwaukee	UP1509	UP509
NIBCO	S-413-Y-LF	T-413-Y-LF

G. Wafer Check Valves – Class 125:

<u>MANUFACTURER</u>	<u>MODEL</u>
Apollo	910WB-LF

H. Lift Check Valves – 2 inch and smaller:

<u>MANUFACTURER</u>	<u>SOLDER ENDS</u>	<u>THREADED ENDS</u>
Hammond	UP947	UP943
Milwaukee	UP1548T	UP548T
NIBCO	S-480-Y-LF	T-480-Y-LF

3.5 APPLICATION SCHEDULE

A. General Application: Use gate, ball, and butterfly valves for shutoff duty; globe, ball, and butterfly for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements.

B. Domestic Water Systems: Use the following valve types:

1. Gate Valves, 2" and smaller: Class 125, with cast bronze body.
2. Ball Valves, 2" and Smaller: Class 150, 600-psi CWP, with stem extension if installed in insulated pipe.
3. Swing Check, 2" and smaller: Class 125, cast bronze, with rubber seat.

3.6 FIELD QUALITY CONTROL

- A. Tests: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.7 ADJUSTING AND CLEANING

- A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.
- B. Inspect valves for leaks after piping systems have been tested and put into service, but before final adjusting and balancing. Adjust or replace packing, as required, on valves with leaks. Replace valve if leak persists.

END OF SECTION 220523

SECTION 220529 – HANGERS AND SUPPORTS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Support and attachment components.
- B. Horizontal-piping hangers and supports.
- C. Shields
- D. Vertical piping clamps
- E. Pipe alignment guides.
- F. Pipe anchors.
- G. Anchors and fasteners.
- H. Miscellaneous materials.
- I. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 22 Section "Plumbing Insulation", for high density insulation for protecting insulation vapor barrier and materials and methods for piping hanger installations.
 - 2. Division 22 "Water Distribution Piping and Specialties", for pipe hanger types and spacing for horizontal and vertical domestic water distribution and heat traced piping of sizes and materials indicated.
 - 3. Division 22 "Sanitary Drainage & Vent Piping and Specialties", for pipe hanger types and spacing for heat traced and cold sanitary piping of sizes and materials indicated.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

1.3 SUBMITTALS

- A. Product Data : Provide manufacturer's standard catalog pages and data sheets for each type of hanger and support. Include a hanger and support schedule showing manufacturer's figure number, size, location, and features for each hanger and support. Submit style and type to Structural Engineer for approval prior to installation.
- B. Product Certificates: Signed by the manufacturer of hangers and supports certifying the products meet the specified requirements.

1.4 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Installer Qualifications for Field-Welding:
 - 1. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
 - 2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
 - 3. Qualify welding processes and welding operators in accordance with ASME BPVC Section IX, "Welding and Brazing Qualifications."
- D. Flame/Smoke Ratings: Provide hangers and supports with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by UL 723 or ASTM E84 (NFPA 255) method.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

1.6 DEFINITIONS

- A. Terminology used in this Section is defined in MSS SP-90.

PART 2 - PRODUCTS AND MATERIALS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Comply with MSS SP-58.
2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of work.
3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
6. Materials: Products and materials listed in this specification are based on indoor, dry locations. Use corrosion resistant materials suitable for the environment where installed.
 - a. Indoor Dry Locations: Painted carbon steel, galvanized steel or zinc-plated steel. Where supports will be field painted in exposed locations, provide carbon steel.
 - b. Indoor Damp or Wet Locations: Galvanized steel or type 304 stainless steel.
 - c. Outdoor Locations: Galvanized steel or type 304 stainless steel.
 - d. Dielectrics Barriers: Provide dielectric barriers between metallic supports and metallic piping and associated items of dissimilar type. Acceptable barriers include rubber, or copper-plated coatings where attachments are in direct contact with copper.
 - e. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - f. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
 - g. Stainless Steel: Type 304 or 316 in accordance with ASTM A240.

B. Metal Channel (Strut) Framing Systems:

1. Manufacturers:
 - a. Cooper B-Line.
 - b. PHD Manufacturing.
 - c. Thomas & Betts Corporation.
 - d. Unistrut, a brand of Atkore International Inc.
 - e. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

2. Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
 3. Comply with MSS SP-69, Type 59, MSS SP-89, and . Welds shall comply with AWS D1.1.
 4. Channel Material:
 - a. Indoor Dry Locations: Galvanized steel or zinc-plated steel.
 - b. Indoor Damp or Wet Locations: Galvanized steel or type 304 stainless steel.
 - c. All nuts, brackets, and clamps shall have the same finish as the channel.
 5. Minimum Channel Thickness: Steel sheet, 14 gage, 0.0747 inch.
 6. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height with factory-punched attachment holes.
 7. Provide plastic galvanic isolators for connecting bare copper pipe for use with pre-engineered support strut system where indicated.
- C. Hanger Rods:
1. Material:
 - a. Indoor Dry Locations: Zinc-plated steel.
 - b. Indoor Damp or Wet Locations or Outdoor Locations: Zinc-plated steel or type 304 stainless steel.
 - c. Natatorium or other treated pool environments: Type 316 stainless steel.
 2. Threaded both ends or continuously threaded.
 3. Minimum Size: Reference piping specification sections for rod thicknesses.
 4. Threaded Rods: Threaded rods are not allowed for floor supports except when the maximum length of the rod is less than 12". Threaded rod sizes shall be the same size diameter as specified for pipe hanger rods based upon pipe size being supported. Refer to system piping specification sections for rod size requirements.
- D. Wire Rope Pipe Hanging Systems:
1. Manufacturers:
 - a. ASC Engineered Solutions.
 - b. Gripple.
 2. General: Wire rope hanger system shall have a minimum 5 to 1 safety factor based upon the applied working load being supported.
 3. Source Limitations: Furnish associated fittings, accessories, and hardware produced by a single manufacturer.
 4. Cast-in-place Concrete Insert: Pressed steel body with sintered steel wedge, 302 stainless steel spring and UV stabilized homopolymer polypropylene end cap. Model: Gripple Spider Hanging Kit.
 5. Cable Stud: Carbon steel, zinc-coated, designed for attachment to concrete inserts. Model: ASC Engineered SolutionsC120.

6. Cable Coupling: Carbon steel, zinc-coated, designed for attachment to threaded rods. Model: ASC Engineered SolutionsC130.
7. Cable Eyelet: Carbon steel, zinc-coated, designed to be directly attached to structural supports via anchors or fasteners. Model: ASC Engineered SolutionsC150.
8. Cable Toggle: Carbon steel, zinc-coated, with toggle designed for insertion into 1/2 inch hole through steel deck hat channel and provides anchor when pulled in tension. Model: ASC Engineered SolutionsC160.
9. Swivel Toggle Insert: Single assembly attached to wire rope cable, manufactured from plated carbon steel toggle, pins, and shackles; swivel insert engineered to be compatible with concrete insert.
10. Wire Rope: High tensile steel wire rope, to ASTM A1023, Class A zinc coating; minimum 7 by 7 cross-sectional thread construction; having a tensile strength of 256,000 psi; No.3 wire size minimum.
11. Adjustable Fastener: Mild steel (type UG2), bright zinc plated, one-channel body; encasing a series of Type 302 stainless-steel springs with serrated self-locking grade 40 chrome steel balls, adjustable by means of an integrated mechanism, capable of accommodating load of 500 lb. Model: Gripple No. 2, 3 or 4 UniGrip.

2.2 HORIZONTAL PIPING HANGERS AND SUPPORTS

A. MANUFACTURERS

1. ASC Engineered Solutions.
2. Cooper B-Line, Inc.
3. Elite Components
4. ERICO/Michigan Hanger Co./Caddy
5. Halfen-DEHA.
6. Hilti.
7. National Pipe Hanger Corporation.
8. PHD Manufacturing.
9. Power-Strut.
10. Unistrut.

B. Single Hangers:

1. Split Ring: Carbon steel, adjustable swivel, split ring type.
2. Split Ring 2 inch and smaller: Copper alloy, split ring type.
3. Clevis Hanger: Carbon steel, adjustable, clevis type.
4. Roll Support Hanger: Adjustable steel yoke, cast iron roll.

C. Trapeze and Strut-mounted Supports:

1. Two-piece clamp: Designed for use with channel strut, held in place at channel shoulder when clamp attachment nut is tightened.

2. Roll Support: Adjustable cast iron roll attached to metal channel strut framing system with brackets and nuts.
- D. Hangers and strut-mounted supports with pre-manufactured polymer inserts:
1. Manufacturers:
 - a. ASC Engineered Solutions.
 - b. Holdrite.
 - c. Klo-Shure.
 2. Strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts designed to receive butted insulation internally. Inserts shall support piping independent of insulation to avoid crushing. Installed system shall provide equal thermal and vapor barrier performance as systems with continuous unbroken insulation. Metal shields are not required with clevis hangers of this type.
- E. Spring Hangers:
1. Reference Section “Vibration Isolation for Plumbing Piping and Equipment” for spring isolation hangers.
- F. Wall Supports:
1. Two-hole strap, galvanized steel or copper to suit pipe material. Provide rigid insulation between strap and pipe to maintain continuous insulation and vapor barrier where required.
 2. Welded steel bracket reinforced with angle or strut. Support pipe from bracket using horizontal pipe hanger or support appropriate for the pipe type.
- G. Floor Supports:
1. Pipe Saddle: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 2. Roller Support: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- H. Pre-Insulated Supports:
1. Manufacturers:
 - a. Aeroflex USA, Inc.
 - b. ASC Engineered Solutions
 - c. Armacell.
 - d. Buckaroos, Inc.
 - e. Cooper B-Line, Inc.
 - f. Pipe Shields, Inc.
 2. General Construction and Requirements:
 - a. Flexible elastomeric insulation with integral high-density pipe support insert shall conform to ASTM C534, Type I.

- b. Surface Burning Characteristics: Assembly shall have a flame spread index/smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.
 - c. Waterproof calcium silicate insulation shall conform to ASTM C795.
 - d. Rigid phenolic foam insulation shall conform to ASTM C1126, Type III.
 - e. Insulation inserts shall be surrounded by a 360 degree jacket or shield.
3. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.

2.3 SHIELDS

A. Insulation Protection Shield:

1. Sheet metal construction, meeting SP-58 Type 40, of 18 gauge for 5-1/2" inside dimension and smaller, 16 gauge for 6-1/2" to 10-3/4" inside dimension 14 gauge for 11-3/4" to 17" inside dimension, and 12 gauge for 18" to 28" inside dimension.
2. Shield shall cover half of the circumference of the pipe and shall be of length indicated by manufacturer for pipe size and thickness of insulation.
3. Lengths for pipes greater than 2 inches: Minimum 8 inch long section at each support.
4. For pipes 2 inch and smaller using fiberglass or flexible elastomeric insulation without pre-insulated supports, provide insulation protection shields installed between hanger and pipe which meets the following minimum length requirements:

Pipe Size (NPS)	Insulation Thickness (inches)	Minimum Shield Length, (in)					
		Hanger Spacing, (ft)					
≤ 1	0.5	5	6	8	-	-	-
	1	3	5	5	-	-	-
	1.5	3	5	5	-	-	-
	2	3	3	3	-	-	-
	3	3	3	3	-	-	-
≤ 2	0.5	8	8	11	11	12	14
	1	5	6	8	9	11	11
	1.5	5	6	8	8	9	9
	2	5	5	6	6	8	8
	3	5	5	6	6	6	8

- ### B. 360° Insulation Protection Shield:
- Shield shall cover all of the circumference of the pipe with two half circumference sections held together with bolts and nuts and shall be of length indicated by manufacturer for pipe size and thickness of insulation.

C. Plastic Shields:

1. Manufacturers:
 - a. Armacell.
 - b. Eaton.
 - c. Hydra-Zorb.

- d. PHD Manufacturing.
 - e. Zsi Foster.
2. Polymer-based, snap-on or clip-on design, with non-adhesive surface and lip to allow lateral movement of piping without damaging insulation, field-paintable.

2.4 VERTICAL-PIPING SUPPORTS

A. Manufacturers:

1. ASC Engineered Solutions.
2. Cooper B-Line, Inc.
3. Halfen-DEHA.
4. Hilti.
5. ERICO/Michigan Hanger Co.
6. National Pipe Hanger Corporation.
7. PHD Manufacturing.
8. Power-Strut.
9. Unistrut.

B. Components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58.

1. Components shall have galvanized coatings where installed for piping and equipment that will not have factory applied or field-applied finish.
2. Pipe attachments shall be copper-plated or have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
3. Components as listed below shall be made of 304 stainless steel where installed in corrosive environments and/or where indicated on the drawings.

C. Riser Clamps with pre-manufactured polymer insert:

1. Manufacturers:

- a. Hydra-Zorb; Titan Riser Clamp.
- b. National Pipe Hanger.
- c. Pipe Hangers, Inc.

D. Riser clamp with pre-manufactured polymer inserts designed to withstand vertical loading and receive butted insulation internally. Inserts shall support piping independent of insulation to avoid crushing. Installed system shall provide equal thermal and vapor barrier performance as systems with continuous unbroken insulation.

2.5 PIPE ALIGNMENT GUIDES

- ### A. Factory fabricated, constructed of cast semi-steel or heavy fabricated steel when applied to steel pipe and copper when applied to copper. Guide shall consist of bolted two-section

outer cylinder and base with two-section guiding spider that bolts tightly to pipe. Length of guides shall be as recommended by manufacturer to allow indicated travel.

1. Pipe Diameter 8 inches and Smaller: Spider or sleeve type.
2. Pipe Diameter 10 inches and Larger: Roller type.
3. Pipe Diameter 18 to 30 inches: 1 inch U-bolt.

2.6 PIPE ANCHORS

- A. Pre-Insulated Anchors: Galvanized steel or stainless steel assembly with high density insulation insert and no metal-to-metal contact.
- B. Anchor Clamps: Assembly with multi-piece clamp, constructed of compatible material with piping or with dielectric barrier.

2.7 ANCHORS AND FASTENERS

- A. Manufacturers:
 1. Hilti, Inc.
 2. Illinois Tool Works, Inc.
 3. Phillips.
 4. Powers Fasteners, Inc.
 5. Rawl.
 6. Simpson Strong-Tie Company Inc.
- B. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
 1. Concrete: Use preset concrete inserts or expansion anchors.
 2. Solid or Grout-Filled Masonry: Use expansion anchors.
 3. Hollow Masonry: Use toggle bolts.
 4. Hollow Stud Walls: Use toggle bolts.
 5. Steel: Use beam clamps.
 6. Sheet Metal: Use sheet metal screws.
 7. Wood: Use wood screws.
 8. Plastic and lead anchors are not permitted.
 9. Hammer-driven anchors and fasteners are permitted only as follows:
 - a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction.
 - b. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction.
- E. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.

1. Comply with MFMA-4.
 2. Channel Material: Use galvanized steel.
 3. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.
 4. Spot Inserts: Carbon steel with zinc plating or galvanized steel body and base plate, with protective sleeve for anchor rod insert, sized to accommodate anchor rod dimensions.
 5. Manufacturers:
 - a. Same as manufacturer of metal channel (strut) framing system.
 - b. DeWalt “Bang-It” concrete inserts.
- F. Post-Installed Concrete and Masonry Expansion Anchors:
1. Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
 2. Self-drilling, drilled flush or shell type. Size inserts to suit threaded rods.
- G. Beam Clamps: MSS SP-58 C-Type or adjustable, Types 19 through 23, 25 or 27 through 30 based on required load.
1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
 2. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- H. Vibration Isolation Anchors: Reference Division 22 Section “Vibration Isolation for Plumbing Piping and Equipment” for vibration isolation anchors.

2.8 MISCELLANEOUS MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Malleable Iron: ASTM A47
- I. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION, GENERAL

- A. Install hangers and supports in accordance with manufacturer's installation instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

3.3 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58 unless indicated otherwise.
- B. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
- C. Space attachments within maximum piping span length specified in Division 22 piping sections.
- D. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- E. Install hangers, supports, clamps and attachments to support piping properly from building structure.
- F. Do not attach to ceilings, equipment, ductwork, conduit and other non-structural elements such as floor and roof decking.
- G. Hanger and clamps sizing:
 - 1. Cold Piping: Provide pipe hangers sized for the pipe outside diameter plus insulation thickness.
 - 2. Hot Piping: Provide pipe hangers sized for the pipe outside diameter.
 - 3. Vertical Piping: Provide clamps sized for the pipe outside diameter and extend clamp through insulation.
 - 4. Refer to Division 22 Section "Plumbing Insulation" for definition of hot and cold piping and required insulation thickness.

- H. Where several pipes can be installed in parallel and at the same elevation, Contractor has option to provide metal channel strut framing. Install supports with maximum spacing specified within Division 22 piping sections.
 - 1. Space strut framing at the required distance for the smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.
 - 2. Where strut systems are attached to walls, install anchor bolts per manufacturer's recommendations.
 - a. Uninsulated Copper Pipe: Install with plastic galvanic isolators
 - b. Insulated Tube or Pipe: Install with 360° insulation protection shields or pre-engineered thermal hanger-shield inserts as specified in Division 22 Section "Plumbing Insulation".
- I. Install building attachments within concrete or to structural steel.
 - 1. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping as specified in Division 22 piping sections.
 - 2. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through openings at top of inserts.
- J. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Provide two nuts on threaded supports to securely fasten the support.
- K. Install appropriate types of hangers and supports to allow controlled movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
- L. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ASME B31.9 Building Services Piping Code is not exceeded.
- N. Insulated Piping: Comply with the following installation requirements.
 - 1. Riser Clamps: Attach riser clamps to piping with riser clamps projecting through insulation. Do not use riser clamps to support horizontal, insulated piping. Seal insulation for hot piping and protect vapor barrier for cold piping as specified in Division 22 Section "Plumbing Insulation".
 - a. Contractor's Option: Provide riser clamps with pre-manufactured polymer insert for cold piping 2-1/2 inches and larger.
 - 2. Insulation Protection Shield: Install insulation protection shield with high density insulation insert where vapor barrier is indicated, sized for the insulation thickness used as specified in Division 22 Section "Plumbing Insulation". Do not use polymer-based shields for hot piping.

- a. Exception for horizontal cold-piping with fiberglass or flexible elastomeric insulation 2 inch and smaller: Rest fiberglass insulated pipe on hanger shield with length specified for pipe size and insulation thickness to prevent puncture or other damage.
 3. Contractor's Option: Provide pre-engineered thermal hanger inserts for piping insulated with flexible elastomeric insulation at pipe supports for piping 2-1/2 inches and larger.
 4. Contractor's Option: Provide strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts.
- O. Strut Framing Systems: Channel strut systems can be used at the Contractors option in lieu of individual hangers for horizontal pipes. Arrange for grouping of parallel runs of horizontal piping. Space channel strut systems at the required distance for the smallest pipe supported. Provide channel gauge and hanger rods per the manufacturer's recommendations for the piping supported. Where strut systems are attached to walls, install anchor bolts per manufacturer's recommendations.
1. Uninsulated Copper Pipe: Install with plastic galvanic isolators
 2. Insulated Tube or Pipe: Install with 360 degree insulation protection shields or pre-engineered thermal hanger-shield inserts as specified in Division 22 Section "Plumbing Insulation".
- P. Vertical Piping Risers:
1. Reference Section "Vibration Isolation for Plumbing Piping and Equipment" for piping riser supports.
- Q. Wire Rope Hanging Systems:
1. Install in accordance with manufacturer's instructions.
 2. Supported load shall not exceed manufacturer's recommended load rating.
 3. Applications for Pipe Supports:
 - a. 3 inch and smaller.
 - b. Wire rope hanging system is not allowed for steam or steam condensate piping.
 4. Do not support pipe by wrapping the rope around the pipe.
 5. Provide appropriate hanger or support compatible with the wire rope hanging system adjustable fastener as specified in Division 22 piping sections.
 6. Install cast-in-place concrete inserts in elevated concrete slabs.
 7. Install bream clamps for attachment to structural beams as required.
- R. Expansion Anchors: Use in existing concrete, masonry or in pre-cast concrete construction.

3.4 INSTALLATION OF PIPE ALIGNMENT GUIDES

- A. Install pipe alignment guides on piping that adjoins expansion joints, as required by expansion joint manufacturer, and elsewhere as indicated on plans and specification sections to eliminate binding and torsional stress on piping systems. Install guides per ASME B31.9 unless noted otherwise. Install pipe insulation at guide to not interfere with movement of pipe within the guide.
- B. Install guide to accommodate 1/2 the thermal movement at the adjacent expansion joint.
- C. Anchor to building substrate.

3.5 INSTALLATION OF ANCHORS

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and with AWS Standards D1.1.
- C. Spacing: 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.

3.6 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 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. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours welded surfaces to match adjacent contours.

3.7 FIELD QUALITY CONTROL

- A. Examine support and attachment components for damage and defects.
- B. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds 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. Comply with Division 09 Section "Painting."
 - 1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- E. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.
- F. Correct deficiencies and replace damaged or defective support and attachment components.

3.8 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Provide the following acceptable hangers and supports for each type of piping system. Hangers and supports may be single type or strut-mounted:
- C. Single Hangers:
 - 1. All pipe sizes 1-1/2 inch and less:
 - a. Band hanger.
 - b. Swivel split ring.
 - c. Clevis hanger.
 - 2. Cold and Hot pipe sizes 2 to 4 inches: Clevis hanger.
 - 3. Cold and Hot pipe sizes 6 inches and greater: Roll support hanger.
 - 4. All drainage pipe sizes: Clevis hanger.
- D. Trapezes and Strut-mounted Supports:
 - 1. All pipe sizes less than 6 inches: Two-piece clamp.
 - 2. Pipe sizes 6 inches and greater: Roll support.
- E. Wall Supports:
 - 1. Pipe sizes 3 inches and less:
 - a. Two-hole strap mounted to wall.
 - b. Welded steel bracket with reinforced angle or strut.
 - 2. Pipe sizes 4 inch and greater:
 - c. U-bolt
 - d. Welded steel bracket with reinforced angle or strut.
- F. Floor Supports:

1. Pipe sizes 4 inch and less: Pipe saddle.
2. Pipe sizes 6 inch and greater: Roll support.

END OF SECTION 220529

SECTION 220553 – IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. Extent of Plumbing work to be identified as required by this Section is indicated on drawings and/or specified in other Division 22 Sections.
- B. Types of identification devices specified in this Section include the following:
 - 1. Painted Identification Materials
 - 2. Plastic Pipe Markers
 - 3. Plastic Tape
 - 4. Underground-Type Plastic Line Marker
 - 5. Valve Tags
 - 6. Valve Schedule Frames
 - 7. Engraved Plastic-Laminate Signs
 - 8. Plastic Equipment Markers
 - 9. Plasticized Tags

1.2 CODES AND STANDARDS:

- A. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.
 - 1. 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.

1.4 SPARE PARTS

- A. Furnish minimum of 5% extra stock of each plumbing identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.

1. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

PART 2 - PRODUCTS AND MATERIALS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide plumbing identification materials of one of the following:
 1. Advanced Graphic Engraving, LLC.
 2. Brady Co.
 3. Brimar Industries, Inc.
 4. Craftmark.
 5. Seton

2.2 PLUMBING IDENTIFICATION MATERIALS

- A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 22 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.3 PAINTED IDENTIFICATION MATERIALS

- A. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping and similar applications. Minimum letter height shall be 1-1/4" high letters for ductwork and 3/4" high letters for access door signs and similar operational instructions.
- B. Stencil Paint: Stencil paint shall be exterior type, oil based, alkyd enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.
- C. Identification Paint: Identification paint shall be oil based, alkyd enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ANSI A13.1 for colors.

2.4 PLASTIC PIPE MARKERS

- A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1
- B. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1
- C. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees F (52 degrees C) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.

- D. Small Pipes: For external diameters less than 6" (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).
 - 4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1-1/2".
- E. Large Pipes: For external diameters of 6" 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. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2" wide; full circle at both ends of pipe marker, tape lapped 3".
 - 3. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.
- F. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.
- G. 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.
- H. Lettering: Comply with piping system nomenclature as specified, scheduled, or shown, and abbreviate only as necessary for each application length.

2.5 PLASTIC TAPE

- A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.
- B. Width: Provide 1-1/2" wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6", 2-1/2" wide tape for larger pipes.
- C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.6 UNDERGROUND-TYPE PLASTIC LINE MARKER

- A. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates the type of service of buried pipe.
 - 1. Provide multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

2.7 VALVE TAGS

- A. Brass Valve Tags: Provide 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.
 - 1. Provide 1-1/2" diameter tags, except as otherwise indicated.
 - 2. Fill tag engraving with black enamel.
- B. Plastic Laminate Valve Tags: Provide manufacturer's standard 3/32" thick engraved plastic laminate valve tags, with piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.
 - 1. Provide 1-1/2" sq. black tags with white lettering, except as otherwise indicated.
- C. Plastic Valve Tags: Provide manufacturer's standard solid plastic valve tags with printed enamel lettering, with piping system abbreviation in approximately 3/16" high letters and sequenced valve numbers approximately 3/8" high, and with 5/32" hole for fastener.
 - 1. Provide 1-1/8" sq. white tags with black lettering.
- D. Valve Tag Fasteners: Provide 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.

2.8 CEILING TACKS

- A. Description: Steel with 3/4" diameter color coded head.
- B. Color:
 - 1. Comply with ANSI A13.1, except where another color selection is indicated.

2.9 ACCESS PANEL MARKERS

- A. Access Panel Markers: Provide manufacturer's standard 1/16" thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8" center hole to allow attachment.

2.10 VALVE SCHEDULE FRAMES

- A. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

2.11 ENGRAVED PLASTIC-LAMINATE SIGNS

- A. General: Provide engraving stock melamine plastic laminate, complying with ASTM D 709, in the sizes and thickness 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 plumbing fastening except where adhesive mounting is necessary because of substrate.

- B. Thickness: 1/16" for units up to 20 sq. in. or 8" length; 1/8" for larger units.
- C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.12 PLASTIC EQUIPMENT MARKERS

- A. General: Provide manufacturer's standard laminated plastic, color coded equipment markers. Conform to the following color code:
 - 1. Green: Cooling equipment and components.
 - 2. Yellow: Heating equipment and components.
 - 3. Yellow/Green: Combination cooling and heating equipment and components.
 - 4. Brown: Energy reclamation equipment and components.
 - 5. Blue: Equipment and components that do not meet any of the above criteria.
 - 6. For hazardous equipment, provide colors and designs recommended by ANSI A13.1.
- B. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
 - 1. Name and plan number.
 - 2. Equipment service.
 - 3. Design capacity.
 - 4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.
- C. Size: Provide 2-1/2" x 4" markers for control devices, dampers, and valves; and 4-1/2" x 6" for equipment.

2.13 PLASTICIZED TAGS

- A. General: Manufacturer's standard pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing. Tags shall be minimum 3-1/4" x 5-5/8" in size, provided with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

2.14 LETTERING AND GRAPHICS

- A. General: Coordinate names, abbreviations and other designations used in plumbing identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of plumbing systems and equipment.

1. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished plumbing spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 PIPING SYSTEM IDENTIFICATION

- A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:
 1. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.
- B. Application: Provide piping system identification for the following systems:
 1. Domestic cold water piping.
 2. Domestic hot water piping.
 3. Domestic hot water recirculating piping.
 4. Non potable water piping
 5. Sanitary and waste piping.
 6. Storm water piping.
 7. Vent piping.
 8. Insulated and non-insulated storm water piping.
- C. Location: Install pipe markers and color bands in the following locations where piping is exposed to view, concealed only by a removable ceiling system, installed in machine rooms, installed in accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
 1. Within 5 feet of each valve and control device.
 2. Within 5 feet of each branch, excluding take-offs less than 25 feet in length for fixtures; mark flow direction of each pipe at branch connection.
 3. Within 5 feet where pipes pass through walls, floors or ceilings or enter non-accessible enclosures. Provide identification on each side of wall, floor or ceiling.
 4. At access doors, manholes and similar access points which permit view of concealed piping.

5. Within 5 feet of major equipment items and other points of origination and termination.
6. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment where there are more than two piping systems or pieces of equipment.

3.3 UNDERGROUND PIPING IDENTIFICATION

- A. General: During back-filling/top-soiling of each exterior underground piping systems, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install single line marker. For tile fields and similar installations, mark only edge pipe lines of field.

3.4 VALVE IDENTIFICATION

- A. 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 and similar rough-in connections of end-use fixtures and units.
- B. List each tagged valve in valve schedule for each piping system. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect/Engineer.
 1. 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.

3.5 CEILING TACK INSTALLATION

- C. Install ceiling tacks to locate valves above lay-in panel ceilings. Locate in corner of panel closest to equipment.

3.6 PLUMBING EQUIPMENT IDENTIFICATION

- A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of plumbing 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:
 1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 2. Meters, gauges, thermometers and similar units.
 3. Pumps
 4. Heat exchangers
 5. Water heaters, tanks and pressure vessels.
 6. Strainers, water treatment systems and similar equipment.

- B. Optional Sign Types: Where lettering larger than 1" height is needed for proper identification, because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved plastic, at Installer's option.
- C. Lettering Size: Minimum 1/4" high lettering for name of unit where viewing distance is less than 2'-0", 1/2" high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.
- D. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
 - 1. Optional Use of Plasticized Tags: At Installer's option, where equipment to be identified is concealed above acoustical ceilings or similar concealment, plasticized tags may be installed within concealed space to reduce amount of text in exposed sign (outside concealment).
 - 2. Operational valves and similar minor equipment items located in non-occupied spaces (including machine rooms) may, at Installer's option, be identified by installation of plasticized tags in lieu of engraved plastic signs.

END OF SECTION 220553

SECTION 220700 – PLUMBING INSULATION

PART 1 - GENERAL REQUIREMENTS

1.1 SECTION INCLUDES

- A. Piping Insulation.
- B. Equipment Insulation.

1.2 RELATED REQUIREMENTS

- A. Division 22 Section "Hangers and Supports for Plumbing Piping," for insulation shields and high-density insulation inserts.

1.3 DEFINITIONS

- A. Cold Pipe: Piping that carries fluid with a minimum operating temperature less than 60 degrees F.
- B. Hot Pipe: Piping that carries fluid with a minimum operating temperature greater than 105 degrees F.
- C. Cold Equipment: Equipment that carries fluids with a minimum operating temperature less than 60 degrees F.
- D. Hot Equipment: Equipment that carries fluids with a minimum operating temperature greater than 105 degrees F.
- E. Exposed: Insulation that is visible from the occupied space.
- F. Exposed to Weather: Insulation that is exposed to potential damage caused by weather, including sunlight, moisture, wind, and solar radiation.
- G. Exterior: Locations outside of or within the building envelope (walls, roof, floors, etc) as defined by the architectural drawings and specifications.
- H. NAIMA: North American Insulation Manufacturers Association

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of Plumbing insulation.
 - 1. Insulation Schedule: Include product name, conductivity k-value, thickness, and furnished accessories for each service.
- B. Maintenance Data: Submit maintenance data and replacement material lists for each type of Plumbing insulation. Include this data and product data in maintenance manual.
- C. Manufacturer's Instructions: Include installation instructions for storage, handling, protection, examination, preparation, and installation of the product.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualification: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.
- B. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- C. Flame/Smoke Ratings: Provide composite plumbing insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less and smoke-developed index of 50 or less, as tested by UL 723 or ASTM E84 (NFPA 255) method.
 - 1. Exception: Exterior plumbing insulation may have flame spread index of 75 and smoke

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage; store in original wrapping.

1.7 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 - PRODUCTS

2.1 PIPING INSULATION MATERIALS

- A. Mineral Fiber (rock, slag, or glass):
 - 1. Manufacturers:
 - a. CertainTeed Corp.
 - b. Knauf Insulation
 - c. Johns Manville
 - d. Owens Corning
 - 2. Insulation: ASTM C547, Type I or II, rigid mineral fiber, pre-formed for the application.
 - a. K-value: ASTM C518 or C177, maximum 0.24 at 75 degrees F.
 - b. Minimum Service Temperature: 0 degrees F
 - c. Maximum Service Temperature: 850 degrees F for Type I, 1200 degrees F for Type II.

- d. Density: Between 3 to 6 pounds per cubic foot for Type I, between 6 to 8 pounds per cubic foot for Type II.
 - 3. Factory Applied Jacket: ASTM C1136, Type I.
 - a. All-Service Jacket (ASJ): Paper/Foil/Scrim, water vapor permeance of 0.02 perms and self-sealing lap.
 - b. Poly ASJ: Paper/Foil/Scrim with polymer coating, water vapor permeance of 0.01 perms and self-sealing lap.
 - c. Color: White.
- B. Flexible Elastomeric:
 - 1. Manufacturers:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. K-Flex USA.
 - 2. Insulation: ASTM C534, Grade I, flexible elastomeric cellular rubber insulation, pre-formed for the application.
 - a. K-value: ASTM C518 or C177, maximum 0.28 at 75 degrees F.
 - b. Minimum Service Temperature: Minus 297 degrees F
 - c. Maximum Service Temperature: 220 degrees F for Grade I, 300 degrees F for Grade II.
 - 3. Factory Applied Jacket:
 - a. Polymeric Coating: Multi-ply, polymeric blend coating, 16 mils thick, designed to prevent damage to underlying insulation from sunlight, installation, and physical abuse, with water vapor permeance of 0.03 perms. Reference Jacket requirements in Part 3 of this specification for application of this jacket.
- C. Field-Applied Jacket:
 - 1. Semi-rigid PVC: One-piece, pre-molded PVC cover conforming to ASTM D1784, including factory-furnished, pre-cut insulation blanket inserts for fittings.
 - a. Outdoor Applications: Provide minimum 30 mils thickness and UV protection.
 - b. Manufacturers:
 - 1) Johns Manville Zeston PVC Jacketing and 2000 Series Fitting Covers
 - 2) Proto Corp LoSmoke PVC Jacketing and Pro Fitting Covers.
 - 3) PIC Plastics PVC Jacketing
 - 2. Rigid Aluminum Shell: One-piece, pre-formed cover conforming to ASTM C1729 with weather-proof construction. Shell shall have the following minimum thickness based on the outer insulation diameter:

Outer Insulation	Minimum Aluminum Jacket Thickness, (in)

	Diameter (in)	Non-Rigid Insulation	Rigid Insulation
Finish			
	≤ 8	0.016	0.016
Stucco	< 12	0.020	0.016
Stucco	≤ 24	0.024	0.016

a. Banding:

- 1) For piping less than or equal to 8 inches, provide 0.020 inch thick, 3/4 inch wide aluminum bands.
- 2) For piping larger than 8 inches, provide 0.020 inch thick, 3/4 inch wide stainless steel bands.

3. Multilayer Laminate Vapor Barrier Cladding: UV-resistant multi-ply outer layer and cold weather acrylic adhesive. Provide VentureClad Plus 1579 CW, or approved equal.

a. Water Vapor Transmission: 0.0 perms per ASTM E96.

b. Puncture Resistance: Minimum 65 pounds per ASTM D1000.

D. Pipe Insulation Accessories: Provide staples, bands, wires, cement, and other appurtenances as recommended by insulation manufacturer for applications indicated.

E. Adhesives, Sealers, Mastics, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

1. Lagging Adhesive: Comply with MIL-A-3316C, Class 1, Grade A. Provide Foster 30-36, Childers CP-50AHV2, or equal.
2. Weather Barrier Breather Mastic: Permeance shall be 1.0 perms or less at 62 mils dry per ASTM E96, Procedure B. Provide Foster 46-50, Childers CP-10/11 or equal.
3. Solvent-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance 0.05 perms or less at 35 mils dry per ASTM F 1249.
4. Water-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance in accordance with ASTM C755 for insulation application. Provide Foster 30-80, Childers CP-38, or equal.

Table: Recommended Maximum Permeance of Water Vapor Retarders (Note 1)

Insulation Application	Insulation Permeability, Less than 4.0 perm-in. (Note 2)	Insulation Permeability, 4.0 or greater perm-in. (Note 2)
	Vapor Retarder perms	Vapor Retarder perms
Pipe and vessels (33 F to ambient)	0.05	0.05
Pipe and vessels (-40 F to 32 F)	0.02	0.02

Notes:

1. Water vapor permeance of the vapor retarder in perms when tested in accordance with Test Methods E96.

5. Water vapor permeability of the insulation material when tested in accordance with Test Methods E96.
- F. Insulation Diameters: Comply with ASTM C585 for inner and outer diameters of rigid thermal insulation.
- G. Pipe, Valve and Fitting Covers: Comply with ASTM C450 for fabrication of fitting covers for pipe, valves and fittings.
- H. Multilayer Laminate Vapor Barrier Cladding: UV-resistant multi-ply outer layer and cold weather acrylic adhesive. Provide VentureClad Plus 1579 CW.
 - a. Water Vapor Transmission: 0.0 perms per ASTM E96.
 - b. Puncture Resistance: Minimum 65 pounds per ASTM D1000.
- I. Pipe Insulation Accessories: Provide staples, Bands, Wires, and Cement and other appurtenances as recommended by insulation manufacturer for applications indicated.
- J. Insulation Diameters: Comply with ASTM C585 for inner and outer diameters of rigid thermal insulation.
- K. Pipe, Valve and Fitting Covers: Comply with ASTM C450 for fabrication of fitting covers for pipe, valves and fittings.
- L. High Density Insulation Billets:
 1. Cellular Glass: ASTM C552.

2.2 EQUIPMENT INSULATION MATERIALS

- A. Flexible Mineral Fiber (rock, slag, or glass):
 1. Manufacturers:
 - a. CertainTeed Corp.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 2. Insulation: ASTM C553, Type I and II or ASTM C547 Type II, flexible mineral fiber blanket.
 - a. K-value: ASTM C518 or C177, maximum 0.31 at 75 degrees F.
 - b. Minimum Service Temperature: Minus 20 degrees F
 - c. Maximum Service Temperature: 450 degrees F for ASTM C553 Types I and II, 1200 degrees F for ASTM C547 Type II.
 - d. Density: Minimum 1.5 pounds per cubic foot.
 3. Factory Applied Vapor Barrier Jacket: ASTM C1136, Type II.
 - a. All-Service Jacket (ASJ): Paper/Foil/Scrim, water vapor permeance of 0.02 perms.

- b. Color: White.
- B. Flexible Elastomeric:
 - 1. Manufacturers:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. K-Flex USA.
 - 2. Insulation: ASTM C534, Grade I or II, flexible elastomeric cellular rubber insulation, sheet form.
 - a. K-value: ASTM C518 or C177, maximum 0.28 at 75 degrees F.
 - b. Minimum Service Temperature: Minus 40 degrees F
 - c. Maximum Service Temperature: 220 degrees F for Grade I, 300 degrees F for Grade II.
- C. Field-Applied Jacket:
 - 1. Aluminum: ASTM B209, 3003 alloy, H-14 temper, with 3-mil thick polyfilm moisture barrier to interior surface.
 - a. Thickness: 0.032 inch sheet.
 - b. Finish: Smooth.
 - c. Joining: Longitudinal slip joints and 2 inch laps.
 - d. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum or 0.010 inch thick stainless steel.
 - 2. Multilayer Laminate Vapor Barrier Cladding: UV-resistant multi-ply outer layer and cold weather acrylic adhesive. Provide VentureClad Plus 1579 CW, or approved equal.
 - a. Water Vapor Transmission: 0.0 perms per ASTM E96.
 - b. Puncture Resistance: Minimum 65 pounds per ASTM D1000.
- D. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape, corner angles, anchors, stud pins, and other appurtenances as recommended by insulation manufacturer for applications indicated.
- E. Adhesives, Sealers, Mastics, and Protective Finishes: Provide cements, adhesives, coating, sealers, mastics, and protective finishes as recommended by insulation manufacturer for applications indicated.
 - 1. Mineral Fiber Lagging Adhesive: Comply with ASTM C916, Type 2 or MIL-A-3316C, Class 2, Grade A. Provide Foster 85-60, Childers CP-127, or equal water-based adhesive.
 - 2. Water-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance 0.05 perms or less at 47 mils dry per ASTM E96. Provide Foster 30-80, Childers CP-38, Design Polymerics 3040, or equal.

3. Lagging Adhesive: Comply with MIL-A-3316C, Class 1, Grade A. Provide Foster 30-36. Childers CP-50AHV2 or equal.
4. Tie Wire: Annealed steel, 16 gauge, 0.0508 inch diameter.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Test piping and ductwork for design pressure, liquid tightness, and continuity prior to applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 PROTECTION AND REPLACEMENT

- A. Provide all required protection for insulation (installed and uninstalled) throughout the duration of construction to avoid exposure to plaster, dust, dirt, paint, moisture, deterioration, and physical damage.
- B. Repair existing plumbing insulation that is damaged during this construction period. Use insulation of same type and thickness as existing insulation. Install new jacket lapping and sealed over existing.
- C. Replace damaged insulation which cannot be repaired satisfactorily at no additional expense to the Owner, including insulation with vapor barrier damage and insulation that has been exposed to moisture during shipping, storage, or installation. Drying the insulation is not acceptable. Dry surfaces prior to installation of new insulation that replaces the damaged or wet insulation.

3.3 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer's installation instructions.
- B. Install in accordance with NAIMA National Insulation Standards.

3.4 PLUMBING PIPING SYSTEM INSULATION

- A. Maintain continuous thermal and vapor-retarder integrity throughout entire installation and protect it from puncture and other damage.
- B. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.
- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
- D. Exposed Piping: Locate insulation and cover seams in least visible locations.
- E. Cold Piping Insulation:

1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
 2. Provide with factory applied vapor barrier jacket.
 3. Provide high density insulation material under supports or pre-insulated supports. Protect insulation with shields to prevent puncture or other damage. Refer to Section “Hangers and Supports for Plumbing Piping” for pre-insulated supports and insulation shields. and for exception where high density insulation inserts are not required.
 4. High density insulation material shall extend a minimum 2 inches past the pipe shield on each side.
 5. Secure all-service jacket with self-sealing longitudinal laps.
- F. Butt pipe insulation tightly at insulation joints. Apply wet coat of vapor barrier lap cement on joint and seal with 3 inch wide vapor barrier tape or band and coat all taped seams and staple penetrations with vapor barrier coating to prevent moisture infiltration.
- G. Hot Piping Insulation:
1. Insulate entire system, including fittings, valves, unions flanges, strainers, flexible connections, pump bodies, and expansion joints.
 2. Provide jackets without vapor barrier. Jackets with factory applied vapor barrier are allowed.
 3. Provide high density insulation material or pre-insulated supports where supports are installed outside of the insulation. Protect insulation with shields to prevent puncture or other damage. Refer to Section “Hangers and Supports for Plumbing Piping” for pre-insulated supports and insulation shields and for exception where high density insulation inserts are not required.
 4. High density insulation material shall extend a minimum 2 inches past the pipe shield on each side.
 5. Secure all-service jacket with self-sealing longitudinal laps.
 6. Butt pipe insulation tightly at insulation joints and wrap insulation around supports. Apply 3 inch wide vapor barrier tape or band over joint.

3.5 INSTALLATION OF PIPING INSULATION

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Maintain continuous thermal and vapor-retarder integrity throughout entire installation unless otherwise indicated.
- C. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.

- D. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
- E. Clean and dry pipe surfaces prior to insulating.
- F. Cold Pipe Insulation:
 - 1. Insulate all cold piping to prevent moisture condensation on exterior surfaces.
 - 2. Provide high density insulation material under supports or pre-insulated supports. Refer to Division 22 Section "Hangers and Supports for Plumbing Piping" for pre-insulated supports.
 - 3. Protect insulation with shields to prevent puncture or other damage. Refer to division 22 Section "Hangers and Supports for Plumbing Piping" for insulation shields.
 - 4. High density insulation material shall extend a minimum 2 inches past the pipe shield on each side.
 - 5. Butt pipe insulation tightly at insulation joints. Apply wet coat of vapor barrier lap cement on joint and seal with 3 inch wide vapor barrier tape or band and coat all taped seams and staple penetrations with vapor barrier coating to prevent moisture ingress.
- G. Hot Pipe Insulation:
 - 1. Provide pipe hangers for hot piping sized for the outside diameter of piping.
 - 2. Butt insulation to hanger or riser clamp for vertical pipe. Butt pipe insulation tightly at insulation joints. Seal exposed insulation at hanger with joint sealant.
- H. Pipe insulation:
 - 1. Insulate all cold piping to prevent moisture condensation on exterior surfaces.
 - 2. Provide high density insulation material under supports or pre-insulated supports. Refer to Division 22 Section "Hangers and Supports for Plumbing Piping" for pre-insulated supports.
 - 3. Protect insulation with shields to prevent puncture or other damage. Refer to division 22 Section "Hangers and Supports for Plumbing Piping" for insulation shields.
 - 4. High density insulation material shall extend a minimum 2 inches past the pipe shield on each side.
 - 5. Butt insulation to hanger or riser clamp for vertical pipe. Butt pipe insulation tightly at insulation joints.
 - 6. For hot pipes, apply 3" wide vapor barrier tape or band over the butt joints.
 - 7. For cold pipes, apply wet coat of vapor barrier lap cement on joint and seal with 3 inch wide vapor barrier tape or band and coat all taped seams and staple penetrations with vapor barrier coating to prevent moisture ingress.
- I. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves (except balancing and flow control valves), strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Butt tightly against adjoining pieces and bond with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves (except balancing and flow control valves), flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- J. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- K. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
- L. Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise indicated.

3.6 REPAIR

- A. Repair damaged sections of existing Plumbing insulation, both previously damaged or damaged during this construction period. Use insulation of same thickness as existing insulation, install new jacket lapping and sealed over existing.

3.7 PROTECTION AND REPLACEMENT

- A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

3.8 PIPING SYSTEM INSULATION SCHEDULE

- A. Reference Pipe Insulation Thickness Schedule at the end of this specification for thickness requirements based on insulation conductivity.
- B. Do not apply insulation to piping that operates outside of the minimum and maximum service temperature range.
- C. Omit insulation on the following:
1. Flexible connections and expansion joints in pipes with fluids above ambient temperatures.
 2. Chrome-plated exposed piping
 3. Water Hammer Arrestors

4. Balancing and flow valves
 5. Drain lines from water coolers
 6. Drainage piping located in crawl spaces or tunnels
 7. Exterior condensate drain piping
 8. Buried piping
 9. Pre-insulated equipment.
- D. Cold Piping (minimum operating temperature less than 60 degrees F.)
1. Service
 - a. Potable cold water piping.
 - b. Non-potable cold water piping
 - c. Potable chilled water piping.
 - d. Plumbing vents within 6 lineal feet of roof outlet.
 - e. Horizontal interior above-ground storm drainage piping and vertical run from roof drain to horizontal run.
 - f. Horizontal and vertical interior above-ground storm drainage piping and vertical run from roof drain to horizontal run.
 - g. Horizontal and vertical interior above-ground overflow storm drainage piping and vertical run from roof drain to horizontal run. Where vertical overflow storm drainage piping from the outlet exceeds 15 feet, only insulate within 15 feet of the outlet.
 - h. Condensate piping inside the building.
 2. Insulate each piping system specified above with one of the following types of insulation.
 - a. Mineral fiber.
- E. Hot Temperature Piping (105 degrees to 180 degrees F (40 to 82 degrees C)):
1. Service:
 - a. Hot water supply and return piping.
 2. Insulate each piping system specified above with one of the following types of insulation.
 - a. Mineral fiber.

3.9 PIPE INSULATION THICKNESS SCHEDULE

- A. P-traps:
1. Insulate P-traps receiving chilled water waste and P-traps of water coolers as described below:
 - a. Flexible Elastomeric: 1" thick for pipe sizes up to and including 2", 1-1/2" thick for pipe sizes 2" to 6" (largest size permitted).
 2. Insulate P-traps receiving hot water waste above 140F as described below:

- a. Fiberglass: 1" thickness.
- b. Flexible Elastomeric (high temp formula up to 300F): 1" thickness.

B. Piping Inside Masonry Wall Units:

- 1. Insulate cold, hot, and hot water recirculation piping installed inside of masonry walls where the piping needs to be insulated as the wall is constructed as described below:
 - a. Flexible Elastomeric: 1/2" thick for pipe sizes up to and including 2", 1" thick for pipe sizes 2-1/2" to 6" (largest size permitted).

C. IECC – 2012 Requirements, Pipe Insulation

Fluid Operating Temp. Range (°F) And Usage	Minimum Pipe Insulation Thickness						
	Insulation Conductivity		Nominal Pipe or Tube Size (in.)				
	Conductivity, Btu·in./(hr·ft ² ·°F)	Mean Rating Temp., °F.	<1	1 to <1-1/2	1-1/2 to <4	4 to <8	≥8
	Insulation Thickness, in.						
141°F–200°F	0.25–0.29	125	1.5	1.5	2.0	2.0	2.0
105°F–140°F	0.21–0.28	100	1.0	1.0	1.5	1.5	1.5
40°F–60°F	0.21–0.27	75	0.5	0.5	1.0	1.0	1.0

Notes:

- a. For piping smaller than 1-1/2 inch and located in partitions within conditioned spaces, reduction of these thicknesses by 1 inch shall be permitted (before thickness adjustment required in footnote b) but not to a thickness less than 1 inch.
- b. For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows: $T = r\{(1 + t/r)^{(K/k)} - 1\}$ where
 - 1) T = minimum insulation thickness (in.),
 - 2) r = actual outside radius of pipe (in.),
 - 3) t = insulation thickness listed in this table for applicable fluid temperature and pipe size,
 - 4) K = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu·in./hr·ft²·°F); and
 - 5) k = the upper value of the conductivity range listed in this table for the applicable fluid temperature.
- c. Insulation thicknesses are based on energy efficiency considerations only. Add insulation where noted on the drawings.
- d. The table is based on steel pipe. Non-metallic pipes schedule 80 thickness or less shall use the table values. For other non-metallic pipes having thermal resistance greater than that of steel pipe, reduced thicknesses are permitted if documentation is provided showing that the pipe with the

proposed insulation has no more heat transfer per foot than a steel pipe of the same size with the insulation thickness shown on the table.

3.10 PIPING JACKET SCHEDULE

- A. Exposed piping within mechanical rooms (below 10 feet):
 - 1. Semi-rigid PVC.
 - 2. Rigid aluminum shell.
- B. Exposed piping within mechanical rooms (above 10 feet):
 - 1. Semi-rigid PVC.
 - 2. Rigid aluminum shell.
- C. Exposed piping:
 - 1. All-service jacket.
 - 2. Poly ASJ jacket, painted with color per architect and paint per division 7.
 - 3. Semi-rigid PVC.
- D. Piping within return air plenums:
 - 1. All-service jacket.

END OF SECTION 220700

SECTION 221100 – WATER DISTRIBUTION PIPING AND SPECIALTIES

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes domestic cold water, hot water, and hot water recirculation piping, fittings, and specialties within the building to a point 5 feet outside the building.
- B. Contractors Option:
 - 1. The Division 22 contractor may provide mechanically joined plumbing piping systems to connect mechanical joints, couplings, fittings, valves, and related components as an option in lieu of, in whole or in part, copper sweat, brazing, threaded or flanged piping methods.
- C. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 22 Section "General Plumbing Requirements," for trenching and backfilling materials and methods for underground piping installations.
 - 2. Division 22 Section "Identification, for Plumbing Piping and Equipment" for labeling and identification of water distribution piping.
 - 3. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations, wall penetrations and equipment pads.
 - 4. Division 22 Section "Basic Piping Material and Methods," for materials and methods for strainers, flexible connectors, unions, dielectric unions, dielectric flanges, and mechanical sleeve seals.
 - 5. Division 22 Section "General Duty Valves for Plumbing Piping," for materials and methods for installing water distribution piping valves.
 - 6. Division 22 Section "Hangers and Supports for Plumbing Piping," for insulation shields, materials, and methods for hanging and supporting water distribution piping.
 - 7. Division 22 Section "Plumbing Insulation," for materials and methods for insulating water distribution piping.
 - 8. Division 22 Section "Sanitary Drainage and Vent Piping and Specialties," for material and methods for trap primer outlet piping.

1.2 DEFINITIONS

- A. Water Distribution Pipe: A pipe within the building or on the premises that conveys water from the water service pipe or meter to the points of usage.
- B. Water Service Pipe: The pipe from the water main or other source of potable water supply to the water distribution pipe of the building served.
- C. Pipe sizes used in this Specification are nominal pipe size (NPS).

- D. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content $\leq 0.25\%$ per Safe Drinking Water Act as amended January 4th, 2011 Section 1417.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.
 - 1. Product data for each piping specialty and valve specified.
 - 2. Welder Certificates signed by Contractor certifying that welders comply with requirements specified in Article "Quality Assurance" below.
 - 3. Certification of Compliance with ASME and UL fabrication requirements specified in Article "Quality Assurance" below.
 - 4. Test reports specified in Part 3 of this Section.
 - 5. Submit certification that specialties and fittings for domestic water distribution for drinking or cooking comply with NSF 61 Annex G and / or NSF 372. The following specialties need not comply:
 - a. Hose bibbs
 - b. Trap primers

1.4 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications."
- B. Regulatory Requirements: Comply with the provisions of the following codes:
 - 1. ASME B31.9 "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
 - 2. ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications" for Qualifications for Welding Processes and Operators.
- C. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of specialties and fittings containing no more than 0.25% lead by weight for domestic water distribution for drinking or cooking.
- D. Pipe, fittings, and specialties shall be manufactured in the United States or be certified to meet ASTM and ANSI standards.

1.5 SPARE PARTS

- A. Maintenance Stock: Furnish one valve key for each key-operated wall hydrant, hose bibb, fixture supply, or faucet installed.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flow Control Valves:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gosset, ITT
 - c. NIBCO
 2. Automatic Flow Control Valves:
 - a. Calefi
 - b. Flow Design, Inc., Autoflow Div.
 - c. Victaulic Company
 3. Hose Bibbs with Vacuum Breaker:
 - a. Chicago Faucet Co.
 - b. Eljer, A Household International Company
 - c. T & S Brass & Bronze Works, Inc.
 4. Hose Bibbs:
 - a. Lee Brass Co.
 - b. Mansfield Plumbing Products
 - c. Mifab Manufacturing, Inc.
 - d. Nibco, Inc.
 - e. Prier, Inc.
 - f. Watts Regulator Co.
 - g. Woodford Mfg. Co.
 5. Relief Valves:
 - a. Cash (A. W.) Valve Mfg. Corp.
 - b. Conbraco Industries, Inc.
 - c. Watts Regulator Co.
 - d. Zurn Industries, Inc. Wilkins Regulator Div.
 6. Piston Type Water Hammer Arresters:
 - a. Amtrol, Inc.
 - b. Josam Co.
 - c. Precision Plumbing Products, Inc.
 - d. Sioux Chief Manufacturing Co.

- e. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
 - f. Watts Regulator Co.
 - g. Zurn Industries, Inc. Wilkins Regulator Div.
- 7. Point of Use Thermostatic Mixing Valves
 - a. Acorn Engineering Co.
 - b. Cash Acme
 - c. Leonard Valve Co.
 - d. Powers Process Controls
- 8. Trap Primers and Distribution Units
 - a. Mifab Manufacturing, Inc.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief
- 9. Plumbing Pipe Support Brackets
 - a. Holdrite
 - b. PROFLO
 - c. Sioux Chief
- 10. Tube Suspension Clamps
 - a. Holdrite
 - b. PROFLO
 - c. Sioux Chief
 - d. Approved Equivalent

2.2 PIPE AND TUBE MATERIALS, GENERAL

- A. Pipe and Tube: Refer to Part 3, Articles "Above Ground Water Distribution Pipe and Fittings" or "Below Ground Water Distribution Pipe and Fittings", for identification of systems where the materials listed below are used.
- B. Copper Tube: ASTM B88, Type L Water Tube, drawn temper.
- C. Copper Tube: ASTM B88, Type K Water Tube, annealed temper.
- D. Brass Pipe: Chrome Plated Schedule 40 ASTM B43 iron pipe size (IPS.)

2.3 FITTINGS

- A. Wrought Copper Solder-Joint Fittings: ANSI B16.22, streamlined pattern.
- B. Ductile or Gray-Iron Flanged Fittings: AWWA C110 Class 125 with AWWA C116 epoxy coating inside and outside.
- C. Brass Fittings: Chrome plated ANSI B16, Class 125 with threaded connections.

- D. Bronze Flanges: ANSI B16.24, Class 150, raised ground face, bolt holes spot faced.

2.4 JOINING MATERIALS

- A. Solder Filler Metal: ASTM B32 Alloy Sb-5, 95-5 Tin-Antimony.
- B. Brazing Filler Metals: AWS A5.8, Bag-7 Silver.
- C. Gasket Material: Thickness, material, and type suitable for fluid to be handled and design temperatures and pressures.

2.5 GENERAL-DUTY VALVES

- A. General-duty valves (i.e., gate, globe, check, ball, and butterfly valves) are specified in Division 22 Section "General Duty Valves for Plumbing Piping." Special duty valves are specified below by their generic name; refer to Part 3, Article "Valve Applications" for specific uses and applications for each valve specified.

2.6 SPECIAL DUTY VALVES

- A. Flow Control Valves: 400 PSI WOG, 1 piece bronze, ball valve, with lead free cast bronze body meeting ASTM B584, handle, memory stop, with solder-end connections.
- B. Automatic Flow Control Valves: 400 PSI WOG, flow regulator, with series 300 stainless steel body, series 300 stainless steel automatic pre-set flow balancing cartridge, union connection body, and threaded-end connections.

2.7 PIPING SPECIALTIES

- A. Hose Connections: Hose connections shall have garden hose thread outlets conforming to ASME B1.20.7.
- B. Hose Bibbs: Bronze body with chrome- or nickel-plated finish, with renewable composition disc, wheel handle, 1/2- or 3/4-inch solder inlet, hose outlet.
- C. Relief Valves: Sizes for relief valves shall be in accordance with ASME Boiler and Pressure Vessel Codes for indicated capacity of the appliance for which installed.
 - 1. Combined Pressure-Temperature Relief Valves: Bronze body, test lever, thermostat, complying with ANSI Z21.22 listing requirements for temperature discharge capacity. Temperature relief valves shall be factory set at 210 deg F, and pressure relief at 150 psi.
- D. Piston Type Water Hammer Arresters: Piston type, with casing of type "L" copper tube and spun copper ends, nylon piston with two EPDM "O" rings pressure lubricated with FDA approved silicone, pressure rated for 250 psi, tested and certified in accordance with PDI Standard WH-201.
- E. Trap Primers: Brass construction, line pressure operation, capacity to prime number of traps as indicated with distribution units complying with requirements of ASSE Standard 1018.

- F. Pipe Support Brackets:
 - 1. Sheet Stud Bracket: 20 gauge copper with nominal copper tube holes of 1/2" on 2" centers and holes of 3/4" or 1" on 4" centers.
 - 2. Pipe Mounted Bracket: 20 gauge copper or plastic bracket with clamps for securing copper water tube and stainless steel hose clamp for securing bracket to vertical waste and vent pipe in wall.
 - 3. Carrier Bracket: 20 gauge copper bracket with 1" hole for supporting rough-in for flush valve copper tube and bolt slot for attaching to chair carrier.
- G. Tube Suspension Clamps
 - 1. Combination plastic supports and insulators for installing copper tube in stud walls with integral bracket for securing to stud with screws.

PART 3 - EXECUTION

1.1 INSTALLATION, GENERAL

- A. Install piping, valves and specialties in accordance with manufacturer's installation instructions.

3.2 PREPARATION FOUNDATION FOR BELOW GROUND WATER DISTRIBUTION PIPE AND FITTINGS

- A. PVC Service Pipe: Support pipe in trench with sand bags level and true to prevent sand, gravel or debris from interfering with the solvent cement process. After pressure testing is complete, gradually install bedding to prevent pipe deflection and then install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements and refer to ASTM D2321 "Underground Installation of Thermoplastic Pipe for Sewers and Gravity-flow Applications" for additional requirements.
- B. Copper Tube: Provide 6" thick sand pipe bed underneath and around sides of pipe, up to middle half of the pipe. Support pipe in trench with sand bags level and true at fittings to prevent sand, gravel or debris from interfering with the brazing process. After pressure testing is complete, install bedding at fittings and install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements.
- C. Ductile Iron Pipe: Shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand bedding. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation. For piping with rock trench bottoms, provide sand pipe bed 6" underneath and around sides of pipe up to middle half of the pipe, including fittings. After pressure testing is complete, provide first layer of pea gravel backfill 6" above pipe, tamp backfill with mechanical tamper and install bedding at fittings and install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements.

3.3 ABOVE GROUND WATER DISTRIBUTION PIPE AND FITTINGS

- A. Install Type L, drawn copper tube with wrought copper fittings and solder joints for pipe sizes 8 inches and smaller, within the building.
- B. Install chrome plated brass pipe and fittings for exposed water piping within the building where indicated on the drawings.
- C. Install ductile or gray-iron epoxy coated fittings for 3" and larger at water service entrance riser and only upstream of the backflow preventer.

3.4 BELOW GROUND WATER DISTRIBUTION PIPE AND FITTINGS

- A. Install Type K, soft annealed copper tube and brazed joints for pipe sizes 2 inches and smaller, with minimum number of joints, inside and outside building.
- B. Install cement-lined ductile-iron pipe with rubber gasketed joints, inside and outside under the building, for pipe 3 inches and larger.

3.5 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.
- B. Use fittings for all changes in direction and branch connections.
- C. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- F. Install horizontal piping as high as possible allowing for proper slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- G. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
- H. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch ball valve, and short 3/4-inch threaded nipple and cap.
- I. Fire Barrier Penetrations: Where pipes pass through fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.

- J. Exterior Wall Penetrations: Seal pipe penetrations through exterior wall constructions with sleeves packing, and sealant. Refer to Division 22 Section “Basic Piping Materials and Methods” for additional information.
- K. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls with sleeves and mechanical sleeve seals. Refer to Division 22 Section “Basic Piping Materials and Methods” for additional information.

3.6 HANGERS AND SUPPORTS

- A. General: Hanger, support, insulation protection shield and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table below for maximum spacing of supports.
- B. Pipe Attachments: Install the following:
 - 1. Adjustable steel clevis hangers, MSS SP-69 Type 1, for individual horizontal runs.
 - 2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs. Provide copper coated riser clamps when in contact with copper tube.
 - 3. Insulation protection shields and high density insulation at each hanger for insulated pipe as specified in Division 22 Sections “Supports and Anchors” and “Plumbing Insulation”.
 - 4. Copper coated extension split ring pipe clamp, MSS SP-69 Type 12, for individual vertical exposed runs of copper tube 2” and smaller on walls and for securing 1-1/4” to 2” copper tube inside walls and chases for battery fixtures. Secure clamp to the copper tube.
 - a. Seal each joint with insulation and split ring pipe to maintain the insulation barrier. Refer to Section “Plumbing Insulation” for requirement for maintenance of the vapor barrier and vapor barrier seal method.
 - 5. Extension split ring pipe clamp, MSS SP-69 Type 12, for individual vertical exposed runs of stainless steel tube 2” and smaller on walls or for securing tube inside walls for connection to faucets.
 - 6. Support copper tube in chases and walls at plumbing fixtures with plastic or copper brackets secured to structure and U-bolts sized to bare on the pipe.
 - 7. Engineered strut support system may be provided, at the contractor’s option, in lieu of individual hangers for horizontal pipes as specified in Division 22 “Hangers and Supports for Plumbing Piping”. Provide two piece straps for uninsulated pipe secured to the bare pipe and provide plastic galvanic isolators for bare copper tube. Provide two piece straps and 360° insulation protection shields sized for the insulation thickness used for the pipe for all insulated pipes.
 - 8. Secure copper tube rough-in for individual fixtures with sheet stud brackets attached to the wall studs or pipe mounting brackets attached to the fixture waste & vent pipe at each plumbing fixture.
 - 9. Secure 1” and smaller copper water tubing in stud walls at stud penetrations with tube suspension clamps.

- a. Cut hole through non-supporting studs with a minimum 1/8" clearance around each uninsulated copper tube or insulated copper tube.
 - b. Seal each joint of insulation and tube suspension clamp to maintain the insulation barrier. Refer to Division 22 "Plumbing Insulation" for requirement for maintenance of the vapor barrier similar to insulation butted against insulation inserts and vapor barrier seal method.
10. Provide roll hangers for individual horizontal runs 100 feet or longer.
- C. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, this specification, and authorities having jurisdiction requirements, whichever are most stringent. Install hangers for horizontal piping with the following maximum spacing and minimum rod diameters:

Nom. Pipe Size - In.	Steel Pipe Max. Span - Ft.	Copper Tube Max. Span - Ft.	Min. Rod Dia. - In.
Up to 1-1/4	12	6	3/8
1-1/2 to 2	12	10	3/8
2-1/2 to 4	12	10	3/8
5	12	10	1/2
6	12	10	1/2
8	12	10	1/2
10 to 12	12	10	5/8
14	12	N/A	3/4
16	12	N/A	7/8

 1. Support vertical steel pipe at each floor and in intervals not to exceed 15 feet.
 2. Support vertical copper tube at each floor and in intervals not to exceed 10 feet.
- D. Support water piping within 12" of each elbow or tee and for water piping 2-1/2" and larger at each valve or strainer.
- E. Support water piping above the floor with pipe supports attached to the floor with anchor bolts where indicated on the drawings. Conform to the table above for maximum spacing of supports.

3.7 PIPE AND TUBE JOINT CONSTRUCTION

- A. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."
- B. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."
 1. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts of piping specialties before soldering and brazing.
 2. Fill the tubing and fittings during brazing with an inert gas (nitrogen or carbon dioxide) to prevent formation of scale.
 3. Heat joints to proper and uniform temperature.
- C. Threaded Joints: Conform to ASME B1.20.1, tapered pipe threads for field-cut threads. Join pipe fittings and valves as follows:

1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 2. Align threads at point of assembly.
 3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
 4. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.
 - a. Damaged Threads: Do not use pipe with corroded or damaged threads. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.
- D. Flanged Joints: Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.
- E. Joints Containing Dissimilar Metals: Provide dielectric unions for 2" and smaller and dielectric flanges for piping 2-1/2" and larger. Provide dielectric waterway fittings for 2" and smaller in concealed locations. Dielectric unions, waterway fittings and flanges are specified in Section "Basic Piping Materials and Methods".
- F. Joints at Valve Assemblies or Connections to Equipment: Provide unions downstream of shutoff valves at valve assemblies or equipment connections. Unions are not required at flanged connections. Unions are specified in Division 22 section "Basic Piping Materials and Methods".

3.8 VALVE APPLICATIONS

- A. General-Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shut-off duty: Use gate, ball, and butterfly valves.

3.9 INSTALLATION OF VALVES

- A. Sectional Valves: Install sectional valves on each branch and riser, close to main, where branch or riser serves 2 or more plumbing fixtures or equipment connections, and elsewhere as indicated. For sectional valves 2 inches and smaller, use ball valves; for sectional valves 2-1/2 inches and larger, use ball, gate or butterfly valves.
- B. Shutoff Valves: Install shutoff valves on inlet of each plumbing equipment item, on each supply to each plumbing fixture, and elsewhere as indicated. For shutoff valves 2 inches and smaller, use ball valves; for shutoff valves 2-1/2 inches and larger, use ball, gate or butterfly valves.
- C. Drain Valves: Install drain valves on each plumbing equipment item, located to drain equipment completely for service or repair. Install drain valves at the base of each riser, at low points of horizontal runs, and elsewhere as required to drain distribution piping system completely. For drain valves 2 inches and smaller, use gate or ball valves; for drain valves 2-1/2 inches and larger, use ball, gate or butterfly valves.

- D. Check Valves: Install swing check valves on discharge side of each pump and elsewhere as indicated.
- E. Hose Bibbs: Install on exposed piping where indicated with vacuum breaker.
- F. Point-of-Use Thermostatic Mixing Valve: Install valve complying with ASSE 1070 on all public lavatories and handwashing sink locations. Install valve to be accessible by maintenance staff. Set temperature limit to 110F for dual temperature faucet or 100F for single temperature faucet.”

3.10 INSTALLATION OF FLOW CONTROL VALVES

- A. Install flow control valves or automatic flow control valves in each hot water recirculating loop, and elsewhere as indicated. Install a shutoff valve and strainer upstream and a union, check valve and shutoff valve downstream of each flow control or automatic flow control valve.
- B. Set flow control valve flow rate as follows:
 - 1. Preliminary Procedures For Hot Water Return System Balancing:
 - a. Before operating the system perform these steps:
 - 1) Open valves at recirculation pump and flow control valves to full open position.
 - 2) Remove and clean all strainers.
 - 3) Check recirculation pump rotation.
 - 4) Set water heater temperature as indicated on the drawings.
 - 2. Procedures For Hot Water Return System Balancing
 - a. Refer to the drawings for required flow rate for each flow control valve.
 - b. Provide required instrumentation to obtain proper measurements. Instruments shall be properly maintained and protected against damage.
 - c. Apply instrument as recommended by the manufacturer.
 - d. Take readings with the eye at the level of the indicated value to prevent parallax.
 - e. Mark flow control valve setting with memory stop. Mark with paint or other suitable, permanent identification materials.
 - f. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.
- C. Reports: Prepare hot water return system balancing reports signed and submit to the Architect upon completion of the project. Include the following information:
 - a. Valve tag number and description of location
 - b. Valve body size
 - c. Differential pressure reading from instrument in psi

- d. Actual flow rate derived from the manufacturer's charts and tables for the valve size and measured differential pressure.

3.11 INSTALLATION OF PIPING SPECIALTIES

- A. Install backflow preventers at each connection to mechanical equipment and systems and in compliance with the plumbing code and authority having jurisdiction. Locate in same room as equipment being connected. Install air gap fitting and pipe relief outlet drain without valves to nearest floor drain.
- B. Install pressure reducing valves with inlet and outlet shutoff valves and balance cock bypass. Install pressure gauge on valve outlet.

3.12 EQUIPMENT CONNECTIONS

- A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by plumbing code.
- B. Mechanical Equipment Connections: Connect hot and cold water piping system to mechanical equipment as indicated. Provide shutoff valve and union for each connection; provide drain valve on drain connection. For connections 2-1/2 inches and larger, use flanges instead of unions.

3.13 FIELD QUALITY CONTROL

- A. Inspections: Inspect water distribution piping as follows:
 - 1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the authority having jurisdiction.
 - 2. During the progress of the installation, notify the plumbing official having jurisdiction at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
 - a. Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed in after system is roughed in and prior to setting fixtures.
 - b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.
 - c. Reinspections: Whenever the plumbing official finds that the piping system will not pass the test or inspection, make the required corrections and arrange for reinspection by the plumbing official.
 - d. Reports: Prepare inspection reports signed by the plumbing official and turn over to the Architect upon completion of the project.
- B. Factory Start-up for Master Thermostatic Mixing Valves: Provide the services of a factory-authorized service representative to test and inspect unit installation, provide start-up service, and demonstrate operation of equipment to the Owner's maintenance personnel for a minimum time of 1 hour.

1. Reports: Prepare inspection reports and required corrective action signed by the factory-authorized service representative and turn over to the Architect upon completion of the project.
- C. Piping System Test: Test water distribution systems in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:
1. Test for leaks and defects all new water distribution piping systems and parts of existing systems that have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
 2. Leave uncovered and unconcealed all new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.
 3. Cap and subject the piping system to a static water pressure of 50 psig above the operating pressure without exceeding the pressure rating of the piping system materials. Isolate the test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
 4. Repair all leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.
 5. Reports: Prepare inspection reports and required corrective action signed by the plumbing official and turn over to the Architect upon completion of the project.

3.14 ADJUSTING AND CLEANING

- A. Clean and disinfect water distribution piping as follows:
1. Purge all new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired prior to use.
 2. Use the purging and disinfecting procedure proscribed by the authority having jurisdiction or, in case a method is not prescribed by that authority, the procedure described in either AWWA C651, or AWWA C652, or as described below:
 - a. Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.
 - b. Fill the system or part thereof with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system or part thereof and allow to stand for 24 hours.
 - c. Drain the system or part thereof of the previous solution and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.
 - d. Following the allowed standing time, flush the system with clean, potable water until chlorine residual is lowered to incoming city water level.
 - e. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.
 3. Reports: Prepare disinfection reports signed by the authority having jurisdiction and turn over to the Architect upon completion of the project.

3.15 COMMISSIONING

- A. Fill the system. Check compression tanks to determine that they are not air bound and that the system is completely full of water.
- B. Before operating the system, perform these steps:
 - 1. Close drain valve, hydrants, and hose bibbs.
 - 2. Open valves to full open position.

END OF SECTION 221100

SECTION 221300 – SANITARY DRAINAGE AND VENT PIPING AND SPECIALTIES

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes building sanitary drainage and vent piping systems, including drains and drainage specialties.
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 22 Section "General Plumbing Requirements," for trenching and backfilling materials and methods for underground piping installations.
 - 2. Division 7 Section "Joint Sealants," for materials and methods for sealing pipe penetrations through basement and foundation walls, and fire and smoke barriers.
 - 3. Division 22 Section "Plumbing Identification," for labeling and identification of drainage and vent piping.
 - 4. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations, wall and floor penetrations and equipment pads
 - 5. Division 22 Section "Basic Piping Material and Methods," for materials and methods for mechanical sleeve seals.
 - 6. Division 22 Section "Hangers and Supports for Plumbing Piping," for materials and methods for hanging and supporting drainage and vent piping.
 - 7. Division 22 Section "Plumbing Insulation," for materials and methods for insulating drainage piping.
 - 8. Division 22 Section "Water Distribution Piping and Specialties," for material and methods for trap primers and trap primer inlet piping.

1.2 DEFINITIONS

- A. Sanitary Building Drain: That part of the lowest piping of a drainage system which receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building sewer.
- B. Sanitary Building Sewer: That part of the drainage system which extends from the end of the building drain and conveys its discharge to a public sewer, private sewer, individual sewage disposal system, or other point of disposal.
- C. Drainage System: Includes all the piping within a public or private premises which conveys sewage or other liquid wastes to a point of disposal. It does not include the mains of public sewer systems or a private or public sewage treatment or disposal plant.
- D. Vent System: A pipe or pipes installed to provide a flow of air to or from a drainage system, or to provide a circulation of air within such system to protect trap seals from siphonage and back pressure.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.
- B. Product data for the following products:
 - 1. Drainage piping
 - 2. Drainage piping specialties
 - 3. Floor drains
 - 4. No-hub fitting restraints
- C. Test reports specified in Part 3 of this Section.

1.4 QUALITY ASSURANCE

- A. Comply with the installation requirements for CPVC pipe and CPVC CTS tube per the Lubrizol "FlowGuard Gold and CORZAN Design and Installation Manual" and the installed manufacturer's installation manual.
- B. Regulatory Requirements: Comply with the provisions of the following codes:
 - 1. 2012 International Plumbing Code

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Drainage Piping Specialties, including backwater valves, expansion joints, cleanouts, floor drains, cast-iron trench drains and vandal-proof vent caps:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Mfg. Co.
 - c. Mifab Manufacturing Co.
 - d. Sioux Chief Manufacturing Co. Inc.
 - e. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
 - f. Watts Industries, Inc.
 - g. Zurn Industries, Inc.; Hydromechanics Div.
 - 2. Cast Iron Soil Pipe and Fittings
 - a. AB & I Foundry
 - b. Charlotte Pipe and Foundry Company
 - c. Tyler Pipe / Soil Pipe Division
 - 3. Shielded Transition Couplings

- a. FERNCO, “Proflex 3000 Series”
 - b. Mifab Manufacturing, Inc. #MI-HUB-ARC-series
 - c. Mission Rubber Company, “Band Seal Specialty Couplings”
- 4. Underground Shielded Adapter Couplings
 - a. FERNCO, “1056 Series with SR73 Shear Ring”
 - b. Mifab Manufacturing, Inc. #MI-HUB-ARC-CL-series
 - c. Mission Rubber Company, “MR56 Series”
- 5. Trap Seals
 - a. Green Drain, Inc.
 - b. Jay R. Smith Mfg. Co.
 - c. Mifab Manufacturing, Inc.
 - d. Proset Systems “Trap Guard”
 - e. Rector Seal, Inc.
 - f. Zurn Industries, Inc.; Hydromechanics Div.
- 6. Hubless Couplings:
 - a. Anaco
 - b. Ideal Tridon
 - c. Mifab Manufacturing, Inc. #MI-HUB- series
 - d. Mission Rubber Company
 - e. hTyler Pipe / Soil Pipe Division

2.2 ABOVE GROUND DRAINAGE AND VENT PIPE AND FITTINGS

- A. Refer to Part 3, Article "Pipe Applications - Above Ground, Within Building" for identification of systems where the materials listed below are used.
- B. Cast-Iron Soil Pipe: CISPI 301 and ASTM A888, no-hub pipe and fittings and bearing the trademark of CISPI and NSF.
 - 1. Couplings and compression gaskets, NSF certified: ASTM C564 and CISPI 310.
- C. Copper Tube: ASTM B306, Type DWV, hard drawn for pipe, and cast copper alloy solder joint drainage fittings (DWV) meeting ASME / ANSI B16.23.
 - 1. Solder Filler Materials: ASTM B32, 95-5 tin-antimony solder.
- D. Copper Tube: ASTM B88, Type M, hard drawn for pipe and wrought copper fittings with soldered joints.
 - 1. Solder Filler Materials: ASTM B32, 95-5 tin-antimony solder.
- E. PVC DWV Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 and ASTM D2665 with “solid wall” PVC meeting ASTM D1784 with cell class 12454-B.

1. Fittings: DWV pattern meeting ASTM D2665 with solvent cement socket joints.
 2. Solvent: ASTM D2564.
- F. PVC Pressure Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 with “solid wall” PVC meeting ASTM D1784 with cell class 12454.
1. Solvent: ASTM D2564.
 2. Fittings: Schedule 40 meeting ASTM D2466 with solvent cement socket joints.
 3. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493.
- G. Shielded Transition Couplings: ASTM C1460 with neoprene adapter gasket with stainless steel Shield and hose clamps.

2.3 UNDERGROUND BUILDING DRAIN AND VENT PIPE AND FITTINGS

- A. Refer to Part 3, Article "Pipe Applications - Below Ground, Within Building" for identification of systems where the materials listed below are used.
- B. Cast-Iron Soil Pipe: ASTM A74, Service weight, hub-and-spigot soil pipe and fittings. Pipe and fittings shall have a heavy coating of coal tar varnish or asphaltum on both inside and outside surfaces and bearing the trademark of CISPI and NSF.
1. Neoprene Compression Gaskets: ASTM C564.
- C. PVC DWV Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 and ASTM D2665 with “solid wall” PVC meeting ASTM D1784 with cell class 12454-B.
1. Fittings: DWV pattern meeting ASTM D2665 with solvent cement socket joints.
 2. Solvent: ASTM D2564.
- D. PVC Pressure Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 with “solid wall” PVC meeting ASTM D1784 with cell class 12454.
1. Solvent: ASTM D2564.
 2. Fittings: Schedule 40 meeting ASTM D2466 with solvent cement socket joints.
- E. Underground Shielded Adapter Couplings: ASTM C1173 with neoprene adapter gasket with stainless steel shield and stainless steel hose clamps.

2.4 DRAINAGE PIPING SPECIALTIES

- A. Cleanout Plugs: As specified on the drawings.
- B. Floor Cleanouts: As specified on the drawings.
- C. Wall Cleanouts: As specified on the drawings.
- D. Floor Drains: As specified on the drawings.
- E. Cast-iron Trench Drains: As specified on the drawings.

- F. Freeze-Proof Vent Caps: Construct of galvanized iron, copper, or lead-coated copper, sized to provide 1 inch air space between outside of vent pipe and inside of flashing collar extension.
- G. Vandal-Proof Vent Caps: Cast-iron body full size of vent pipe, with caulked type base connection for cast-iron pipes, threaded base for steel pipes.
- H. Trap seals: Provide trap seals meeting either description below:
 - 1. Smooth, soft, flexible, elastomeric PVC material molded into shape of duck's bill, open on top with curl closure at bottom. The flow of wastewater allows duck's bill to open and adequately discharge to floor drain through its interior. The duck's bill closes and returns to original molded shape after wastewater discharge is complete. Or, smooth, soft, flexible, elastomeric PVC material with a flapper closure. The flow of wastewater allows flapper to open and adequately discharge to floor drain through its interior. The flapper closes and returns to original molded shape after wastewater discharge is complete.

2.5 PVC DWV EXPANSION JOINTS

- A. Schedule 40 PVC DWV meeting ASTM D2665 with socket connections and telescoping expansion joint with EPDM O-ring seal.

2.6 NO-HUB FITTING RESTRAINTS

- A. Pre-engineered kits of galvanized steel pipe straps with stainless steel band clamps and tee bolts, meeting requirements of the CISPI Installation Handbook.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install pipe and specialties in accordance with manufacturer's installation instructions.

3.2 PREPARATION FOUNDATION FOR UNDERGROUND SANITARY BUILDING DRAINS

- A. Pipe Beds:
 - 1. PVC and ABS Pipe: Support pipe in trench with sand bags level and true to prevent sand, gravel or debris from interfering with the solvent cement process. After pressure testing is complete, gradually install bedding to maintain continuous pipe slope and prevent pipe deflection and then install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements and refer to ASTM D2321 "Underground Installation of Thermoplastic Pipe for Sewers and Gravity-flow Applications" for additional requirements.
 - 2. Cast Iron Soil Pipe: Shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand bedding. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to

ensure continuous bearing of the pipe barrel on the foundation and maintain continuous pipe slope. For piping with rock trench bottoms, provide sand pipe bed 6" underneath and around sides of pipe, including fittings. After pressure testing is complete, install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements.

3.3 PIPE APPLICATIONS - ABOVE GROUND, WITHIN BUILDING

- A. Install hubless, cast-iron soil pipe and fittings for 15" and smaller soil, waste, and vent pipe.
- B. Install Type DWV copper tube with cast copper alloy solder joint drainage fittings (DWV) fittings, copper sweat X screwed with solder joints, for waste connections from urinals, lavatories, sinks, water coolers, and kitchen equipment to cast iron drainage piping.
- C. Install Type M copper tube with wrought copper fittings with solder joints, 1" and smaller, with 3/4" minimum size and install Type DWV copper tube with cast copper alloy solder joint drainage fittings (DWV) fittings for 1-1/4" and larger for waste connections from kitchen equipment and terminate over floor receptors with air gap.
- D. Condensate drain piping and pumped condensate drain piping inside the building: Provide 3/4" minimum size or as indicated on the drawings. Slope gravity drainage condensate piping from mechanical equipment at 1/8" per foot minimum slope. Discharge to floor receptor with air gap.
 - 1. Install galvanized schedule 40 steel pipe and malleable iron fittings.
 - 2. Install Type M copper tube with wrought copper fittings with solder joints, 1" and smaller and install Type DWV copper tube with cast copper alloy solder joint drainage fittings (DWV) fittings for 1-1/4" and larger. Provide galvanic isolators as specified in Division 22 "*Basic Piping Materials and Methods*".
 - 3. Install PVC pressure pipe and fittings for 1" and smaller and install "solid wall" PVC Type DWV pipe and fittings for 1-1/4" and larger. Except no plastic pipe shall be installed in return air plenums.
 - 4. Install CPVC CTS pipe and fittings, 2" and smaller.
- E. Condensate drain piping outside the building: Provide 3/4" minimum size or as indicated on the drawings. Slope condensate piping at 1/8" per foot minimum slope to discharge point. Discharge to roof receptors or roof drains with air gap.
 - 1. Install galvanized schedule 40 steel pipe and malleable iron fittings.
 - 2. Install Type M copper tube with wrought copper fittings with solder joints, 1" and smaller, and install Type DWV copper tube with cast copper alloy solder joint drainage fittings (DWV) fittings for 1-1/4" and larger. Provide galvanic isolators as specified in Division 22 "*Basic Piping Material and Methods*".
 - 3. Install PVC pressure pipe and fittings for 1" and smaller and install "solid wall" PVC Type DWV pipe and fittings for 1-1/4" and larger.
- F. As a contractor's option with Owner approval, install PVC Type DWV Plastic pipe and fittings for drainage and vent pipe, except install no plastic pipe in return air plenums.

- G. Install PVC pressure pipe and fittings for sump pump discharge, except install no plastic pipe in return air plenums.
- H. Install 1/2" type L copper tube for trap primer outlet piping.

3.4 PIPE APPLICATIONS - BELOW GROUND, WITHIN BUILDING

- A. Install hub-and-spigot, service weight, cast-iron, soil pipe and fittings with gasketed joints for 15 inch and smaller for soil, waste, and vent pipe.
- B. As a contractor's option with Owner approval, install PVC Type DWV Plastic pipe and fittings for drainage and vent pipe for 24" and smaller. Install fabricated fittings for 16 inch and larger.
- C. Install type "K" soft copper tube with wrought copper fittings with solder joints for sump pump discharge pipe, 2" and smaller.
- D. Install 1/2" type K soft copper tube for trap primer outlet piping.

3.5 PIPE AND TUBE JOINT CONSTRUCTION

- A. Copper Tubing: Solder joints in accordance with the procedures specified in AWS "Soldering Manual."
- B. Cast-Iron Soil Pipe: Make hubless joints in accordance with the Cast-Iron Soil Pipe & Fittings Handbook, Chapter IV. Install Couplings as followings:
 - 1. Install hubless couplings complying with CISPI 310 on soil, waste and vent piping.
 - 2. Install hubless couplings complying with CISPI 310 on soil and waste piping 3" and smaller and all vent piping.
 - 3. Install heavy duty hubless couplings on soil or waste stacks, soil and waste piping connections to soil or waste stacks and all soil and waste piping 4" and larger.
 - 4. Install No-Hub fitting restraints on joints 5" and larger at:
 - a. Changes of direction from vertical to horizontal
 - b. 4" branch connections, including tees, wyes and wye combination fittings to soil and waste piping 5" and larger
 - c. Horizontal changes of direction 22-1/2 degrees and greater
 - d. Changes in diameter of two pipe sizes or greater.
- C. PVC DWV Pipe: Joining and installation of PVC drainage pipe and fittings shall conform to ASTM D2665.
- D. ABS to PVC Transition Joints: When joining ABS to PVC components (such as an ABS building drain to PVC sewer pipe) make joints using solvent cements conforming to ASTM D3138.
- E. Cast Iron to PVC Above Grade: Join cast iron to PVC with shielded transition couplings.

3.6 INSTALLATION

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing, slope, expansion, and other design considerations. So far as practical, install piping as indicated.
- B. Use fittings for all changes in direction and all branch connections.
- C. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- F. Install horizontal piping as high as possible allowing for proper slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- G. Paint exposed copper drain lines serving kitchen equipment with a minimum of two coats of chromium-based paint.
- H. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and sealer. Refer to Division 22 Section " Basic Piping Material and Methods" for special sealers and materials.
- I. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls using sleeves and mechanical sleeve sealers. Refer to Division 22 Section "Basic Piping Material and Methods" for additional information.
- J. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings and floors, maintain the fire rated integrity. Refer to Division 22 Section " Basic Piping Material and Methods" for special sealers and materials.
- K. Foundation Penetrations: Where pipes pass through foundation walls above strip footings or under strip footings, protect pipes from building load with cast iron soil pipe sleeves two pipe sizes larger than the pipe. Sleeves installed under the strip footing shall be encased in concrete.
- L. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of Non-Fire Rated Walls and Concrete Slab on Grade Penetrations: Provide sleeves and seal pipes that pass through waterproof floors, non-fire rated walls, partitions and ceilings or concrete slab on grade. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.

- M. Make changes in direction for drainage and vent piping using appropriate 45 degree wyes, combination wye and eighth bend, or long sweep, quarter, sixth, eighth, or sixteenth bends. Sanitary tees or quarter bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical, except use long-turn pattern combination wye and eighth bends where two fixtures are installed back to back and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. Double wyes or double wye combinations shall not be used in the horizontal. No change in direction of flow greater than 90 degrees shall be made. Where different sizes of drainage pipes and fittings are connected, use proper sized standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.
- N. Install underground building drains to conform with the plumbing code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.
- O. Install drainage piping pitched down at a minimum slope of 1/4 inch per foot (2 percent) for piping 3 inch and smaller, and 1/8 inch per foot (1 percent) for piping 4 inch and larger. Install vent piping pitched to drain back by gravity to the sanitary drainage piping system.
- P. Install condensate drains pitched down at a minimum slope of 1 to 10 for piping 3 inches and smaller.
- Q. Extend building drain to connect to service piping, of size and in location indicated for service entrance to building. Sewer service piping is specified in a separate section of Division 2.

3.7 HANGERS AND SUPPORTS

- A. General: Hanger, support, insulation protection shields, and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table below for maximum spacing of supports.
- B. Install the following pipe attachments:
 - 1. Adjustable clevis hangers, MSS SP-69 Type 1, for individual horizontal runs.
 - 2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs.
 - 3. Insulation protection shields and high density insulation at each hanger for insulated pipe as specified in Division 22 Sections "Hangers and Supports for Plumbing Piping" and "Plumbing Insulation".
 - a. Install high density insulation on insulated pipe.
 - 4. Provide vinyl coated hangers and riser clamps for use with PVC pipe and CPVC CTS tube.
- 1. Provide roll hangers for individual horizontal runs 100 feet or longer.

2. Provide ceiling flanges attached to the floor, all thread rod and split ring pipe clamps for indirect drains and condensate drains supported from the floor 2" and smaller.

- C. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, this specification, and authorities having jurisdiction requirements, whichever are most stringent. Install hangers for horizontal piping with the following maximum spacing and minimum rod diameters:

Nom. Pipe	Steel Pipe Size – In.	Copper Tube Max. Span – Ft.	Min. Rod Max. Span – Ft.	Dia. - In.
	Up to 1-1/4	12	6	3/8
	1-1/2 to 2	12	10	3/8
	2-1/2 to 4	12	10	3/8
	5	12	10	1/2
	6	12	10	1/2
	8	12	10	1/2
	10 to 12	12	10	5/8
	14 to 15	12	N/A	3/4

Nom. Pipe Size In Inches.	CTS CPVC Tube Max. Span - Ft.	CPVC Tube Min. Rod Dia. - In.
1/2	3	3/8
3/4	3	3/8
1	3	3/8
1-1/4	4	3/8
1-1/2	4	3/8
2	4	3/8

1. Support all sizes of horizontal cast iron piping every five feet, except up to ten feet where ten foot sections are installed. Support all sizes of hubless horizontal cast iron piping every other joint, unless over four feet, then support each joint. Provide support adjacent to joint, not to exceed 18". Provide support at each horizontal branch.
2. Support all sizes of vertical cast iron piping every ten feet.
3. Support all sizes of horizontal of PVC piping every four feet.
4. Support piping within 12" of each elbow or tee.
5. Support each P-trap.

3.8 INSTALLATION OF PIPING SPECIALTIES

- A. Install backwater valves in sanitary building drain piping as indicated, and as required by the plumbing code. For interior installation, provide cleanout cover flush to floor centered over backwater valve cover and of adequate size to remove valve cover for service.
- B. Provide PVC DWV expansion joints every 30' on straight vertical PVC waste or sanitary stacks receiving hot water waste. Install expansion joint at middle travel for equal expansion and contraction travel. Provide riser clamps within 18" of each end of expansion joint. Install expansion joint per manufacturer's installation instructions.

- C. Above Ground Cleanouts: Install in above ground piping and building drain piping as indicated, and:
 - 1. as required by plumbing code;
 - 2. at each change in direction of piping greater than 45 degrees;
 - 3. at minimum intervals of 50' for piping 4" and smaller and 100' for larger piping;
 - 4. at base of each vertical soil and waste stack.
- D. Cleanout Covers: Install floor and wall cleanout covers for concealed piping, types as indicated.
- E. Floor Cleanouts: Install in below floor building drain piping as indicated, and:
 - 1. as required by plumbing code;
 - 2. at each change in direction of piping greater than 45 degrees;
 - 3. Install in below floor building drain piping at minimum intervals of 50' for piping 4" and smaller and 75' for larger piping;
 - 4. Install floor cleanouts in waterproof floors with waterproof membrane securely flashed with cleanout body flashing clamp so that no leakage occurs between cleanout body and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.
- F. Exterior Cleanouts: Install exterior cleanouts embedded in a 18" x 18" x 8" block of concrete, flush with finished grade.
- G. Frost-Proof Vent Caps: Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1 inch clearance between vent pipe and roof substrate.

3.9 INSTALLATION OF FLOOR DRAINS AND FLOOR SINKS

- A. Install floor drains, floor sinks, shower linear trench drains and floor troughs in locations indicated.
- B. Install floor drains, trench drains and shower linear trench drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor. Set floor sinks and floor troughs flush with the level finish floor.
- C. Refer to architectural documents for floor slope requirements and set floor drain elevation to match. Where architectural documents do not indicate the requirements, set the floor drain elevation depressed below the finished slab elevation as listed below to provide proper slope to drain:

<u>DEPRESSION IN INCHES</u>	<u>RADIUS OF AREA DRAINED - FEET</u>
1/2	5
3/4	10
1	15
1-1/4	20
1-1/2	25

- D. Provide P-traps for drains connected to the sanitary sewer.

- E. Install floor drains and floor sinks in waterproof floors with waterproof membrane securely flashed with drain flashing clamp so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.
- F. Position drains so that they are level, accessible and easy to maintain.

3.10 INSTALLATION OF TRAP PRIMERS

- A. Install trap primer outlet piping with 1/32" per foot slope towards drain trap where possible.
- B. Connect trap primer outlet piping only to factory installed taps on the drain body or P-trap assembly or provide an auxiliary inlet fitting with factory installed trap primer tap.
- C. Install trap primer outlet piping in elevated slabs or slabs on grade below concrete reinforcing bars. Wrap with 1/2" thick flexible unicellular insulation, attach to the reinforcing bars with plastic ties and spacers every five feet to eliminate galvanic corrosion. Refer to Division 22 Section "Plumbing Insulation" for flexible unicellular insulation.
- D. Where proper trap primer outlet piping slope can be maintained and the trap primer outlet line would not be subject to freezing, trap primer outlet lines may be installed as follows:
 - 1. Install below elevated floor slabs.
 - 2. Install in the sub grade of slab on grade.
- E. Install sleeves and caulk at penetrations through building floor for watertight installation. In an elevated floor slab installation, bracket the piping to bottom of floor once the slab is poured.
- F. Refer to Division 22 Section "Water Distribution Piping and Specialties" for trap primer and trap primer inlet pipe requirements.

3.11 INSTALLATION TRAP SEALS:

- A. Install trap seals in accordance with manufacturer's written instructions and in locations indicated.
- B. Make watertight seal using an adhesive type caulk along bottom of trap seal, if required by the manufacturer.
- C. Employ a test plug for testing and remove before normal floor drain use. Clean inside of drain tailpiece and install trap seal after testing.
- D. Do not touch elastomeric plug or allow contact with primer or solvent cement.

3.12 CONNECTIONS

- A. Piping Runouts to Fixtures: Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated; but in no case smaller than required by the plumbing code.
- B. Locate piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

3.13 FIELD QUALITY CONTROL

A. Inspections

1. Do not enclose, cover, or put into operation drainage and vent piping system until it has been inspected and approved by the authority having jurisdiction.
2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
 - a. Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.
 - b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to insure compliance with the requirements of the plumbing code.
 - c. Reinspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for reinspected by the plumbing official.
 - d. Reports: Prepare inspection reports, signed by the plumbing official.

B. Piping System Test: Test drainage and vent system in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:

1. Test for leaks and defects all new drainage and vent piping systems and parts of existing systems, which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
2. Leave uncovered and unconcealed all new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose all such work for testing, that has been covered or concealed before it has been tested and approved.
3. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open jointed drain tile, test the piping of plumbing drainage and venting systems upon completion of the rough piping installation. Tightly close all openings in the piping system, and fill with water to the point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before the inspection starts, through completion of the inspection. Inspect all joints for leaks.
4. Final Plumbing Test Procedure: After the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gas and water-tight. Tightly close all openings, initially except vents thru the roof, in the system and fill the system with smoke from one or more smoke machines designed for smoke testing of plumbing systems. When smoke appears at a vent thru the roof, seal the vent thru roof with a test plug. Pressurize the system with 1" water column of smoke for 15 minutes. Use a "U" tube or manometer inserted in the trap of a water closet to measure this pressure. Visually verify all joints for leaks.
5. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.

6. Reports: Prepare inspection reports and required corrective action signed by the plumbing official and turn over to the Architect upon completion of the project.

3.14 ADJUSTING AND CLEANING

- A. Clean interior of piping system. Remove dirt and debris as work progresses.
- B. Clean drain strainers, domes, and traps. Remove dirt and debris.

3.15 PROTECTION

- A. Protect drains during remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.
- C. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with 2 coats of a water based latex paint.

END OF SECTION 221300

SECTION 224000 – PLUMBING FIXTURES

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes plumbing fixtures and trim, fittings, and accessories, appliances, appurtenances, equipment, and supports associated with plumbing fixtures.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 7 Section "Joint Sealants," for materials and methods for sealing between plumbing fixtures and interior walls.
 - 2. Division 22 Section "General Duty Valves for Plumbing Piping" for valves used as supply stops.
- C. Products furnished but not installed under this Section include:
 - 1. Plumbing fittings (including faucets) and piping indicated, for fixtures, appliances, appurtenances, and equipment provided by Owner.
 - 2. Plumbing fittings (including faucets) and piping indicated, for fixtures, appliances, appurtenances, and equipment specified in other Sections.
- D. Products installed but not furnished under this Section include:
 - 1. Owner furnished fixtures, as indicated.
 - 2. Accessories, appliances, appurtenances, and equipment specified in other Sections, requiring plumbing services or fixture-related devices, as indicated.

1.2 DEFINITIONS

- A. Accessible: Describes a plumbing fixture, building, facility, or portion thereof that can be approached, entered, and used by physically handicapped people.
- B. Accessory: Device that adds effectiveness, convenience, or improved appearance to a fixture but is not essential to its operation.
- C. Appliance: Device or machine designed and intended to perform a specific function.
- D. Appurtenance: Device or assembly designed to perform some useful function when attached to or used with a fixture.
- E. Equipment: Device used with plumbing fixtures or plumbing systems to perform a certain function for plumbing fixtures but that is not part of the fixture.
- F. Fitting: Fitting installed on or attached to a fixture to control the flow of water into or out of the fixture.
- G. Fixture: Installed receptor connected to the water distribution system, that receives and makes available potable water and discharges the used liquid or liquid-borne wastes directly or indirectly into the drainage system. The term "Fixture" means the actual receptor, except when used in a general application where terms "Fixture" and "Plumbing

Fixture" include associated trim, fittings, accessories, appliances, appurtenances, support, and equipment.

- H. Roughing-In: Installation of piping and support for the fixture prior to the actual installation of the fixture.
- I. Support: Device normally concealed in building construction, for supporting and securing plumbing fixtures to walls and structural members. Supports for urinals, lavatories, and sinks are made in types suitable for fixture construction and the mounting required. Categories of supports are:
 - 1. Carrier: Floor-mounted support for wall-mounted water closet, and support fixed to wall construction for wall-hung fixture.
 - 2. Chair Carrier: Support for wall-hung fixture, having steel pipe uprights that transfer weight to the floor.
 - 3. Chair Carrier, Heavy Duty: Support for wall-hung fixture, having rectangular steel uprights that transfer weight to the floor.
 - 4. Reinforcement: Wood blocking or steel plate built into wall construction, for securing fixture to wall.
- J. Trim: Hardware and miscellaneous parts, specific to a fixture and normally supplied with it required to complete fixture assembly and installation.
- K. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content $\leq 0.25\%$ per Safe Drinking Water Act as amended January 4th 2011 Section 1417.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
 - 1. Product data for each type of plumbing fixture specified, including fixture and trim, fittings, accessories, appliances, appurtenances, equipment, supports, construction details, dimensions of components, and finishes.
 - 2. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."
 - 3. Warranty coverage and period for each plumbing fixture.
- B. Submit third party certification that faucets and trim for domestic water distribution for drinking or cooking comply with NSF 61 Annex G and / or NSF 372. The following faucets and trim need not comply:
 - 1. Electronic faucets
 - 2. Service sink faucets
 - 3. Flush valves
 - 4. Shower valves and heads

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements of ICC Standard A117.1, "Accessible and Usable Buildings and Facilities," and "2010 ADA Standards for Accessible Design" with respect to plumbing fixtures for individuals with disabilities.
- B. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.
 - 1. The terms "listed" and "labeled" shall be as defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- C. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of faucets and trim containing no more than 0.25% lead by weight for domestic water distribution for drinking or cooking.
- D. Design Concept: The drawings indicate types of plumbing fixtures and are based on the specific descriptions, manufacturers, models, and numbers indicated. Plumbing fixtures having equal performance characteristics by other manufacturers may be considered provided that deviations in dimensions, operation, color or finish, or other characteristics are minor and do not change the design concept or intended performance as judged by the Architect. Burden of proof for equality of plumbing fixtures is on the proposer.

1.5 SPARE PARTS

- A. Deliver spare parts to Owner. Furnish spare parts described below matching products installed, packaged with protective covering for storage, and identified with labels clearly describing contents.
- B. Faucet Washers and O-rings: Furnish quantity of identical units not less than 10 percent of amount of each installed.
- C. Faucet Cartridges and O-rings: Furnish quantity of identical units not less than 5 percent of amount of each installed.
- D. Flushometer Repair Kits: Furnish quantity of identical units not less than 10 percent of amount of each flushometer installed.
- E. Provide individual metal boxes or a hinged-top wood or metal box having separate compartments for each type and size of above extra materials.
- F. Water Closet Tank Repair Kits: Furnish quantity of identical flush valve units not less than 5 percent of amount of each type installed.
- G. Toilet Seats: Furnish quantity of identical units not less than 5 percent of amount of each type toilet seat installed.
- H. Filter Cartridges: Furnish quantity of identical filter cartridges not less than 50 percent of amount of each type and size installed.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products in each category, by one of the following listed for that category:
1. Water Closets:
 - a. American Standard, Inc.
 - b. Kohler Co.
 - c. Sloan Valve Co.
 - d. TOTO KIKI USA, Inc.
 - e. Zurn Plumbing Products Group
 2. Urinals:
 - a. American Standard, Inc.
 - b. Kohler Co.
 - c. Sloan Valve Co.
 - d. TOTO KIKI USA, Inc.
 - e. Zurn Plumbing Products Group
 3. Lavatories:
 - a. American Standard, Inc.
 - b. Just Manufacturing Co.
 - c. Kohler Co.
 - d. Sloan Valve Co.
 - e. TOTO KIKI USA, Inc.
 - f. Zurn Plumbing Products Group
 4. Sinks:
 - a. American Standard, Inc.
 - b. Elkay Manufacturing Co.
 - c. Franke
 - d. Just Manufacturing Co.
 - e. Kohler Co.
 5. Service Sinks:
 - a. Acorn Engineering Co.
 - b. American Standard, Inc.
 - c. Elkay Manufacturing Co.
 - d. Just Manufacturing Co.

- e. Kohler Co.
- 6. Mop Basins:
 - a. Acorn Engineering Co.
 - b. Fiat Products.
 - c. Florestone Products Co., Inc.
 - d. Stern-Williams Co., Inc.
- 7. Toilet Seats:
 - a. Bemis Mfg. Co.
 - b. Beneke Div.; Sanderson Plumbing Products, Inc.
 - c. Church Seat Co.
 - d. Kohler Co.
 - e. Olsonite Corp.
 - f. Sperzel Industries, Inc.
- 8. Flushometers – Diaphragm Type:
 - a. Coyne & Delany Co.
 - b. Sloan Valve Co.
 - c. Zurn Industries, Inc.; Flush Valve Operations.
- 9. Flushometers – Piston Type:
 - a. American Standard, Inc
 - b. Kohler Co.
 - c. Sloan Valve Co.
 - d. Toto Kikki, USA
 - e. Zurn Industries, Inc.; Flush Valve Operations.
- 10. Stop Valves & Supplies:
 - a. Brass Craft Subsidiary; Masco Co.
 - b. Chicago Faucet Co.
 - c. Engineered Brass Company
 - d. Kohler Co.
 - e. McGuire Manufacturing Co., Inc.
 - f. Royal Brass Mfg. Co.
 - g. T & S Brass and Bronze Works, Inc.
 - h. Watts Brass and Tubular
 - i. Zurn Industries
- 11. P-traps, Drains & Miscellaneous Fittings:
 - a. Brass Craft Subsidiary; Masco Co.

- b. Dearborn Brass
 - c. Engineered Brass Company
 - d. Franke
 - e. McGuire Manufacturing Co., Inc.
 - f. Watts Brass and Tubular
 - g. Zurn Industries
- 12. Supports:
 - a. Josam Co.
 - b. Smith (Jay R.) Mfg. Co.
 - c. Wade Div.; Tyler Pipe.
 - d. Watts Drainage Products
 - e. Zurn Industries, Inc.; Hydromechanics Div.
 - f. Mifab Manufacturing, Inc.
- 13. Insulation Kits
 - a. Brocar
 - b. McGuire
 - c. Plumberex
 - d. Trap-Wrap
 - e. Truebro, Inc.

2.2 PLUMBING FIXTURES, GENERAL

- A. Provide plumbing fixtures and trim, fittings, other components, and supports as specified on the drawings and below:

2.3 FAUCETS

- A. Faucets General: As described on the drawings.

2.4 STOP VALVES & SUPPLIES

- A. Supplies General: As described on the drawings.
 - 1. Exposed piping and parts shall be polished chrome plated.

2.5 P-TRAPS, DRAINS AND MISCELLANEOUS FITTINGS:

- A. Fittings General: As described on the drawings, except as listed below.
 - 1. Exposed piping and fittings shall be polished chrome plated.
 - 2. Fittings installed concealed inside a plumbing fixture or within wall construction may be without chrome plate finish.
 - 3. Fitting and faucet bodies for domestic water distribution shall be of lead free brass or lead free cast bronze.

- B. Sink Continuous Wastes: Polished chrome-plated, tubular brass, 1-1/2 inches, 17 gauge, with brass nuts on slip inlets, and of configurations indicated.
- C. Escutcheons: Wall flange with set screw.
- D. Escutcheons: Polished chrome-plated, sheet steel wall flange with friction clips.
- E. Deep Pattern Escutcheons: Wall flange with set screw or sheet steel wall flange with friction clips, of depth adequate to conceal protruding roughing-in fittings.

2.6 FLUSHOMETERS

- A. Provide flushometers compatible with fixtures, with features and of consumption indicated As described on the drawings.
 - 1. Exposed metal parts shall be polished chrome plated.
 - 2. Flush valves installed within wall construction may be without chrome plate finish.

2.7 TOILET SEATS

- A. General: As described on the drawings.

2.8 PLUMBING FIXTURE SUPPORTS

- A. Supports: ASME A112.6.1M, categories and types as required for wall-hanging fixtures specified, and wall reinforcement.
- B. Support categories are:
 - 1. Carriers: Supports for wall-hanging water closets and fixtures supported from wall construction. Water closet carriers shall have an additional faceplate and coupling when used for wide pipe spaces. Provide tiling frame or setting gauge with carriers for wall-hanging water closets.
 - 2. Chair Carriers: Supports with steel pipe uprights for wall-hanging fixtures. Urinal chair carriers shall have bearing plates.
 - 3. Chair Carriers, Heavy Duty: Supports with rectangular steel uprights for wall-hanging fixtures.
 - 4. Reinforcement: 2-inch by 4-inch wood blocking between studs or 1/4-inch by 6-inch steel plates attached to studs, in wall construction, to secure floor-mounted and special fixtures to wall.
- C. Support Types: Provide support of category specified, of type having features required to match fixture.
- D. Provide supports specified as part of fixture description, in lieu of category and type requirements above.

2.9 INSULATION KITS

- A. Insulation kits for lavatory and sink waste and supplies of vinyl plastic with reusable fasteners and openings for access to supply stop handles.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install fixtures, trim and supports in accordance with manufacturer's installation instructions.

3.2 APPLICATION

- A. Install plumbing fixtures and specified components, in accordance with designations and locations indicated on Drawings.
- B. Install supports for plumbing fixtures in accordance with categories indicated, and of type required:
 - 1. Carriers for following fixtures:
 - a. Wall-hanging water closets.
 - b. Wall hanging lavatories
 - c. Wall-hanging fixtures supported from wall construction.
 - 2. Chair carriers for the following fixtures:
 - a. Wall-hanging urinals.
 - b. Wall-hanging lavatories and sinks.
 - 3. Heavy-duty chair carriers for the following fixtures:
 - a. Accessible lavatories.
 - b. Fixtures where specified.
 - 4. Reinforcement for the following fixtures:
 - a. Floor-mounted lavatories required to be secured to wall.
 - b. Floor-mounted sinks required to be secured to wall.
 - c. Recessed, box-mounted electric water coolers.
 - d. Wall mounted and mop sink faucets.
 - e. Urinal flush valve solid pipe ring supports.

3.3 INSTALLATION OF PLUMBING FIXTURES

- A. Install plumbing fixtures level and plumb, in accordance with fixture manufacturers' written installation instructions, roughing-in drawings, and referenced standards.
- B. Install wall-hanging, back-outlet water closets with support manufacturer's tiling frame or setting gauge.
- C. Install wall-hanging, back-outlet urinals with gasket seals.
- D. Fasten wall-hanging plumbing fixtures securely to supports attached to building substrate when supports are specified, and to building wall construction where no support is indicated.

- E. Fasten floor-mounted fixtures and special fixtures having holes for securing fixture to wall construction, to reinforcement built into walls.
- F. Fasten wall-mounted fittings to reinforcement built into walls.
- G. Fasten counter-mounting-type plumbing fixtures to casework.
- H. Secure supplies behind wall or within wall pipe space, providing rigid installation.
- I. Set mop basins in leveling bed of cement grout.
- J. Install stop valve in an accessible location in each water supply to each fixture.
- K. Install trap on fixture outlet except for fixtures having integral trap.
- L. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork. Use deep pattern escutcheons where required to conceal protruding pipe fittings.
- M. Seal fixtures to walls, floors, and counters using a sanitary-type, one-part, mildew-resistant, silicone sealant in accordance with sealing requirements specified in Division 7 Section "Joint Sealers." Match sealant color to fixture color.
- N. Install insulation kits on ADA compliant sink and lavatory waste, continuous wastes, hot and cold water supplies where indicated on the drawings and as required by the ADA.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other sections of Division 22. The Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
 - 1. Install piping connections between plumbing fixtures and piping systems and plumbing equipment specified in other sections of Division 22.
 - 2. Install piping connections indicated between appliances and equipment specified in other sections, direct connected to plumbing piping systems.

3.5 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.

3.6 ADJUSTING AND CLEANING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flushometers having controls, to provide proper flow and stream.

- C. Replace washers of leaking and dripping faucets and stops.
- D. Clean fixtures, fittings, and spout and drain strainers with manufacturers' recommended cleaning methods and materials.
- E. Adjust faucet wrist blade handles perpendicular to the spout while in the closed position.
- F. Review the data in Operating and Maintenance Manuals. Refer to Division 1 Section "Project Closeout."

3.7 FIXTURE SCHEDULE

- A. Provide plumbing fixtures as specified on the drawings.
- B. Install rough-in for plumbing fixtures as scheduled on the drawings.

3.8 MOUNTING HEIGHTS SCHEDULE:

- A. Refer to the architectural drawings for plumbing fixture mounting heights. Unless indicated otherwise, install plumbing fixtures with the mounting heights as listed below with final approval by the Architect:

FIXTURE	MOUNTING HEIGHT
Lavatory or Sink	
Standard Height	31" floor to rim
ADA Accessible	34" floor to rim
Child Height	24" floor to rim
Urinal	
Standard Height	24" floor to rim
ADA Accessible	17" floor to rim
Child Height	14" floor to rim
Water Closet	
Standard	15" floor to rim
ADA Accessible	17" to 19" floor to top of seat
Child Height	10" floor to rim
Janitor's Sink Faucet Fittings	42" floor to centerline
Hose Bibbs	36" AFF to centerline

END OF SECTION 224000

SECTION 230010 – GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL REQUIREMENTS

1.1 DESCRIPTION OF WORK

- A. This Division requires the furnishing and installing of complete functioning systems, and each element thereof, as specified or indicated on the Drawings and Specifications or reasonably inferred; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation, and utilities.
- B. Division 23 of the Specifications and Drawings numbered with prefixes M, MP or ME, or MEP generally describe these systems, but the scope of the Mechanical work includes all such work indicated in the Contract Documents: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing and Electrical Drawings and Specifications; and Addenda.
- C. The Drawings have been prepared diagrammatically intended to convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, ductwork, piping, etc. without showing all the exact details as to elevations, offsets, control lines, and other installation requirements. The Contractor shall use the Drawings as a guide when laying out the work and shall verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers requirements, will ensure a complete, coordinated, satisfactory and properly operating system.

1.2 QUALITY ASSURANCE

- A. All work under this Division shall be executed in a thorough professional manner by competent and experienced workmen licensed to perform the Work specified.
- B. All work shall be installed in strict conformance with manufacturers' requirements, recommendations, and installation instructions. Equipment and materials shall be installed in a neat and professional manner and shall be aligned, leveled, and adjusted for satisfactory operation.
- C. Material and equipment shall be new, shall be of the best quality and design, shall be current model of the manufacturer, shall be free from defects and imperfections and shall have markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Material and equipment of the same type shall be made by the same manufacturer whenever practicable.
- D. Unless specified otherwise, manufactured items shall have been installed and used, without modification, renovation, or repair for not less than one year prior to date of bidding for this project.

1.3 CODES, REFERENCES AND STANDARDS

- A. Execute Work in accordance with the National Fire Protection Association and all Local, State, and National codes, ordinances and regulations in force governing the particular

class of Work involved. Obtain timely inspections by the constituted authorities, and upon final completion of the Work obtain and deliver to the Owner executed final certificates of acceptance from the Authority Having Jurisdiction.

- B. Any conflict between these Specifications and accompanying Drawings and the applicable Local, State and Federal codes, ordinances and regulations shall be reported to the Architect in sufficient time, prior to the opening of Bids, to prepare the Supplementary Drawings and Specification Addenda required to resolve the conflict.
- C. The governing codes are minimum requirements. Where these Drawings and Specifications exceed the code requirements, these Drawings and Specification shall prevail.
- D. All material, manufacturing methods, handling, dimensions, method or installation and test procedure shall conform to but not be limited to the following industry standards and codes:

BOCA	Building Officials Code Administration
IBC	International Building Code
IMC	International Mechanical Code
IPC	International Plumbing Code
IECC	International Energy Conservation Code
IFC	International Fire Code
IFGC	International Fuel Gas Code
ADA	American Disabilities Act
ADC	Air Diffusion Council
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
AHRI	Air Conditioning, Heating and Refrigeration Institute
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineering
ASTM	American Society of Testing Materials
AWS	American Welding Society
AWWA	American Water Works Association
CISPI	Cast Iron Soil Pipe Institute
ETL	Electrical Testing Laboratories
HI	Hydraulic Institute
MSS	Manufacturer's Standardization Society of the Valve and Fitting Industry
NBFU	National Board of Fire Underwriters
NEC	National Electrical Code
NFPA	National Fire Protection Association
NEMA	National Electrical Manufacturers' Association
OSHA	Occupational Safety and Health Act
PDI	Plumbing and Drainage Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Inc.
UL	Underwriter's Laboratories

- E. Contractor shall comply with rules and regulations of public utilities and municipal departments affected by connections of services.
- F. All mechanical work shall be performed in compliance with applicable safety regulations, including OSHA regulations. Safety lights, guards, shoring and warning signs required for the performance of the mechanical work shall be provided by the Contractor.

1.4 DEFINITIONS

A. General:

1. **Furnish:** The term “furnish” is used to mean “supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations.”
2. **Install:** The term “install” is used to describe operations at the project site including the actual “unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.”
3. **Provide:** The term “provide” means “to furnish and install, complete and ready for the intended use. When ‘furnish’, ‘install’, ‘perform’, or ‘provide’ is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, “provide” is implied.
4. **Furnished by Owner or Furnished by Others:** The item will be furnished by the Owner or Others. It is to be installed and connected under the requirements of this Division, complete and ready for operation, including items incidental to the Work, including services necessary for proper installation and operation. The installation shall be included under the guarantee required by this Division.
5. **Engineer:** Where referenced in this Division, “Engineer” is the Engineer of Record and the Design Professional for the Work under this Division, and is a Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the “Architect”.
6. **AHJ:** The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
7. **NRTL:** Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other listed Manufacturers and models that meet the specified criteria.
8. **Substitution:** Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.
 - a. **Substitutions for Cause:** Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - b. **Substitutions for Convenience:** Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
9. **Value Engineering:** A systematic method to improve the “value” of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.

- B. The terms "approved equal", "equivalent", or "equal" are used synonymously and shall mean "accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified". The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.
- C. The following definitions apply to excavation operations:
 - 1. Additional Excavation: Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
 - 2. Bedding: Bedding as used in this section refers to the compacted sand or pea gravel installed in the bottom of a trench to immediately support and cover a pipe or duct.
 - 3. Subbase: as used in this Section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.
 - 4. Subgrade: as used in this Section refers to the compacted soil immediately below the slab or pavement system.
 - 5. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Architect.

1.5 COORDINATION

- A. The Contractor shall visit the site and ascertain the conditions to be encountered while installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provision for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, incorrect or faulty installation of Work under this Division or for additional compensation for Work covered by this Division.
- B. The Contractor shall refer to Drawings of the other disciplines and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. The Contractor shall make offsets required to clear equipment, beams and other structural members; and to facilitate concealing piping and ductwork in the manner anticipated in the design.
- C. The Contractor shall confirm and coordinate the final location and routing of all mechanical, electrical, plumbing, fire protection, control and audio-visual systems with all architectural features, structural components, and other trades. The contractor shall locate equipment, components, ductwork, piping, conduit, and related accessories to maintain the desired ceiling heights as indicated on the architectural drawings. The contractor shall inform the architect of any areas where conflicts may prevent the indicated ceiling height from being maintained. The contractor shall not proceed with any installation in such areas until the architect has given written approval to proceed or has provided modified contract drawings or written instructions to resolve the apparent conflict.
- D. The Contractor shall provide materials with trim which will fit properly the types of ceiling, wall, or floor finishes actually installed.
- E. The Contractor shall maintain a foreman on the jobsite at all times to coordinate the work with other contractors and subcontractors so that various components of the mechanical

systems will be installed at the proper time, will fit the available space, and will allow proper service access to the equipment. Carry on the Work in such a manner that the Work of the other contractors and trades will not be handicapped, hindered, or delayed at any time.

- F. Work of this Division shall progress according to the "Construction Schedule" as established by the Prime Contractor and their subcontractors and as approved by the Architect. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of schedule dates.

1.6 MEASUREMENTS AND LAYOUTS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Figured dimensions shall be taken in preference to scale dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing the Contract Documents. The Contractor will be held responsible for errors which could have been avoided by proper checking and inspection.

1.7 SUBMITTALS

- A. Refer to Division 01 and General Conditions for submittal requirements in addition to requirements specified herein.

1.8 ELECTRONIC DRAWING FILES

- A. In preparation of shop drawings or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of \$200 for a drawing set up to 12 sheets and \$15 per sheet for each additional sheet. Contact the Architect for Architect's written authorization. Contractor shall request and complete the Electronic File Release Agreement form from the Engineer. Send the form along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form. In addition to payment, Architect's written authorization and Engineer's release agreement form must be received before electronic drawing files will be sent.

1.9 SUBSTITUTIONS

- A. Refer to Division 01 and General Conditions for Substitutions in addition to requirements specified herein.
- B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.
- C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.

1.10 OPERATION AND MAINTENANCE MANUALS

- A. Refer to Division 01 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.

1.11 SPARE PARTS

- A. Provide to the Owner the spare parts specified in the individual sections in Division 23 of this specification.

1.12 RECORD DRAWINGS

- A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.

1.13 PAINTING

- A. Factory finishes, shop priming and special finishes are specified in the individual equipment specification sections.
- B. Where factory finishes are provided and no additional field painting is specified, marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish.

1.14 DELIVERY, STORAGE AND HANDLING

- A. Refer to Division 01 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.

1.15 GUARANTEES AND WARRANTIES

- A. Refer to Division 01 and General Conditions for Guarantees and Warranties in addition to requirements specified herein.

1.16 TEMPORARY FACILITIES

- A. Refer to Division 01 and General Conditions for Temporary Facilities requirements in addition to requirements specified herein.

1.17 PROJECT CONDITIONS

- A. Conditions Affecting Work In Existing Buildings:
 - 1. The Drawings describe the general nature of remodeling to the existing building. However, the Contractor shall visit the Site prior to submitting their bid to determine the nature and extent of work involved.
 - 2. Work in the existing building shall be scheduled with the Owner.
 - 3. Certain demolition work must be performed prior to the remodeling. The Mechanical Contractor shall perform the demolition which involves Mechanical systems, equipment, piping, equipment supports or foundations and materials.

4. Mechanical Contractor shall remove articles which are not required for the new Work. Unless otherwise indicated, each item removed by the Mechanical Contractor during this demolition shall become their property and shall be removed by the Mechanical Contractor from the premises and dispose of them in accordance with applicable federal, state and local regulations.
 5. Mechanical Contractor shall relocate and reconnect Mechanical facilities that must be relocated in order to accomplish the remodeling shown in the Drawings or indicated in the Specifications. Where Mechanical equipment or materials are removed, the Mechanical Contractor shall cap unused piping beyond the floor line or wall line to facilitate restoration of finish.
 6. General Contractor shall install finish material.
 7. Obtain permission from the Architect for channeling of floors or walls not specifically noted on the Drawings.
 8. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
 9. Locate, identify, and protect mechanical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.
- B. Conditions Affecting Excavations: The following project conditions apply:
1. Maintain and protect existing building services which transit the area affected by selective demolition.
 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
- C. Site Information: Subsurface conditions were investigated during the design of the Project. Reports of these investigations are available for information only; data in the reports are not intended as representations or warranties of accuracy or continuity of conditions. The Owner will not be responsible for interpretations or conclusions drawn from this information.
- D. Use of explosives is not permitted.
- E. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

PART 2 - PRODUCTS AND MATERIALS

2.1 NOT USED

PART 3 - EXECUTION

3.1 PERMITS

- A. Secure and pay for permits required in connection with the installation of the Mechanical Work. Arrange with the various utility companies for the installation and connection of required utilities for this facility and pay charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

3.2 EXISTING UTILITIES

- A. Schedule and coordinate with the Utility Company, Owner and with the Engineer connection to, or relocation of, or discontinuation of normal utility services from existing utility lines. Premium time required for any such work shall be included in the bid.
- B. Existing utilities damaged due to the operations of utility work for this project shall be repaired to the satisfaction of the Owner or Utility Company without additional cost.
- C. Utilities shall not be left disconnected at the end of a work day or over a weekend unless authorized by representatives of the Owner or Engineer.
- D. Repairs and restoration of utilities shall be made before workmen leave the project at the end of the workday in which the interruption takes place.
- E. Contractor shall include in their bid the cost of furnishing temporary facilities to provide services during interruption of normal utility service.

3.3 SELECTIVE DEMOLITION

- A. Refer to Division 02 and General Conditions for Selective Demolition requirements in addition to the requirements specified herein.
- B. General: Demolish, remove, demount, and disconnect abandoned mechanical materials and equipment indicated to be removed and not indicated to be salvaged or saved.
- C. Materials and Equipment to Be Salvaged: Remove, demount, and disconnect existing mechanical materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.
- D. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.
- E. Mechanical Materials and Equipment: Demolish, remove, demount, and disconnect the following items:
 - 1. Inactive and obsolete piping, fittings and specialties, equipment, ductwork, controls, and insulation.

- a. Piping and ducts embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove exposed materials and materials above accessible ceilings. Drain and cap piping and ducts allowed to remain.
 - b. Perform cutting and patching required for demolition in accordance with Division 01, General Conditions and "Cutting and Patching" portion of this Section in Division 23.
- F. Provide schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.
 - 1. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 01 Section "Summary of Work."

3.4 CUTTING AND PATCHING

- A. Cut walls, floors, ceilings, and other portions of the facility as required to install work under this Division.
- B. Obtain permission from the Architect prior to cutting. Do not cut or disturb structural members without prior approval from the Architect and Structural Engineer.
- C. For post-tension slabs, x-ray slab and closely coordinate all core drill locations with Architect and Structural Engineer prior to performing any work. Obtain approval from Architect and Structural Engineer for all core drills and penetrations at least four days prior to performing work.
- D. Penetrations shall be made as small as possible while maintaining required clearances between the building element penetrated and the system component.
- E. Patch around openings to match adjacent construction, including fire ratings, if applicable.
- F. Repair and refinish areas disturbed by work to the condition of adjoining surfaces in a manner satisfactory to the Architect.

3.5 CLEANING

- A. Refer to Division 01 and General Conditions for Cleaning requirements in addition to requirements specified herein.

END OF SECTION 230010

SECTION 230015 – ELECTRICAL COORDINATION FOR MECHANICAL EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section specifies the basic requirements for electrical components which are an integral part of packaged mechanical equipment. These components include, but are not limited to factory furnished motors, starters, and disconnect switches furnished as an integral part of packaged mechanical equipment.
- B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for mechanical equipment are scheduled on the Drawings.
- C. System shall be complete and operational with power and control wiring provided to meet the design intent shown on the drawings and specified within the specification sections.

1.2 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.

1.3 QUALITY ASSURANCE

- A. Electrical components and materials shall be UL labeled.
- B. All electrical equipment provided and the wiring and installation of electrical equipment shall be in accordance with the requirements of this Section and Division 26.

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL

- A. The Contractors shall provide all motors, starters, disconnects, wire, conduit, etc. as specified in the Construction Documents. If, however, the Division 23 Contractor furnishes a piece of equipment requiring a different motor, starter, disconnect, wire size, etc. than what is shown and/or intended on the Construction Documents, this Contractor shall coordinate the requirements with any other Contractor and shall be responsible for any additional cost incurred by any other Contractor that is associated with installing the different equipment and related accessories for proper working condition.
- B. Refer to Division 26, "COMMON WORK RESULTS FOR ELECTRICAL" for specification of motor connections.

PART 3 - EXECUTION

3.1 CONTRACTOR COORDINATION

- A. Unless otherwise indicated, all motors, equipment, controls, etc. shall be furnished, set in place and wired in accordance with Table 1. Any items not listed but shown on the drawings shall be considered part of the Contract Documents and brought to the attention of the Architect.
- B. The General Contractor is the central authority governing the total responsibility of all trade contractors. Therefore, deviations and clarifications of this schedule are permitted provided the General Contractor assumes responsibility to coordinate the trade contractors different than as indicated herein. If deviations or clarifications to this schedule are implemented, submit a record copy to the Engineer.

TABLE 1: ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

ITEM	FURN BY	SET BY	POWER WIRING	CONTROL WIRING
Loose motor starters, disconnect switches, thermal overloads and heaters.	DIV26	DIV26	DIV26	DIV23t
Manual operating multi-speed switches	DIV23m	DIV26	DIV26	DIV23t
Control relays	DIV23t	DIV23t	DIV26	DIV23t
Control power transformers	DIV23t	DIV23t	DIV26	DIV23t
Control power transformers furnished with equipment	DIV23m	DIV23m	DIV26	DIV23t
Motor and solenoid operated valves	DIV23t	DIV23m	DIV23t	DIV23t

DIV23m = Mechanical Contractor

DIV23t = Temperature Controls Sub-Contractor

DIV26 = Electrical Contractor

DIV28 = Electronic Safety and Security

END OF SECTION 230015

SECTION 230500 – COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Mechanical equipment nameplate data.
- B. Non-shrink grout for equipment installations.
- C. Sleeves for mechanical penetrations.
- D. Miscellaneous metals for support of mechanical materials and equipment.
- E. Wood grounds, nailers, blocking, fasteners, and anchorage for support of mechanical materials and equipment.
- F. Joint sealers for sealing around mechanical materials and equipment.

1.2 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 23 Section General Mechanical Requirements.
 - 1. Product data for the following products:
 - a. Joint sealers.

PART 2 - PRODUCTS AND MATERIALS

2.1 MECHANICAL EQUIPMENT NAMEPLATE DATA

- A. For each piece of power operated mechanical equipment, provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance's, and similar essential data. Locate nameplates in an accessible location.

2.2 GROUT

- A. Provide nonshrink, nonmetallic grout conforming to ASTM C 1107, Grade B, in premixed and factory-packaged containers.
- B. Grout shall have post-hardening, volume-adjusting, dry, non-staining, non-corrosive, non-gaseous, hydraulic-cement characteristics and shall be as recommended by manufacturer for interior and exterior applications.
- C. Grout shall have 5,000 psi, 28-day compressive strength design mix.

2.3 PENETRATIONS

- A. Sleeves:

1. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A-53 grade A or 12 gauge (0.1084 inches) welded galvanized steel formed to a true circle concentric to the pipe.
 2. Sheet-Metal Sleeves: 10 gauge (0.1382 inches), galvanized steel, round tube closed with welded longitudinal joint.
- B. Frames for rectangular openings attached to forms and of a maximum dimension established by the Architect. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, provide 18 gauge (0.052 inches) welded galvanized steel. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, provide 10 gauge (0.1382 inches) welded galvanized steel. Notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.

2.4 MISCELLANEOUS METALS

- A. Steel plates, shapes, bars, and bar grating: ASTM A 36.
- B. Cold-Formed Steel Tubing: ASTM A 500.
- C. Hot-Rolled Steel Tubing: ASTM A 501.
- D. Steel Pipe: ASTM A 53, Schedule 40, welded.
- E. Fasteners: Zinc-coated, type, grade, and class as required.

2.5 MISCELLANEOUS LUMBER

- A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPB rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.
- B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 15/32 inches.

2.6 JOINT SEALERS

- A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
- B. Colors: As selected by the Architect from manufacturer's standard colors.
- C. Nonacid Curing Sealer: One-part, nonacid-curing, silicone sealant complying with ASTM C920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.
 1. Manufacturers:
 - a. Dow Corning, Dowsil 790.
 - b. Dow Corning, Dowsil 795.

- c. GE, Silglaze II SCS 2350.
 - d. GE, Silpruf SCS 2000.
 - e. Owens Corning, Energy Complete.
 - f. Pecora, 864 NST.
 - g. Tremco, Spectrem 1.
 - h. Tremco, Spectrem 2.
- D. High Humidity Sealer: One-part, mildew-resistant, silicone sealant complying with ASTM C920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.
 - 1. Manufacturers:
 - a. Dow Corning, Dowsil 786.
 - b. GE, Momentum SCS1700.
 - c. Pecora, 898 Silicone NST.
- E. Hybrid Joint Sealer: One-part, non-sag, paintable complying with ASTM C920, Type S, Grade NS, Class 50, recommended for exposed applications on interior and exterior locations involving joint movement of not more than plus or minus 50 percent.
 - 1. Manufacturers:
 - a. BASF, MasterSeal NP 100.
 - b. Pecora, DyanTrol I-XL.
 - c. Tremco, Dymonic FC.
- F. Acrylic Latex Joint Sealer: One-part, non-sag, mildew-resistant, paintable acrylic latex or siliconized acrylic latex, complying with ASTM C834, Type OP, Grade NF, recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent.
 - 1. Manufacturers:
 - a. Pecora, AC-20
 - b. Sherwin Williams 950A
 - c. Tremco, Tremflex 834

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

3.2 INSTALLATION OF ACCESS DOORS

- A. Provide access doors for all concealed equipment and duct and piping accessories that require service where indicated or as required, except where above lay-in ceilings. Refer to Section "Identification for HVAC Piping and Equipment" for labeling of access doors.
- B. Access doors shall be adequately sized for the devices served with a minimum size of 18 inches x 18 inches, furnished by the respective Contractor or Subcontractor and installed by the General Contractor.
- C. Access doors must be of the proper construction for type of construction where installed.
- D. The exact location of all access doors shall be verified with the Architect prior to installation.
- E. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- F. Adjust hardware and panels after installation for proper operation.

3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS "Structural Welding Code."

3.4 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.5 PREPARATION FOR JOINT SEALERS

- A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.
- B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

3.6 APPLICATION OF JOINT SEALERS

- A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.

1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
 2. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.
- B. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.7 PENETRATIONS:

- A. Construction in Existing Facilities:
1. Saw cut or core drill existing walls and slabs to install sleeves and sleeve seals in existing facilities. Do not cut or drill any walls or slabs without first coordinating with, and receiving approval from, the Architect, Owner, or both. Seal sleeves and sleeve seals into concrete walls or slabs with a waterproof non-shrink grout acceptable to the Architect.
- B. Provide sleeves and/or box frames for openings in all concrete and masonry construction and fire or smoke partitions, for all mechanical work that passes through such construction; Coordinate with other trades and Divisions to dimension and lay out all such openings.
- C. The General Contractor will provide only those openings specifically indicated on the Architectural or Structural Drawings as being provided under the General Contractor's work.
- D. The cutting of new or existing construction shall not be permitted except by written approval of the Architect.
- E. Floor sleeves shall be fitted with means for attachment to forms and shall be of length to extend at least two inches above the floor level.
- F. All sleeves shall be of ample size to allow for movement of conduit, duct or pipe and insulation through the sleeves without damage to the insulation.
- G. Cut sleeves to length for mounting flush with both surfaces of walls.
- H. Extend sleeves installed in floors 2 inches above finished floor level.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- J. Seal space outside of sleeves with approved joint compound for penetrations of gypsum board assemblies.
- K. All circular and oval openings sleeved through underground exterior walls shall be sealed with mechanical sleeve seals as specified in Division 23 Section "Basic Piping Materials and Methods". All rectangular openings through underground exterior walls shall be

flanged and flashed with non-corrosive material on each side and the gap sealed with weatherproof sealant.

END OF SECTION 230500

SECTION 230510 – BASIC PIPING MATERIALS AND METHODS

PART 1 - GENERAL REQUIREMENTS

1.1 SECTION INCLUDES

- A. Joining materials.
- B. Nipples.
- C. Unions.

1.2 SUBMITTALS

- A. Refer to Division 01 and Division 23 Section “General Mechanical Requirements” for administrative and procedural requirements for submittals.
- B. Product Data, including, rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties and accessories, and installation instructions.
 - 1. Piping Schedule: Submit a piping schedule that states the material being proposed for each piping system application in the project including manufacturer’s catalog information, pipe materials, sizes, fittings, Type, Grade, Schedule, applicable ASTM standard, and connection method(s).
- C. Submit certification that fittings and specialties are manufactured in plants located in the United States or certified that they comply with applicable ANSI and ASTM standards.
- D. Refer to the individual piping system specification sections in Division 23 for additional requirements.

1.3 QUALITY ASSURANCE

- A. Comply with ASME B31.9 - Building Services Piping, most recent edition.
- B. Soldering and Brazing procedures shall conform to ANSI B9.1 Safety Code for Mechanical Refrigeration.
- C. Pipe specialties and fittings shall be manufactured in plants located in the United States or certified to meet the specified ASTM, ASME, and ANSI standards.
- D. Refer to the individual piping system specification sections in Division 23 for additional requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

- C. Refer to the individual piping system specification sections in Division 23 for additional requirements.

PART 2 - PRODUCTS AND MATERIALS

2.1 PIPE AND FITTINGS

- A. Refer to the individual piping system specification sections in Division 23 for specifications on piping and fittings relative to that particular system.

2.2 JOINING MATERIALS

- A. Refer to individual Division 23 Piping Sections for special joining materials not listed below.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.
- C. Brazing Filler Metals: Comply with SFA-5.8, Section II, ASME BPVC for brazing filler metal materials appropriate for the materials being joined.
 - 1. AWS A5.8, Classification BAg-5:
 - a. Silver (Ag) 44.0 – 46.0 percent.
 - b. Zinc (Z) 23.0 – 27.0 percent.
 - c. Copper (Cu) 29.0 – 31.0 percent.
 - 2. AWS A5.8, Classification BCuP-5:
 - a. Phosphorus (P) 4.8 - 5.2 percent.
 - b. Silver (Ag) 14.5 - 15.5 percent.
 - c. Copper (Cu) remainder.
- D. Soldering Filler Metals: ASTM B32, 95-5 Tin-Antimony and water flushable flux in accordance with ASTM B813.

2.3 NIPPLES

- A. Steel: ASTM A733, made of ASTM A53, Schedule 40, black steel; Type S seamless for pipe sizes 2 inch and smaller, Type E electric-resistance welded for pipe sizes 2-1/2 inch and larger.

2.4 UNIONS:

- A. Manufacturers:
 - 1. Anvil International.
 - 2. Hart Industries.
 - 3. Mueller Streamline Co.
 - 4. Victaulic Company of America.
 - 5. Watts Regulator Co.

6. Approved equal.
- B. Hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.
 1. Malleable-iron: ASME B16.39, class as specified in section “Hydronic Piping” for the piping system used.
 2. Bronze: ASME B16.15, cast bronze body meeting ASTM B62, class as specified in section “Hydronic Piping” for the piping system used.
 3. Copper: ASME B16.22 wrought copper body.
 - a. For hydronic systems, provide class as specified in section “Hydronic Piping” for the piping system used.
 - b. For refrigerant systems, provide pressure rating as required for the refrigerant type used.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

3.2 INSTALLATION, GENERAL

- A. Install products in accordance with manufacturer’s instructions.
- B. Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.
- C. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view. Install escutcheons at each wall, floor and ceiling penetration in exposed finished locations. Provide deep pattern escutcheons where required to conceal protruding pipe fittings.
- D. Install piping free of sags and bends and with ample space between piping to permit proper insulation applications.
- E. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.
- F. Install horizontal piping as high as possible allowing for specified slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1 inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

- G. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
- H. Support piping from structure. Do not support piping from ceilings, equipment, ductwork, conduit and other non-structural elements.
- I. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4 inch ball valve, and short 3/4 inch threaded nipple and cap.
- J. Verify final equipment locations for roughing in.
- K. Use fittings for all changes in direction and all branch connections.
- L. Remake leaking joints using new materials.
- M. Install components with pressure rating equal to or greater than system operating pressure.
- N. Piping Protection:
 - 1. Protect piping during construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.
 - 2. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

3.3 PIPE JOINT CONSTRUCTION

- A. Threaded Joints:
 - 1. Provide tapered pipe threads for field cut threads. Cut threads full and clean using sharp dies.
 - 2. Ream threaded pipe ends to remove burrs and restore full inner diameter.
 - 3. Note the internal length of threads in fittings or valve ends and proximity of internal seat or wall to determine how far pipe should be threaded into joint.
 - 4. Align threads at point of assembly.
 - 5. Apply appropriate tape or thread compound to the male pipe threads except where dry seal threading is specified.
 - 6. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded. Tighten joint to leave not more than 3 threads exposed.
 - 7. Damaged Threads: Do not use pipe or pipe fittings with threads which are corroded or damaged.
- B. Brazed and Soldered Joints:
 - 1. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."
 - 2. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."
 - 3. WARNING: Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.
 - 4. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts at piping specialties before brazing.

1. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emery cloth, prior to making joint.
 2. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.
5. Copper-to-copper joints shall be made using BCuP-5 brazing filler metal without flux.
 6. Dissimilar metals such as copper and brass shall be jointed using an appropriate flux with either BCuP-5 or BAg-5 brazing filler metal. Apply flux sparingly to the clean tube only and in a manner to avoid leaving any excess inside the completed joint.
 7. Continuously purge the pipe and fittings during brazing with an inert gas (i.e., dry nitrogen or carbon dioxide) to prevent formation of scale. Maintain purge until the joint is cool to the touch.
 8. Heat joints using oxy-acetylene torch. Heat to proper and uniform temperature.
 9. Provide temporary cap or cover on completed joints with open ends to prevent entry of contaminating materials.
- B. Joints for other piping materials are specified within the respective piping system Sections.

3.4 UNIONS

- A. Install unions on pipes 2 inch and smaller, adjacent to each valve, at final connections to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.

3.5 PIPE FIELD QUALITY CONTROL

- A. Testing: Refer to individual piping system specification sections.

END OF SECTION 230510

SECTION 230529 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Support and attachment components.
- B. Horizontal piping hangers and supports.
- C. Vertical piping clamps.
- D. Anchors and fasteners.
- E. Miscellaneous materials.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

1.3 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each type of hanger and support. Include a hanger and support schedule showing manufacturer's figure number, size, location, and features for each hanger and support. Submit style and type to Structural Engineer for approval prior to installation.
- B. Product Certificates: Signed by the manufacturer of hangers and supports certifying the products meet the specified requirements.
- C. Maintenance Data: For inclusion in Operating and Maintenance manual specified in Division 01 and Division 23 Section "General Mechanical Requirements."

- D. Installer's Qualifications: Include evidence of compliance with specified requirements.
- E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.4 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Flame/Smoke Ratings: Provide hangers and supports with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by UL 723 or ASTM E84 (NFPA 255) method.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 - PRODUCTS AND MATERIALS

1.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test fluid. Include the weight of the pipe, valves, insulation and piping accessories.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.2 SUPPORT AND ATTACHMENT COMPONENTS

- B. General Requirements:
 - 1. Comply with MSS SP-58.
 - 2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of work.
 - 3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.

4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
 5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
 6. Materials: Products and materials listed in this specification are based on indoor, dry locations. Use corrosion resistant materials suitable for the environment where installed.
 - a. Indoor Dry Locations: Provide painted carbon steel, galvanized steel or zinc-plated steel. Where supports will be field painted in exposed locations, provide carbon steel.
 - a. Indoor Damp or Wet Locations: Galvanized steel or type 304 stainless steel.
- C. Hanger Rods:
1. Material:
 - a. Indoor Dry Locations: Zinc-plated steel.
 - b. Indoor Damp or Wet Locations or Outdoor Locations: Zinc-plated steel or type 304 stainless steel.
 - c. Natatorium or other treated pool environments: Type 316 stainless steel.
 2. Threaded both ends or continuously threaded.
 3. Minimum Size: Reference piping specification sections for rod thicknesses.
 4. Threaded Rods: Threaded rods are not allowed for floor supports except when the maximum length of the rod is less than 12". Threaded rod sizes shall be the same size diameter as specified for pipe hanger rods based upon pipe size being supported. Refer to system piping specification sections for rod size requirements.

2.2 HORIZONTAL PIPING HANGERS AND SUPPORTS

- A. Manufacturers:
1. Armacell.
 2. ASC Engineered Solutions.
 3. Cooper B-Line, Inc.
 4. Elite Components.
 5. ERICO/Michigan Hanger Co./Caddy
 6. Ferguson/FNW.
 7. Halfen-DEHA.
 8. Hilti.
 9. National Pipe Hanger Corporation.
 10. PHD Manufacturing.

11. Piping Technology and Products, Inc.
 12. Power-Strut.
 13. Unistrut.
- B. Wall Supports:
1. Two-hole strap, galvanized steel or copper to suit pipe material. Provide rigid insulation between strap and pipe to maintain continuous insulation and vapor barrier where required.
 2. Welded steel bracket reinforced with angle or strut. Support pipe from bracket using horizontal pipe hanger or support appropriate for the pipe type.
- C. Pre-Insulated Supports:
1. Manufacturers:
 - a. Aeroflex USA, Inc.
 - b. Armacell.
 - c. ASC Engineered Solutions
 - d. Buckaroos, Inc.
 - e. Cooper B-Line, Inc.
 - f. Pipe Shields, Inc.
 2. General Construction and Requirements:
 - a. Flexible elastomeric insulation with integral high-density pipe support insert shall conform to ASTM C534, Type I.
 - b. Surface Burning Characteristics: Assembly shall have a flame spread index/smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.
 - c. Waterproof calcium silicate insulation shall conform to ASTM C795.
 - d. Rigid phenolic foam insulation shall conform to ASTM C1126, Type III.
 - e. Insulation inserts shall be surrounded by a 360 degree jacket or shield.
 3. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.

2.3 VERTICAL-PIPING SUPPORTS

- A. Manufacturers:
1. ASC Engineered Solutions.
 2. Cooper B-Line, Inc.
 3. Halfen-DEHA.
 4. Hilti.
 5. ERICO/Michigan Hanger Co.
 6. National Pipe Hanger Corporation.

7. PHD Manufacturing.
 8. Piping Technology and Products, Inc.
 9. Power-Strut.
 10. Unistrut.
- B. Components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58.
1. Components shall have galvanized coatings where installed for piping and equipment that will not have factory applied or field-applied finish.
 2. Pipe attachments shall be copper-plated or have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
 3. Components as listed below shall be made of 304 stainless steel where installed in corrosive environments and/or where indicated on the drawings.
- C. Riser Clamps with pre-manufactured polymer insert:
1. Manufacturers:
 - a. Hydra-Zorb; Titan Riser Clamp.
 - b. National Pipe Hanger.
 - c. Pipe Hangers, Inc.
 2. Riser clamp with pre-manufactured polymer inserts designed to withstand vertical loading and receive butted insulation internally. Inserts shall support piping independent of insulation to avoid crushing. Installed system shall provide equal thermal and vapor barrier performance as systems with continuous unbroken insulation.

2.4 ANCHORS AND FASTENERS

- A. Manufacturers:
1. Hilti, Inc.
 2. Illinois Tool Works, Inc.
 3. Phillips.
 4. Powers Fasteners, Inc.
 5. Rawl.
 6. Simpson Strong-Tie Company Inc.
- B. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
1. Concrete: Use preset concrete inserts or expansion anchors.
 2. Solid or Grout-Filled Masonry: Use expansion anchors.
 3. Hollow Masonry: Use toggle bolts.
 4. Hollow Stud Walls: Use toggle bolts.

5. Steel: Use beam clamps.
 6. Sheet Metal: Use sheet metal screws.
 7. Wood: Use wood screws.
 8. Plastic and lead anchors are not permitted.
 9. Hammer-driven anchors and fasteners are permitted only as follows:
 - a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction.
 - b. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction.
- C. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
1. Comply with MFMA-4.
 2. Channel Material: Use galvanized steel.
 3. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch minimum base metal thickness.
 4. Spot Inserts: Carbon steel with zinc plating or galvanized steel body and base plate, with protective sleeve for anchor rod insert, sized to accommodate anchor rod dimensions.
 5. Manufacturers:
 - a. Same as manufacturer of metal channel (strut) framing system.
 - b. DeWalt “Bang-It” concrete inserts.
- D. Post-Installed Concrete and Masonry Expansion Anchors:
1. Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
 2. Self-drilling, drilled flush or shell type. Size inserts to suit threaded rods.
- E. Beam Clamps: MSS SP-58 C-Type or adjustable, Types 19 through 23, 25 or 27 through 30 based on required load.
1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
 1. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- F. Vibration Isolation Anchors: Reference Section “Vibration Isolation for HVAC” for vibration isolation anchors.

2.5 MISCELLANEOUS MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Malleable Iron: ASTM A47

- C. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION, GENERAL

- A. Install products in accordance with manufacturer's instructions.
- B. Provide hangers and supports according to the Pipe Hanger and Support Schedule below.
- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- E. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- F. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- H. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- I. Provide vibration isolators at hangers and supports where specified in Section "Vibration Isolation for HVAC".

3.3 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58 unless indicated otherwise.
- B. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

- C. Space attachments within maximum piping span length specified in Division 23 piping sections.
- D. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- E. Install hangers, supports, clamps and attachments to support piping properly from building structure.
- F. Do not attach to ceilings, equipment, ductwork, conduit and other non-structural elements such as floor and roof decking.
- G. Hanger and clamps sizing:
 - 1. Cold Piping: Provide pipe hangers sized for the pipe outside diameter plus insulation thickness.
 - 2. Hot Piping: Provide pipe hangers sized for the pipe outside diameter plus insulation thickness.
 - 3. Vertical Piping: Provide clamps sized for the pipe outside diameter and extend clamp through insulation.
 - 4. Refer to Section "HVAC Insulation" for definition of hot and cold piping and required insulation thickness.
- H. Install building attachments within concrete or to structural steel.
 - 1. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping as specified in Division 23 piping sections.
 - 2. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through openings at top of inserts.
- I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Provide two nuts on threaded supports to securely fasten the support.
- J. Install appropriate types of hangers and supports to allow controlled movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
- K. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ASME B31.9 Building Services Piping Code is not exceeded.
- M. Insulated Piping: Comply with the following installation requirements.
 - 1. Riser Clamps: Attach riser clamp to piping with riser clamps projecting through insulation. Do not use riser clamps to support horizontal, insulated piping. Seal

insulation for hot piping and protect vapor barrier for cold piping as specified in Division 23 Section "HVAC Insulation".

- a. Contractor's Option: Provide riser clamps with pre-manufactured polymer insert.
2. Pipe Covering Protection Saddles: Install pipe covering protection saddles where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
 - a. If insulation protection shields are used instead of protection saddles on hot piping where vapor barrier is not required, provide high density insulation insert sized for the insulation thickness used as specified in Division 23 Section "HVAC Insulation".
3. Insulation Protection Shield: Install insulation protection shield with high density insulation insert, sized for the insulation thickness used as specified in Division 23 Section "HVAC Insulation". Do not use polymer-based shields for hot piping.
 - a. Exception for 2 inch and smaller horizontal piping with cellular glass, flexible elastomeric, or polyisocyanurate insulation: High density insulation insert is not required. Provide insulation protection shield over the insulation with length specified for pipe size and insulation thickness to prevent puncture or other damage.
4. Contractor's Option: Provide pre-engineered thermal hanger inserts for piping insulated with flexible elastomeric insulation at pipe supports for piping 2-1/2 inches and larger.
5. Contractor's Option: Provide strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts.

N. Vertical Piping Risers:

1. Reference Section "Vibration Isolation for HVAC" for piping riser supports.

3.4 EQUIPMENT SUPPORT AND ATTACHMENT

- A. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
- B. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls.
- C. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
- D. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- E. Preset Concrete Inserts and Expansion Anchors: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
 1. Where concrete slabs form finished ceiling, locate anchors flush with slab surface.
- F. Secure fasteners according to manufacturer's recommended torque settings.

- G. Remove temporary supports.
- H. Fabricate structural steel supports to suspend equipment from structure above or support equipment from floor.
- I. Grouting: Place grout under supports for piping and equipment.

3.5 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

3.6 FIELD QUALITY CONTROL

- A. Examine support and attachment components for damage and defects.
- B. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.
- E. Correct deficiencies and replace damaged or defective support and attachment components.

3.7 PIPE HANGER AND SUPPORT SCHEDULE

- A. Additional hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Provide the following acceptable hangers and supports for each type of piping system. Hangers and supports may be single type or strut-mounted:
- C. Wall Supports:
 - 1. Pipe sizes 3 inches and less:
 - a. Two-hole strap mounted to wall.
 - b. Welded steel bracket with reinforced angle or strut.
 - 2. Pipe sizes 4 inch and greater:
 - a. U-bolt.
 - b. Welded steel bracket with reinforced angle or strut.

END OF SECTION 230529

SECTION 230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data for each product required.
 - 1. Custom Signage: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- B. Manufacturer's Installation Instructions: Indicate special procedures and installation for each product required.

PART 2 - PRODUCTS AND MATERIALS

2.1 ACCEPTABLE MANUFACTURERS

- A. Advanced Graphic Engraving, LLC.
- B. Brady Corporation.
- C. Brimar Industries, Inc.
- D. Craftmark.
- E. Industrial Safety Supply Co., Inc.
- F. Kolbi Pipe Marker Co.
- G. MIFAB, Inc.
- H. Seton Identification Products, a Tricor Direct Company..

2.2 IDENTIFICATION APPLICATIONS AND REQUIREMENTS

- A. General:
 - 1. Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 23 sections. Where more than a single type is specified for application, selection is the installer's option, but provide single selection for each product category.
 - 2. Lettering: Coordinate names, abbreviations, and other designations used in mechanical identification work with the corresponding designations shown on the drawings, scheduled, and specified. If not otherwise indicated, provide numbering, lettering, and wording as recommended by the manufacturer or as required for

proper identification, operation, and maintenance of mechanical systems and equipment.

3. Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (e.g., Boiler No. 3, Air Supply No. 1H, etc.).

B. Fans: Nameplates.

C. Thermostats: Nameplates.

2.3 NAMEPLATES

A. Nomenclature: Include the following, matching terminology on schedules as closely as possible:

1. Name and mark number.
2. Equipment service.
3. Design capacity.
4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.

B. Size: 2-1/2 inch x 4 inch for control panels and components, 4-1/2 inch x 6 inch for equipment.

C. Letter Color: White.

D. Letter Height: 1/4 inch.

E. Background Color:

1. Cooling equipment: Green.
2. Heating equipment: Yellow.
3. Combination cooling and heating equipment: Yellow/Green.
4. Energy reclamation equipment: Brown.
5. Hazardous equipment: Colors and designs recommended by ASME.
6. Equipment and components that do not meet any of the above criteria: Blue.

F. Plastic: Conform to ASTM D709.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 GENERAL INSTALLATION

- A. 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. Install products in accordance with manufacturer's instructions.
- C. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

3.3 EQUIPMENT IDENTIFICATION

- A. Install nameplates and engraved plastic laminate signs for identification of equipment. Provide additional signs and lettering as follows:
 - 1. To distinguish between multiple units in close proximity.
 - 2. To inform operator of operational requirements.
 - 3. To indicate safety and emergency precautions.
 - 4. To warn of hazards and improper operations.
- B. Adjust lettering size based on viewing distance from normal location of identification:
 - 1. Less than 2 feet: Minimum 1/4 inch.
 - 2. Up to 6 feet: Minimum 1/2 inch.
 - 3. Greater than 6 feet: Proportionally increase letter size based on recommendations above.
 - 4. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.
 - 5. Stencils may be used in lieu of nameplates when lettering greater than 1 inch is needed for proper identification because of distance from normal location of required identification.
- C. Where equipment to be identified is concealed above acoustical ceilings or similar removable concealment, equipment tags may be installed in the concealed space to reduce the amount of text in exposed sign.

END OF SECTION 230553

SECTION 230593 – TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. General testing, adjustment, and balancing requirements.
- B. Testing, adjustment, and balancing of air systems.
- C. Testing, adjustment, and balancing of hydronic systems.
- D. This section excludes:
 - 1. Specifications for materials and installation of adjusting and balancing devices. If devices must be added to achieve proper adjusting and balancing, refer to the respective system sections for materials and installation requirements.
 - 2. Requirements and procedures for piping and ductwork systems leakage tests.

1.2 DEFINITIONS

- A. TAB: Testing, adjusting, and balancing.
- B. Test: To determine quantitative performance of equipment.
- C. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment (e.g., reduce fan speed, throttling).
- D. Balance: To proportion flows within the distribution system (submains, branches, and terminals) according to specified design quantities.
- E. Procedure: Standardized approach and execution of sequence of work operations to yield reproducible results.
- F. Report forms: Data sheets arranged for collecting test data in logical order for submission and review. Data should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.
- G. Terminal: The point where the controlled fluid enters or leaves the distribution system. Examples include inlets and outlets on water terminals, inlets and outlets from air terminal units, and inlets and outlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.
- H. Main: Duct or pipe containing the major or entire fluid flow of the system.
- I. Submain: Duct or pipe containing part of the system capacity and serving two or more branch mains.
- J. Branch main: Duct or pipe serving two or more terminals.

- K. Branch: Duct or pipe serving a single terminal.

1.3 SUBMITTALS

A. Certifications:

1. Submit qualifications of TAB agency.
2. Submit qualifications of TAB supervisor.

B. Test Reports:

- a. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
2. Sample Forms: Submit sample forms if they are other than the standard forms available from the certification association followed for the project.

- (1) Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.

ii) Progress Reports.

3. Certified TAB Reports:

a. General:

- 1) Submit within two weeks after completion of testing, adjusting, and balancing.
- 2) Revise TAB plan to reflect actual procedures and submit as part of final report.
- 3) Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

- b. Draft Report: Submit draft copies of report for review prior to final acceptance of Project. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit 2 complete sets of draft reports. Only 1 complete set of draft reports will be returned.

- c. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports. The final report shall be certified proof of the following:

- 1) The systems have been tested, adjusted, and balanced in accordance with the referenced standards.
- 2) The report reflects an accurate representation of how the systems have been installed.

- 3) The report reflects a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures.
 - 4) The report is an accurate record of all final quantities measured to establish normal operating values of the systems.
- d. Report Format: Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, and cover identification at front and side. Include set of reduced size drawings indicating air outlets, equipment, and thermostat locations identified to correspond with report forms. Divide the report into the following divisions:
- 1) General Information and Summary
 - a) Include project name, location, altitude, and date.
 - b) Identify TAB agency, contractor, owner, architect, and engineer.
 - c) Include addresses, contact names, and telephone numbers.
 - d) Include certification sheet containing the seal, name, address, telephone number, and signature of the certified TAB Supervisor.
 - e) Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - 2) Air Systems
 - 3) Hydronic Systems
 - 4) Temperature Control Systems
 - a) Report Forms: Standard forms prepared by the TAB certification standard being followed for each respective item and system to be tested, adjusted, and balanced. If not specified, follow ASHRAE 111.
- e. Units of Measure: Report data in I-P (inch-pound) units only.

1.4 QUALITY ASSURANCE

- A. Comply with ASHRAE Standard 111, Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
- B. Comply with ASHRAE Handbook, HVAC Applications Volume, Chapter "Testing, Adjusting, and Balancing", most current edition.
- C. TAB Agency Qualifications:
 1. Act as the single source of responsibility for TAB of the HVAC systems.
 2. Staff the project at all times by qualified personnel.

3. Have a minimum of 5 years documented experience on projects with TAB requirements similar to those required for the project.
 4. Certified by one of the following Certification Associations:
 - a. AABC (NSTSB): Associated Air Balance Council, National Standards for Total System Balance.
 - b. NEBB: National Environmental Balancing Bureau, Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
- D. TAB Supervisor and Technician Qualifications:
1. Certified by the same organization as TAB agency.
 2. TAB Supervisor shall be a professional engineer licensed in the state in which the project is located.

PART 2 - PRODUCTS AND MATERIALS – NOT USED

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Begin work after systems to be tested, adjusted, or balanced are fully operational, duct systems are sealed, piping systems have been tested for leaks, and equipment is operational. Complete work prior to Substantial Completion of the project.
- B. Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.
- C. Coordinate with Division 22 drawings for testing, adjusting, and balancing scope of work.
- D. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- E. Submit progress reports at least once a week to the General Contractor to communicate status of work so that the TAB work is completed in a timely manner.
- F. Notice of Tests: Provide seven days advance notice for each test. Include scheduled test dates and times.
- G. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- H. All required instrumentation shall be calibrated to tolerances specified in the referenced standards within a period of six months prior to starting the project.

3.2 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:

1. Systems are started and operating 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. Motors and bearings are lubricated.
 5. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 6. Duct systems are clean of debris.
 7. Fans are rotating correctly and belts have tension.
 8. Fire, smoke, fire/smoke, and volume dampers are in place and open.
 9. Air coil fins are cleaned and combed.
 10. Volume dampers are installed at locations needed for balancing the air systems.
 11. Access doors are closed and duct end caps are in place.
 12. Air outlets are installed and connected.
 13. Visually inspect duct systems to ensure they are sealed and leakage is minimized.
 14. Hydronic systems are flushed, filled, and vented.
 15. Hydronic systems are tested for leaks.
 16. Test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves are properly installed and that their location is accessible.
 17. Pumps are rotating correctly.
 18. Proper strainer baskets are clean and in place.
 19. Service and balance valves are open.
 20. Expansion tanks are not air bound and have appropriate charge.
 21. Air vents are operating freely.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

- A. Pre-Balancing Conference: Prior to beginning of the testing, adjusting, and balancing procedures, schedule and conduct a coordination meeting with all installers whose work will be tested, adjusted, or balanced.
- B. Furnish all instruments required for testing, adjusting, and balancing operations.
1. Verify all instruments have been calibrated.
 2. Furnish instruments as recommended by the manufacturer for the TAB application.
 3. Furnish instruments that are best suited to the function being measured.

4. Furnish instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.
- C. Furnish additional balancing devices as required for TAB to the appropriate contractor for installation.
- D. Obtain copies of approved shop drawings of air handling equipment, terminal outlets, and temperature control diagrams.
- E. Obtain manufacturer's fan and terminal device outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.
- F. Determine best locations in main and branch ductwork for most accurate duct traverses.
- G. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.

3.4 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Balance main ducts and equipment to within plus or minus 5 percent of design airflow.
- B. Air Outlets and Inlets: Balance branch ducts and terminal devices to within plus or minus 10 percent of design airflow.
- C. Hydronic Systems: Balance to within plus or minus 5 percent of design flow.

3.5 RECORDING AND ADJUSTING

- A. Record data regarding design conditions from contract documents and installed conditions from shop drawings including equipment identification number, model number, location, area served, manufacturer, model number, serial number, motor nameplate horsepower and rpm, fan rpm, capacity and electrical voltage, amps and phases.
- B. For all systems measure and record the ambient conditions at the time of testing and balancing. Include the following:
 1. Dry bulb temperature.
 2. Relative humidity.
 3. Cloud cover.
 4. Wind speed.
 5. Time.
- C. Field Logs: Maintain written logs including:
 1. Running log of events and issues.
 2. Discrepancies, deficient or uncompleted work by others.
 3. Contract interpretation requests.

4. Lists of completed tests.

- D. Ensure recorded data represents actual measured or observed conditions.
- E. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- F. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- G. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- H. Cut insulation around ductwork and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.
- I. Patch and seal insulation, vapor barrier, ductwork, and housings, using materials identical to those removed.
- J. Seal ducts and piping and test and repair leaks.
- K. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- L. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- M. Check and adjust systems approximately six months after final acceptance and submit report.
- N. When averaging values, take a sufficient quantity of readings which will result in a repeatability error of less than 5 percent. When measuring a single point, repeat readings until 2 consecutive values are obtained.
- O. Take all readings at eye level of the indicated value to prevent parallax.
- P. Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.
- Q. Take measurements in the system where best suited for the task.
- R. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

3.6 AIR SYSTEM TESTING, ADJUSTMENT, AND BALANCING PROCEDURE

- A. Check filters for cleanliness.
- B. Check dampers (both volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans.
- C. Verify volume dampers are installed at locations needed for balancing the air systems.

- D. Prepare report test sheets for both fans and outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.
- E. Determine best locations in main and branch ductwork for most accurate duct traverses.
- F. Place outlet dampers in the full open position.
- G. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.
- H. Lubricate all motors and bearings.
- I. Check fan belt tension.
- J. Check fan rotation.
- K. Energize fan motors and adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude. Replace fan and motor pulleys as required to achieve design conditions.
- L. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- M. Measure air quantities at air inlets and outlets.
- N. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- O. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Affect volume control by duct internal devices such as dampers and splitters.
- P. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- Q. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- R. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- S. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- T. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

3.7 HYDRONIC SYSTEM TESTING, ADJUSTMENT, AND BALANCING PROCEDURE

- A. Open valves to full open position. Close coil bypass valves.

- B. Remove and clean all strainers.
- C. Check pump rotation.
- D. Clean and set automatic fill valves for required system pressure.
- E. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.
- F. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type).
- G. Set temperature controls so all coils are calling for full flow.
- H. Check operation of automatic bypass valves.
- I. Check and set operating temperatures of chillers to design requirements.
- J. Lubricate all motors and bearings.
- K. Adjust water systems to provide required or design quantities.
- L. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on correlated flow from temperature and pressure gauges across the heat transfer elements in the system.
- M. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- N. Affect system balance with automatic control valves fully open to heat transfer elements.
- O. Affect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- P. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.
- Q. Balance cooling tower water distribution systems to ensure even water flow to each tower cell.
- R. Test cooling tower systems for capacity, recording pump flow and head, fan airflow, ambient air wet and dry bulb temperatures at tower inlet and outlet and tower inlet and outlet water temperatures.
- S. Record the necessary information for optimizing pump operation as defined on the controls drawings. Give this information to the controls contractor for building automation system programming.

END OF SECTION 230593

SECTION 230700 – HVAC INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Piping Insulation.

1.2 RELATED REQUIREMENTS

- A. Division 23 Section "Hangers & Supports for HVAC Piping & Equipment," for insulation shields, pipe saddles, and high-density insulation inserts.

1.3 DEFINITIONS

- A. Cold Pipe: Piping that carries fluid with a minimum operating temperature less than 60 degrees F.
- B. Hot Pipe: Piping that carries fluid with a minimum operating temperature greater than 105 degrees F.
- C. Neutral Ductwork: Ductwork that carries airflow with temperatures between the defined cold and hot temperatures.
- D. Cold Equipment: Equipment that carries fluids with a minimum operating temperature less than 60 degrees F.
- E. Hot Equipment: Equipment that carries fluids with a minimum operating temperature greater than 105 degrees F.
- F. Exposed: Insulation that is visible from the occupied space.
- G. Unconditioned Spaces: An enclosed space within a building that is not provided with mechanical heating or cooling.

1.4 SUBMITTALS

- A. Product Data: Submit technical product data, thermal characteristics, and materials for each type of mechanical insulation.
- B. Insulation Schedule: Include product name, conductivity k-value, thickness, and furnished accessories for each service.
- C. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.
- D. Manufacturer's Instructions: Include installation instructions for storage, handling, protection, examination, preparation, and installation of the product.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualification: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.
- B. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- C. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less and smoke-developed index of 50 or less, as tested by UL 723 or ASTM E84 (NFPA 255) method.
 - 1. Exception: Exterior mechanical insulation may have flame spread index of 75 and smoke developed index of 150.
 - 2. Exception: Industrial mechanical insulation that will not affect life safety egress of building may have flame spread index of 75 and smoke developed index of 150.
 - 3. Exception: Polyisocyanurate insulation that is not installed in a return air plenum may have a flame spread index of 25 and smoke developed index of 450.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage; store in original wrapping.

1.7 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 - PRODUCTS

2.1 PIPING INSULATION MATERIALS

- A. Mineral Fiber (rock, slag, or glass):
 - 1. Manufacturers:
 - a. Johns Manville.
 - b. Knauf Insulation.
 - c. Owens Corning.
 - 2. Insulation: ASTM C547, Type I or II, rigid mineral fiber, pre-formed for the application.
 - a. K-value: ASTM C518 or C177, maximum 0.24 at 75 degrees F.
 - b. Minimum Service Temperature: 0 degrees F

- c. Maximum Service Temperature: 850 degrees F for Type I, 1200 degrees F for Type II.
 - d. Density: Between 3 to 6 pounds per cubic foot for Type I, between 6 to 8 pounds per cubic foot for Type II.
 - 3. Factory Applied Jacket: ASTM C1136, Type I.
 - a. All-Service Jacket (ASJ): Paper/Foil/Scrim, water vapor permeance of 0.02 perms and self-sealing lap.
 - b. Poly ASJ: Paper/Foil/Scrim with polymer coating, water vapor permeance of 0.01 perms and self-sealing lap.
 - c. Color: White.
- B. Flexible Elastomeric:
 - 1. Manufacturers:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. K-Flex USA.
 - 2. Insulation: ASTM C534, Grade I, flexible elastomeric cellular rubber insulation, pre-formed for the application.
 - a. K-value: ASTM C518 or C177, maximum 0.28 at 75 degrees F.
 - b. Minimum Service Temperature: Minus 297 degrees F
 - c. Maximum Service Temperature: 220 degrees F for Grade I, 300 degrees F for Grade II.
 - 3. Factory Applied Jacket:
 - a. Polymeric Coating: Multi-ply, polymeric blend coating, 16 mils thick, designed to prevent damage to underlying insulation from sunlight, installation, and physical abuse, with water vapor permeance of 0.03 perms. Reference Piping Jacket Schedule in Part 3 of this specification for application of this jacket.
- C. Pipe Insulation Accessories: Provide staples, bands, wires, cement, and other appurtenances as recommended by insulation manufacturer for applications indicated.
- D. Adhesives, Sealers, Mastics, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.
 - 1. Lagging Adhesive: Comply with MIL-A-3316C, Class 1, Grade A. Provide Foster 30-36, Childers CP-50AHV2, or equal.
 - 2. Weather Barrier Breather Mastic: Permeance shall be 1.0 perms or less at 62 mils dry per ASTM E96, Procedure B. Provide Foster 46-50, Childers CP-10/11 or equal.
 - 3. Solvent-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance 0.05 perms or less at 35 mils dry per ASTM F 1249.

4. Water-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance in accordance with ASTM C755 for insulation application. Provide Foster 30-80, Childers CP-38, or equal.

Table: Recommended Maximum Permeance of Water Vapor Retarders (Note 1)

Insulation Application	Insulation Permeability, Less than 4.0 perm-in. (Note 2)	Insulation Permeability, 4.0 or greater perm-in. (Note 2)
	Vapor Retarder perms	Vapor Retarder perms
Pipe and vessels (33 F to ambient)	0.05	0.05
Pipe and vessels (-40 F to 32 F)	0.02	0.02
Ducts (40 F to ambient)	1.0	0.03

Notes:

1. Water vapor permeance of the vapor retarder in perms when tested in accordance with Test Methods E96.
 5. Water vapor permeability of the insulation material when tested in accordance with Test Methods E96.
- E. Insulation Diameters: Comply with ASTM C585 for inner and outer diameters of rigid thermal insulation.
- F. Pipe, Valve and Fitting Covers: Comply with ASTM C450 for fabrication of fitting covers for pipe, valves and fittings.
- G. High Density Insulation Billets:
1. Calcium Silicate: ASTM C533 and C795.
 2. Flexible elastomeric: ASTM C534, Type 1.
 3. Polystyrene: ASTM C578, Type XIII.
 4. Phenolic: ASTM C1126, Type III, Grade 1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Test piping and ductwork for design pressure, liquid tightness, and continuity prior to applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 PROTECTION AND REPLACEMENT

- A. Provide all required protection for insulation (installed and uninstalled) throughout the duration of construction to avoid exposure to plaster, dust, dirt, paint, moisture, deterioration, and physical damage.
- B. Repair existing mechanical insulation that is damaged during this construction period. Use insulation of same type and thickness as existing insulation. Install new jacket lapping and sealed over existing.

- C. Replace damaged insulation which cannot be repaired satisfactorily at no additional expense to the Owner, including insulation with vapor barrier damage and insulation that has been exposed to moisture during shipping, storage, or installation. Drying the insulation is not acceptable. Dry surfaces prior to installation of new insulation that replaces the damaged or wet insulation.

3.3 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.

3.4 PIPING SYSTEM INSULATION INSTALLATION

- A. Maintain continuous thermal and vapor-retarder integrity throughout entire installation and protect it from puncture and other damage.
- B. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.
- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
- D. Cold Pipe Insulation:
 - 1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
 - 2. Provide vapor barrier jacket according to the Piping Jacket Schedule.
 - 3. Provide high density insulation material under supports or pre-insulated supports. Protect insulation with shields to prevent puncture or other damage. Refer to Section "Hangers & Supports for HVAC Piping & Equipment" for pre-insulated supports and insulation shields. and for exception where high density insulation inserts are not required.
 - 4. High density insulation material shall extend a minimum 2 inches past the pipe shield on each side.
 - 5. Secure all-service jacket with self-sealing longitudinal laps.
 - 6. Butt pipe insulation tightly at insulation joints. Apply wet coat of vapor barrier lap cement on joint and seal with 3 inch wide vapor barrier tape or band and coat all taped seams and staple penetrations with vapor barrier coating to prevent moisture ingress.
- E. Hot Pipe Insulation:
 - 1. Insulate entire system, including fittings, valves, unions flanges, strainers, flexible connections, pump bodies, and expansion joints.
 - 2. Provide jackets without vapor barrier according to the Piping Jacket Schedule. Jackets with vapor barrier are allowed.

3. Provide high density insulation material or pre-insulated supports where supports are installed outside of the insulation. Protect insulation with shields to prevent puncture or other damage. Refer to Section "Hangers & Supports for HVAC Piping & Equipment" for pre-insulated supports and insulation shields and for exception where high density insulation inserts are not required.
4. High density insulation material shall extend a minimum 2 inches past the pipe shield on each side.
5. Secure all-service jacket with self-sealing longitudinal laps.
6. Butt pipe insulation tightly at insulation joints and wrap insulation around supports. Apply 3 inch wide vapor barrier tape or band over joint.

F. Insulation of Fittings, Valves, Strainers, Flanges, and Unions:

1. Insulate fittings, joints, and valves with molded insulation of like material, vapor barrier coating, and thickness as adjacent pipe. Provide pre-formed insulation pieces, segmented insulation, or sectional pipe insulation for the application. Provide the same insulation jacket as adjoining pipe.
2. Sectional pipe insulation: Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Hold sectional cuts in place with tie wire or bands. Wire and bands shall be compatible with insulation and jacket.
3. Segmented pipe insulation: Cover segmented insulated surfaces with a layer of finishing cement and finish with a coating or mastic. Reinforce the mastic with fabric-reinforcing mesh. Trowel the coating or mastic to a smooth and well-shaped contour.
4. Butt each insulation piece tightly against adjoining piece of insulation. Bond pieces together according to Cold Pipe or Hot Pipe installation instructions.
5. Insulate valves up to and including the bonnets, valve stuffing-box studs, bolts, and nuts with a removeable insulation cover. Sectional valve insulation covers shall divide the section along the vertical center line of the valve body.
6. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover.
7. Insulate flanges and unions with a removeable insulation cover. Sectional pipe insulation covers shall divide the section along the center line of pipe.
8. When removeable covers are made from sectional block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, around the insulated device with tie wire. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
9. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation. PVC fitting covers with end caps are also acceptable. Tape PVC covers to adjoining insulation facing using PVC tape.
10. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

- G. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- H. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated. Maintain vapor barrier through the penetration.

3.5 PIPING SYSTEM INSULATION SCHEDULE

- A. Reference Pipe Insulation Thickness Schedule at the end of this specification for thickness requirements based on insulation conductivity.
- B. Do not apply insulation to piping that operates outside of the minimum and maximum service temperature range.
- C. Omit insulation on the following:
 - 1. Hot piping within radiation enclosures or unit cabinets.
 - 2. Cold piping within unit cabinets provided piping is located over drain pan.
 - 3. Heating piping between coil and shutoff valves provided piping is located within heated space and not more than three feet from coil.
 - 4. Condensate piping between steam trap and union.
 - 5. Steam relief vent piping.
 - 6. Chiller emergency refrigerant vent piping.
 - 7. Flexible connections and expansion joints in pipes with fluids above ambient temperatures.
- D. Cold Piping (40 degrees F (4.4 degrees C) to 60 degrees F):
 - 1. Service:
 - a. Chilled water supply and return piping.
 - 2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
 - a. Mineral fiber.
 - b. Flexible elastomeric.
- E. Warm Temperature Piping (105 degrees to 140 degrees F (40 to 94 degrees C)):
 - 1. Service:
 - a. Heating hot water supply and return piping.
 - 2. Insulate each piping system specified above with one of the following types of insulation.
 - a. Mineral fiber.
 - b. Flexible elastomeric.

F. Hot Non-Steam Piping (141 to 200 degrees F (61 to 94 degrees C)):

1. Service:
 - a. Heating hot water supply and return piping.
2. Acceptable Insulation:
 - a. Mineral fiber.
 - b. Flexible elastomeric .

3.6 PIPE INSULATION THICKNESS SCHEDULE

A. IECC – 2018 Requirements, Pipe Insulation

Fluid Operating Temp. Range (°F) And Usage	Minimum Pipe Insulation Thickness						
	Insulation Conductivity		Nominal Pipe or Tube Size (in.)				
	Conductivity, Btu·in./(hr·ft ² ·°F)	Mean Rating Temp., °F.	<1	1 to <1-1/2	1-1/2 to <4	4 to <8	≥8
	Insulation Thickness, in.						
>350°F	0.32–0.34	250	4.5	5.0	5.0	5.0	5.0
251°F–350°F	0.29–0.32	200	3.0	4.0	4.5	4.5	4.5
201°F–250°F	0.27–0.30	150	2.5	2.5	2.5	3.0	3.0
141°F–200°F	0.25–0.29	125	1.5	1.5	2.0	2.0	2.0
105°F–140°F	0.21–0.28	100	1.0	1.0	1.5	1.5	1.5
40°F–60°F	0.21–0.27	75	0.5	0.5	1.0	1.0	1.0
<40°F	0.20–0.26	50	0.5	1.0	1.0	1.0	1.5

Notes:

- a. For piping smaller than 1-1/2 inch and located in partitions within conditioned spaces, reduction of these thicknesses by 1 inch shall be permitted (before thickness adjustment required in footnote b) but not to a thickness less than 1 inch.
- b. For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows: $T = r[(1 + t/r)^{(K/k)} - 1]$ where
 - 1) T = minimum insulation thickness (in.),
 - 2) r = actual outside radius of pipe (in.),
 - 3) t = insulation thickness listed in the table for applicable fluid temperature and pipe size,
 - 4) K = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu·in/hr·ft²·°F); and
 - 5) k = the upper value of the conductivity range listed in this table for the applicable fluid temperature.
- c. Insulation thicknesses are based on energy efficiency considerations only. Add insulation where noted on the drawings.

- d. For piping that shall be installed below grade, reference Division 23 section "Underground Hydronic and Steam Piping."
- e. The table is based on steel pipe. Non-metallic pipes schedule 80 thickness or less shall use the table values. For other non-metallic pipes having thermal resistance greater than that of steel pipe, reduced thicknesses are permitted if documentation is provided showing that the pipe with the proposed insulation has no more heat transfer per foot than a steel pipe of the same size with the insulation thickness shown on the table.

3.7 PIPING JACKET SCHEDULE

- A. Piping within return air plenums:
 - 1. All-service jacket.

END OF SECTION 230700

SECTION 230913 – INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Control valves.
- B. Operators.
- C. Input/Output sensors and transmitters.
- D. Output control devices.
- E. Power Supplies.

1.2 DEFINITIONS

- A. BAS: Building Automation System.
- B. Control Wiring: Includes conduit, wire and wiring devices to install complete control systems including motor control circuits, interlocks, thermostats, EP and IP switches and like devices. Includes all wiring from Intelligent Devices and Controllers to all sensors and points defined in the input/output summary shown on the drawings or specified herein and required to execute the sequence of operations.
- C. Cv: Design Valve Flow Coefficient.
- D. DDC: Direct Digital Control.
- E. EPDM: Ethylene Propylene Diene Monomer.
- F. High voltage: 50 volts or higher.
- G. Low voltage: Below 50 volts.
- H. PTFE: Polytetrafluoroethylene.
- I. TEFZEL: A modified ETFE (ethylene tetrafluoroethylene) fluoroplastic.

1.3 CONTRACTOR RESPONSIBILITIES

- A. Reference Division 23 Section "Electrical Coordination for Mechanical Equipment" for contractor responsibilities.
- B. BAS Contractor:
 - 1. Installation of the BAS shall be by the BAS Contractor or their subcontractors.
 - 2. Low voltage control wiring.
 - 3. Coordinate high voltage control wiring to instrumentation and control devices with Division 26. Where high voltage power is required for instrumentation and control

devices that is in addition to what is shown on the drawings, the BAS contractor shall cover the cost of providing this wiring.

4. All interlock wiring regardless of voltage (e.g., exhaust fan interlocked to supply fan).
5. Coordinate with Division 26 that motor starters are provided with auxiliary contacts as required for interlocks.
6. Coordinate power wiring to BAS controllers and instrumentation and control devices with Division 26.
7. Coordinate installation of back-box rough-in for wall-mounted control devices sensors, etc. with Division 26. Coordinate with mechanical contractor all locations, quantities, and sizes required for installation by Division 26.

C. Sheet Metal Contractor:

1. Installation of automatic control dampers, smoke control dampers, and necessary blank off plates.
2. Access doors where and as required.

D. Mechanical Contractor:

1. Installation of immersion wells.
2. Installation of flow switches.
3. Installation of automatic control valves.
4. Installation of pressure tappings and associated shut-off cocks.
5. Coordinate conduit and wall box rough-in, power wiring and magnetic starter requirements for controls and mechanical equipment with Division 26.

1.4 SUBMITTALS

A. Refer to Division 01 for submittal procedures.

B. Product Data: Provide description and engineering data for each control system component. Include dimensions, capacities, size, performance characteristics, electrical characteristics, and finishes of materials.

1. Schedule for control valves and actuators, including the following:
 - a. Tag.
 - b. Quantity.
 - c. Model number.
 - d. Equipment served.
 - e. Flow at project design conditions.
 - f. Selected valve flow coefficient (Cv). For butterfly valves, submit the corresponding valve position at which the Cv is calculated.
 - g. Pressure differential drop across valve at project design flow conditions and selected Cv.

- h. Maximum close-off pressure.
 - i. Valve Configuration (2-way/3-way).
 - j. Valve Normal Position and Fail Position (e.g., NO/FO; normally open/fail open).
 - k. Valve Size.
 - l. Line Size.
 - m. Valve Type.
 - n. Actuator Signal Type (Open/Close, Modulating 0-10 Vdc, 2-10 Vdc, 4-20 mA, etc.)
 - o. Torque required to close valve at pump shutoff head.
 - p. Selected actuator maximum torque output.
- C. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.
 - D. Manufacturer's Instructions: Provide for all manufactured components.
 - E. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
 - F. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.
 - G. Warranty: Submit manufacturer warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- C. Control valves shall be manufactured in plants located in the United States or certified to meet the specified ASTM, ANSI and MSS standards.
- D. Measurement devices and sensors shall be calibrated using NIST traceable standards.

1.6 WARRANTY

- A. Correct defective Work within a one year period after Substantial Completion.
- B. Provide extended warranty for control devices and equipment as specified herein.

PART 2 - PRODUCTS

2.1 CONTROL VALVES

A. General:

1. Factory fabricated of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated. Each valve shall be equipped with proper packing to ensure there will be no leakage at the valve stem.
2. Pressure Ratings:
 - a. Valve body and packing rated to withstand the system static head plus the maximum pump head and the maximum temperature of the control medium (i.e. chilled water, steam, hot water, etc.).
 - 1) Minimum pressure class 125 psig.
 - b. Two-way modulating valves and their operators shall have close-off pressure ratings exceeding the dead-head condition of the pump in the system it serves.
 - c. Two-way modulating valves with equal percentage flow characteristics and their operators shall be rated to safely operate within a differential pressure range between 2 and 50 psi across the valve without cavitating.
3. Sizing:
 - a. Hydronic Systems:
 - 1) Two-Position: Line size or sized using a maximum pressure differential of 1 psi. Size butterfly valves using the 90 degree flow coefficient (Cv).
 - 2) Modulating: Select valves with an appropriate flow coefficient (Cv) to achieve a minimum design valve authority of 0.5 relative to the total pressure drop of the piping branch the valve controls. Calculate Cv based on the larger of the following:
 - a) 5-psig pressure drop at the design flow rate specified in the Schedules.
 - b) Twice the equipment design pressure drop as specified in the Schedules unless otherwise noted.
 - c) Valve shall not be less than 1/2 Inch in size.
 - d) Size butterfly valves using the 60 degree of full open flow coefficient (Cv).
4. Flow Characteristics:
 - a. Hydronic Service:
 - 1) Two-way valves: Equal percentage characteristic.
 - 2) Three-way valves: Linear characteristic.
5. End Connections:

- a. Reference the Control Valve Schedule in Part 3 for allowable end connections by pipe material.
- b. Carbon steel and stainless steel valves shall comply with ASME B16.34.
- c. Comply with ASME B16.10 for face-to-face and end-to-end dimensions.
- d. Threads:
 - 1) Comply with ASME B1.20.1.
 - 2) Comply with ASME B16.4 for cast iron.
 - 3) Comply with ASME B16.15 for cast copper alloys, including bronze and brass.

B. Globe Pattern:

- 1. Size: Reference the Control Valve Schedule in Part 3 for allowable valve size and end connection by application.
- 2. Construction:
 - a. Up to 2 inches: Class 150, ASTM B62 bronze body, bronze trim, rising stem, renewable composition disc, screwed ends with backseating capacity repackable under pressure.
 - 1) Bronze body and bonnet shall conform to ASTM B62 up to pressure class 150. Conform to ASTM B61 for pressure class 200 and higher.
 - b. Over 2 Inches: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, renewable seat and disc.
 - 1) Iron body and bonnet shall conform to ASTM A126, class B.
 - c. Bonnet:
 - 1) Bronze body, Class 125: Threaded type.
 - 2) Bronze body, Class 150 or higher: Union type.
 - 3) Iron body: Bolted type.
 - d. Disc Material:
 - 1) PTFE.
 - 2) Stainless steel.
 - e. Stem: Outside screw and yoke. Include extension for insulation.
 - f. Two-piece brass packing gland assembly, non-asbestos composition packing.
- 3. Rangeability: Minimum 50:1.
- 4. Leakage:
 - a. Up to 1-1/4 Inch: Minimum ANSI Class III per ANSI/FCI 70-2.
 - b. 1-1/2 Inch and Larger: Minimum ANSI Class IV per ANSI/FCI 70-2.
- 5. Design and Testing:

- a. MSS SP-80 for bronze.
 - b. MSS SP-85 for cast iron.
- C. Manufacturers:
 - 1. Belimo.
 - 2. Bray.
 - 3. Danfoss.
 - 4. Fisher Controls.
 - 5. Griswold Controls.
 - 6. Honeywell.
 - 7. Johnson Controls, Inc.
 - 8. Kele.
 - 9. Schneider Electric.
 - 10. Siemens.
 - 11. Victaulic (Tour & Andersson).

2.2 OPERATORS

- A. General:
 - 1. Voltage: Voltage selection shall be as required to achieve the required torque for the application.
 - a. Reference Part 3 for Damper Operator Voltage Schedule.
 - 2. Type: Motor operated, with or without gears. Motor type shall be continuous duty.
 - 3. Construction:
 - a. For Actuators Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
 - b. For Actuators from 100 to 400 W: Gears ground steel, oil immersed, shaft hardened steel running in bronze, copper alloy or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel or cast-aluminum housing.
 - c. For Actuators Larger Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.
 - 4. Field Adjustment:
 - a. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.
 - b. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.
 - 5. Modulating Actuators:

- a. Operation: Capable of stopping at all points across full range, and starting in either direction from any point in range.
 - b. Control Input Signal:
 - 1) Three Point, Tristate, or Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position and other input drives actuator to close position. No signal of either input remains in last position.
 - 2) Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10-Vdc or 2- to 10-Vdc and 4- to 20-mA signals.
 - 3) Pulse Width Modulation (PWM): Actuator drives to a specified position according to pulse duration (length) of signal from a dry contact closure, triac sink, or source controller.
 - c. Programmable Multi-Function:
 - 1) Control Input, Position Feedback, and Running Time: Factory or field programmable.
 - 2) Diagnostic: Feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.
 - 3) Service Data: Include, at a minimum, number of hours powered and number of hours in motion.
- 6. Attachment:
 - a. Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to device without the need for connecting linkages.
 - b. Attach actuator to device drive shaft in a way that ensures maximum transfer of power and torque without slippage.
- 7. Temperature and Humidity:
 - a. Temperature: Suitable for operating temperature range encountered by application.
 - b. Humidity: Suitable for humidity range encountered by application, non-condensing.
- 8. Enclosure:
 - a. Suitable for ambient conditions encountered by application.
- 9. Stroke Time:
 - a. Coordinate with stroke time indicated on the control drawings.
 - b. Unless otherwise noted, select operating speed to be compatible with equipment and system operation.

B. Valve Operators

1. Sizing: Select operator with sufficient torque capacity to operate the valve under all conditions and to guarantee tight shut-off of as specified against system pressure encountered.
 - a. Operators for Hydronic Control Valves: Capable of closing valve against system pump dead head.
 2. Fail Positions:
 - a. Operator shall fail in place for all other applications not listed under spring return.
- C. Manufacturers:
1. Valve Operators:
 - a. Belimo.
 - b. Bray.
 - c. Danfoss.
 - d. Fisher Controls.
 - e. Honeywell.
 - f. Johnson Controls.
 - g. Schneider Electric (Invensys).
 - h. Siemens.

2.3 INPUT/OUTPUT SENSORS AND TRANSMITTERS

- A. General:
1. Performance Requirements:
 - a. Device must be compatible with project DDC controllers.
 - b. Elements used shall be general-purpose type.
 - c. Provide transmitters or transducers with sensors as required, with range suitable for the system encountered.
 - 1) Transmitters and transducers shall have offset and span adjustments.
 - 2) Shock and vibration shall not harm the transmitter or transducer.
 - 3) Transmitters and transducers shall have a zeroing capability of readjusting the transmitter zero.
 - d. Accuracy requirements shall include the combined effects of linearity, hysteresis, repeatability, and the transmitter.
 2. Output: Linear, proportional type over shielded cable pair, 4 - 20 mA or 0 – 10 Vdc signal.
 3. Input Power: Low voltage, nominal 24 Vdc.
- B. Temperature Sensors:

1. General: Temperature sensing elements shall have characteristics resistant to moisture, vibration, and other conditions consistent with the application without affecting accuracy and life expectancy. Sensor shall be UL 873 listed for temperature equipment.
2. Performance Requirements:
 - a. Thermistor:
 - 1) Accuracy (All): Plus/minus 0.36 degrees F minimum.
 - 2) Temperature Differential Accuracy: Plus/minus 0.15 degrees F minimum.
 - 3) Resolution: Plus/minus 0.2 degrees F minimum.
 - 4) Heat Dissipation Constant: 2.7 mW per degree C.
 - 5) Drift: 0.04 degree F after 10 years within temperature range.
 - b. RTD:
 - 1) Construct RTD of nickel or platinum with base resistance of 1000 ohms at 70 degrees F. 100 ohm platinum RTD is acceptable if used with project DDC controllers.
 - 2) Accuracy (All): Plus/minus 1 degree F minimum, unless otherwise noted below.
 - a) Room Sensor Accuracy: Plus/minus 0.5 degrees F minimum.
 - b) Chilled Water Accuracy: Plus/minus 0.5 degrees F minimum.
 - c) Temperature Differential Accuracy: Plus/minus 0.15 degrees F minimum.
 - 3) Resolution: Plus/minus 0.2 degree F.
 - 4) Drift: 0.04 degrees F after 10 years within temperature range.
 - c. Sensing Range:
 - 1) Provide limited range sensors if required to sense the range expected for a respective point.
 - d. Wire Resistance:
 - 1) Use appropriate wire size to limit temperature offset due to wire resistance to 1.0 degree F or use temperature transmitter when offset is greater than 1.0 degree F due to wire resistance.
 - 2) Compensate for wire resistance in software input definition when feature is available in the DDC controller.
3. Room Temperature Sensors:
 - a. Construct for surface or wall box, or enclosure with insulated backing suitable for exterior wall mounting or where noted on the drawings.
 - b. Provide the following features:

- 1) Non-adjustable, blank front panel.
- 2) Locking cover where noted on the drawings.

2.4 OUTPUT CONTROL DEVICES

A. Control Relays:

1. Provide relay with contact rating, configuration, and coil voltage that is suitable for the application.
2. Provide NEMA 1 enclosure when relay is not installed in a local control panel.
3. Control relays shall be UL listed plug-in type with dust cover and LED “energized” indicator.
4. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable plus/minus 200 percent minimum from setpoint.
5. Electromechanical relays shall be UL listed, compact in size, provided with quick connect terminals and be impervious to shock and vibration.
6. Electronic relays shall be microcomputer-based with PI, time proportioning control capability, have average life greater than 500,000 cycles, have a built-in transformer and have LED status indication.

B. Fan Speed Controllers:

1. Solid-state model providing field-adjustable proportional control of motor speed. Equip with filtered circuit to eliminate radio interference.

2.5 POWER SUPPLIES

- A. Control power transformers shall meet NEMA/ANSI standards.
- B. Control power transformers shall be UL listed for Class 2 current-limited service or provided with over-current protection on both primary and secondary circuits for Class 2 current-limited service.
- C. Connected load on the transformer shall not exceed 80 percent of the transformer’s rated capacity.
- D. The core and windings shall be completely encased in a UL approved thermoplastic. No metal parts shall be exposed other than the terminals.
- E. Performance Characteristics:
 1. Accuracy: Plus/minus 1 percent at 5.0 A full scale output.
- F. Provide a disconnect switch for each transformer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.

- B. Verify that systems are ready to receive work.
- C. Beginning of installation means installer accepts existing conditions.
- D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.
- E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.2 EXISTING EQUIPMENT

- A. Pneumatic Equipment: Where equipment is allowed to be reused for project scope as indicated on the drawings, verify the integrity and proper operation of equipment prior to reuse.
- B. Wiring: The contractor may reuse any abandoned wires. The integrity of the wire and its proper applications to the installation are the responsibility of the contractor. The wire shall be properly identified and tested. Unused or redundant wiring that remains in place shall be identified as such.
- C. Local Control Panels: The contractor may reuse any existing local control panels to locate new equipment. All redundant equipment within these panels shall be removed. Panel face cover shall be patched to fill all holes caused by removal of unused equipment or replaced with new.
- D. Repair: Unless otherwise directed, the contractor is not responsible for repair or replacement of existing energy equipment and systems, valves, dampers, or actuators. Should the contractor find existing equipment that requires maintenance, notify the engineer immediately.
- E. Temperature sensor wells: The contractor may reuse any existing wells in piping for temperature sensors. The wells shall be modified as required for proper fit of new sensors.
- F. Indicator Gauges: Where these devices remain and are not removed, recalibrate and ensure reasonable accuracy.
- G. Unless otherwise noted, salvage, recondition, and reuse the following devices:
 - 1. Electronic sensors and transmitters.
 - 2. Controller and auxiliary electronic devices.
 - 3. Control valves.
- H. Patch holes and finish to match existing walls.

3.3 INSTALLATION

- A. Cooperate with other contractors performing work on this project as necessary to achieve a complete and coordinated installation. Each Contractor shall consult the Drawings and Specifications for all trades to determine the nature and extent of others work.

B. General Workmanship:

1. Install equipment, piping, and wiring/raceway parallel to building lines wherever possible.
2. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
3. Install all equipment in readily accessible locations.
4. All installations shall comply with industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.
5. Install all products in accordance with manufacturer's instructions.

C. Sensors:

1. Mount sensors rigidly and adequately for the environment within which the sensor operates.
2. Provide thermistor type temperature sensors for temperature ranges between minus 30 degrees F to 230 degrees F. Provide RTD type temperature sensors for extended ranges beyond minus 30 degrees F to 230 degrees F.
3. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing. Coordinate installation of room/space sensors with architect and other trades to ensure a neat and orderly installation.
4. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
5.
 - a.
6. Verify location and mounting height of thermostats, humidistats, and exposed control sensors with plans and room details before installation. Align with adjacent lighting switches and humidistats.
 - a. Install devices to meet ADA requirements unless otherwise noted on the plans.
7. Provide separable sockets for liquids and flanges for air bulb elements.
8. Provide guards on thermostats in areas indicated on the drawings.
9. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.

D. Control Valves:

1. Do not install brass valves in open-loop systems.
2. Install pipe reducers for valves smaller than line size. Position reducers as close to valve as possible but at distance to avoid interference and impact to performance. Install with manufacturer-recommended clearance.
3. Install flanges or unions to allow valve removal and installation.

4. Locate valves for easy access and provide separate support of valves that cannot be handled by service personnel without hoisting mechanism.
 5. Valve Orientation:
 - a. Where possible, install globe and ball valves installed in horizontal piping with stems upright and not more than 15 degrees off of vertical, not inverted.
 - b. Install valves in a position to allow full stem movement.
 - c. Where possible, install butterfly valves that are installed in horizontal piping with stems in horizontal position and with low point of disc opening with direction of flow.
 6. Provide valves with position indicators where sequenced with other controls.
 7. Tag valves in accordance with Division 23 Section, "Identification for HVAC Piping and Equipment."
- E. Operators:
1. Mount and link control damper actuators according to manufacturer's instructions.
 - a. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5 degrees open position, manually close the damper, and then tighten the linkage.
 - b. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 - c. Provide all mounting hardware and linkages for actuator installation.
 2. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer.
- F. Provide an insulation standoff on control devices, cables, and other items that do not require flush mounting to ductwork, piping, or equipment.

3.4 MAINTENANCE

- A. Refer to Division 01 closeout requirements for additional requirements relating to maintenance service.
- B. Provide service and maintenance of control system for one year from Date of Substantial Completion.
- C. Provide complete service of controls systems, including call backs, and submit written report of each service call.

3.5 STARTUP AND DEMONSTRATION

- A. Control Valves:
 1. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.

2. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.
3. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.
4. Verify that all two-position valves operate properly and that the normal positions are correct.
5. Verify that all modulating valves are functional, that the start and span are correct, that direction and normal positions are correct, and that they achieve proper closure.

3.6 CONTROL VALVE SCHEDULES

A. Allowable Valve Type and Size by Control Application:

VALVE TYPE	CONTROL APPLICATION	
	MODULATING	TWO-POSITION
Globe	≤ 4 IN	≤ 2 IN
Characterized Ball	≤ 4 IN	≤ 4 IN
Butterfly	> 4 IN	≥ 2-1/2 IN

B. Allowable Valve Body Material by Service Application:

VALVE BODY MATERIAL	SERVICE APPLICATION	
	CLOSED LOOP	OPEN LOOP
Bronze	Allowed	Allowed
Brass	Allowed	Not Allowed
Iron	Allowed	Allowed
Stainless Steel	Allowed	Allowed

C. Allowable End Connection by System Material:

1. Copper Tube:
 - a. 2-1/2 Inch and smaller: Threaded ends.
2. Steel Pipe:
 - a. 2 Inch and Smaller: Threaded.
 - b. 2-1/2 Inch and Larger:
 - 1) Flanged.
 - 2) Grooved ends for water systems.

D. Allowable End Connection by Size Schedule:

VALVE TYPE	END CONNECTION TYPE		
	THREADED	FLANGED	GROOVED
Globe	≤ 2-1/2 IN	≤ 4 IN	N/A
Characterized Ball	≤ 2-1/2 IN	≤ 3 IN	N/A
Butterfly	N/A	≥ 2-1/2 IN	≥ 2-1/2 IN

END OF SECTION 230913

SECTION 232113 – HYDRONIC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Hydronic system requirements.
- B. Hydronic piping materials.
- C. Hydronic piping fittings.
- D. Hydronic piping joining materials.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.3 SUBMITTALS

- A. Submit in accordance with conditions of Contract and Division 01 submittal procedures.
- B. Reference Division 23 Section, “Basic Piping Materials and Methods” for additional submittal requirements.
- C. Reports as specified in Part 3 of this Section.
- D. Product Data: Submit product data for hydronic piping that meets the requirements of this section.

1.4 QUALITY ASSURANCE

- A. Comply with Division 23 Section, “Basic Piping Materials and Methods.”
- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this Section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this Section, with minimum three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Division 23 Section, “Basic Piping Materials and Methods.”

PART 2 - PRODUCTS AND MATERIALS

2.1 HYDRONIC PIPING MATERIALS

- A. Carbon Steel Pipe:
 - 1. NPS 2 inch and Smaller: ASTM A53 or A106, Type E electric-resistance welded or Type S seamless, Grade B, Schedule 40, black steel, plain ends.
- B. Copper Tubing:
 - 1. Drawn Temper Tubing: ASTM B88, Type L.

2.2 HYDRONIC PIPING FITTINGS:

- A. General: Fittings shall be of wall thickness, pressure rating, and material matching adjoining pipe.
- B. Reference Division 23 Section “Basic Piping Materials and Methods” for basic piping materials and fittings.
- C. Threaded:
 - 1. All threads shall conform to ASME B1.20.1.
 - 2. Malleable-Iron: ASME B16.3, standard pattern.
 - 3. Cast-Iron: ASME B16.4, standard pattern.
 - 4. Galvanized: ASTM A197, standard pattern.
- D. Flanged:
 - 1. Cast-Iron Threaded: ASME B16.1, raised ground face, bolt holes spot faced.
 - 1. Galvanized Threaded: ASME B16.5, raised ground face, bolt holes spot faced.
 - 2. Wrought Cast-Iron, Forged Steel, and Stainless Steel: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connection, and facing:
 - a. Material Group: 1.1.
 - b. End Connections: Butt welding.
 - c. Facings: Raised face.
- E. Solder-Joint: Wrought-copper, ASME B16.18 or B16.22, streamlined pattern.
- F. Brazed-Joint: Wrought-copper, ASME B16.50, streamlined pattern.

2.3 HYDRONIC PIPING JOINING MATERIALS:

- A. Reference Division 23 Section “Basic Piping Materials and Methods” for basic joining materials.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install products in accordance with manufacturer's instructions.
- B. Install piping to ASME B31.9 requirements.
- C. Reference Division 23 Section "Basic Piping Materials and Methods" for general piping installation requirements.
- D. Do not install PVC or non-plenum rated CPVC piping in return air plenums.

3.2 PIPE APPLICATION SCHEDULE

- A. Heating Hot Water Piping, Above Grade:
 - 1. Acceptable Pipe Materials:
 - a. Carbon steel with threaded fittings for pipes 2 inch and smaller, and flanged or welded fittings for pipes 2-1/2 inch and larger.
 - b. Type L copper with soldered, brazed, or flanged fittings.
 - 2. Fitting Pressure Class: Minimum rating of 125 psig.
- B. Chilled Water Piping, Above Grade:
 - 1. Acceptable Pipe Materials:
 - a. Carbon steel with threaded fittings for pipes 2 inch and smaller, and flanged or welded fittings for pipes 2-1/2 inch and larger.
 - b. Type L copper with soldered, brazed, or flanged fittings.
 - 2. Fitting Pressure Class: Minimum rating of 125 psig.

3.3 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment using jointing system specified.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.4 PIPING INSTALLATION

- A. Provide long radius elbows with a minimum centerline radius of 1-1/2 times the pipe diameter. Short radius elbows with a minimum centerline radius of 1 times the pipe diameter may be used only where space does not permit the long radius elbows.
- B. Install piping at a uniform grade of 1 inch in 40 feet upward in the direction of flow.

- C. Make reductions in pipe sizes using eccentric reducer fitting installed with the level side up.
- D. Install branch connections to mains using Tee fittings in main with take-off out the top or side of the main unless otherwise shown on the drawings. Up-feed risers shall have take-off out the top of the main line.
 - 1. Tee-drilling is prohibited as a means for connecting branch taps into any main.
 - 2. Bull-head tees are prohibited. Do not install tee fittings in such a way that the flow through the branch leg equals the sum of the flows through the two main legs.

3.5 PIPE HANGERS AND SUPPORTS APPLICATION

- C. Comply with the requirements of Division 23 Section “Hangers and Supports for HVAC Piping and Equipment.”

- A. Install hangers with the following minimum rod sizes and maximum spacing:

Nom. Pipe Size - In.	Steel Pipe Max. Span - Ft.	Copper Tube Max. Span - Ft.	Min. Rod Dia. - In.
Up to 3/4	7	5	3/8
1	7	6	3/8
1-1/4	7	7	3/8
1-1/2	9	8	3/8
2	10	8	1/2

- B. Support vertical runs at roof, at each floor, and at maximum 15-foot intervals between floors.
- C. Install a support within one foot of each change of direction.
- D. Space supports not more than five feet apart at valves, strainers, or piping accessories in piping larger than 2 inches.

3.6 PIPE JOINT CONSTRUCTION

- A. Reference Division 23 Section, “Basic Piping Materials and Methods” for basic pipe joint construction.
- B. Where more than one pipe material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
- C. Install non-conductive dielectric connections whenever joining dissimilar metals.
- D. Pipe-to-Valve and Pipe-to-Equipment Connection: Install flanges or unions between piping and valves and equipment for servicing. Do not use direct welded, brazed, or soldered connections unless specifically called for in the manufacturer’s installation instructions.

3.7 FIELD QUALITY CONTROL

A. Preparation for Testing:

1. Prepare hydronic piping in accordance with ASME B31.9.
2. Leave joints, including welds, uninsulated and exposed for examination during the test.
3. Provide temporary restraints for expansion joints which cannot sustain the reactions due to test pressure. If temporary restraints are not practical, isolate expansion joints from testing.
4. Isolate equipment that is not to be subjected to the test pressure from the piping. If a valve is used to isolate the equipment, its closure shall be capable of sealing against the test pressure without damage to the valve. Flanged joints at which blinds are inserted to isolate equipment need not be tested.
5. Install relief valve set at a pressure no more than 1/3 higher than the test pressure, to protect against damage by expansion of liquid or other source of overpressure during the test.

B. Pressure Testing:

1. Use ambient temperature water as the testing medium, except where there is a risk of damage due to freezing. Another liquid may be used if it is safe for workmen and compatible with the piping system components.
2. Use vents installed at high points in the system to release trapped air while filling and prevent vacuum while draining the system. Use drains installed at low points for complete removal of the liquid.
3. Examine system to see that equipment and parts that cannot withstand test pressures are properly isolated. Examine test equipment to ensure that it is tight and that low pressure filling lines are disconnected.
4. Subject piping system to a hydrostatic test pressure which at every point in the system is 1.5 times the maximum system design pressure but not less than 100 psi. The test pressure shall not exceed the maximum pressure for any vessel, pump, valve, or other component in the system under test. Make a check to verify that the stress due to pressure at the bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength, or 1.7 times the "SE" value in Appendix I of ASME B31.9, Code For Pressure Piping, Building Services Piping.
5. After the hydrostatic test pressure has been applied for at least 15 minutes, examine piping, joints, and connections for leaks. Eliminate leaks by tightening, repairing, or replacing components as appropriate, and repeat hydrostatic test until there are no leaks.
6. Provide test reports summarizing the test procedures and results of the tests.

C. Flushing:

1. After satisfactory pressure test is obtained, flush piping system using a minimum velocity of 4 FPS through all portions of the system.

2. Make all provisions required to isolate HVAC equipment, coils, control valves, automatic flow control valves, pressure independent control valves, and balance valves during flushing.
 3. Isolate new pipe from existing pipe during flushing.
 4. Provide temporary valves, connections, and bypasses where required.
 5. System pumps may be used for flushing. Where system pumps are not used, provide temporary pumps with temporary connections.
 6. Continue flushing until discharge water shows no discoloration and strainers are no longer collecting dirt and other foreign materials.
 7. Upon completion of flushing, drain all water from system at low points, and remove, clean, and replace strainers.
 8. Open vents installed at high points in the system to release trapped air while filling and prevent vacuum while draining the system.
- D. Fluid Testing: After filling the system as described under Paragraph “Startup”, perform the following fluid test procedures:
1. Circulate the fluid for a minimum of 24 hours with all pumps operating and with shutoff valves and control valves in wide open position to ensure thorough mixing of the antifreeze or glycol solution throughout the system.
 2. Remove fluid from a minimum of three different locations and test fluid samples at an independent testing agency for percentage of antifreeze or glycol. Coordinate with the testing agency for amount of sample needed for proper testing.
 3. If any sample does not meet the specified percentages, remove sufficient fluid from the system, add antifreeze or glycol as required to achieve the specified percentage and repeat the circulation and testing procedures specified above. Coordinate with the water treatment supplier.
 4. After the samples meet the specified percentages, submit to the Owner and Engineer signed and dated test report(s) from independent testing agency that document the location of the sample and the results of the fluid test.
 5. One month prior to end of the warranty period, Contractor shall submit samples to an independent testing agency to test the fluid for percentage of antifreeze or glycol. If the test samples have the specified percentage, submit copies of the test reports to the Owner and Engineer as described above in Paragraph 4. If any sample does not meet the specified percentage, Contractor shall perform the work described above in Paragraphs 3 and 4.

3.8 ADJUSTING AND CLEANING

- A. After installation of entire system, fill, clean, and treat systems.
- B. Cleaning Agent Concentration:
 1. Use neutralizer agents on recommendation of system cleaner supplier and approval of Engineer.
- C. Hot Water Heating Systems:

1. Apply heat while circulating, slowly raising temperature to 160 F and maintain for 12 hours minimum.
 2. Remove heat and circulate to 100 F or less, drain systems as quickly as possible.
 3. Refill with clean water and circulate for 6 hours at design temperatures, then drain.
 4. Refill with clean water and repeat until system cleaner is removed.
- D. Chilled Water Systems:
1. Circulate for 48 hours, then drain systems as quickly as possible.
 2. Refill with clean water, circulate for 24 hours, then drain.
 3. Refill with clean water and repeat until system cleaner is removed.
- E. Open vents installed at high points in the system to release trapped air while filling and prevent vacuum while draining the system.
- F. Remove and clean or replace strainer screens.
- G. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.
- H. After cleaning system, but before balancing, remove disposable fine mesh strainers in pump suction diffusers.
- I. Mark calibrated name plates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.
- J. Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.
- K. Inspect valves for leaks after piping systems have been tested and put into service, but before final adjusting and balancing. Adjust or replace packing, as required, on valves with leaks. Replace valve if leak persists.

3.9 STARTUP

- A. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.
- B. Before operating the system perform these steps:
1. Open valves to full open position. Close coil bypass valves.
 2. Remove and clean strainers.
 3. Check pump for proper direction of correct improper wiring.
 4. Set automatic fill valves for required system pressure.
 5. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type).
 6. Set temperature controls so all coils are calling for full flow.

7. Check operation of automatic bypass valves.
8. Check and set operating temperatures of boilers, chillers, and cooling towers to design requirements.
9. Lubricate motors and bearings.

END OF SECTION 232113

SECTION 233113 – METAL DUCTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Metal ductwork.
- B. Duct sealants.
- C. Duct hangers and supports.

1.2 DEFINITIONS

- A. Sealing Requirements Definitions: For the purposes of duct systems sealing requirements specified in this Section, the following definitions apply:
 - 1. Seams: A seam is defined as joining of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints.
 - 2. Joints: Joints include girth joints; branch and subbranch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes or alterations to the layout or configuration of the duct system must be specifically approved in writing. Accompany requests for layout modifications with calculations showing that the proposed layout will provide the original design results without increasing the system total pressure.

1.4 SUBMITTALS

- A. Product data including details of construction relative to materials, dimensions of individual components, profiles, and finishes for the following items:
 - 1. Sealing Materials.
- B. Record drawings including duct systems routing, fittings details, reinforcing, support, and installed accessories and devices, in accordance with Division 23 Section "General Mechanical Requirements" and Division 1.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

- C. NFPA Compliance: Comply with the following NFPA Standards:
 - 1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," except as indicated otherwise.
 - 2. NFPA 90B, "Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
- D. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA): Provide ductwork systems in conformance with "HVAC Duct Construction Standards – Metal and Flexible," latest edition.
- E. Underwriter's Laboratories (UL): Comply with the UL standards listed within this section. Provide mastic and tapes that are listed and labeled in accordance with UL 181A and marked according to type.

1.6 PROTECTION AND REPLACEMENT

- A. Protect ductwork during shipping and storage from dirt, debris and moisture damage. Provide plastic covers over ends of ductwork during shipping, storage and installation.

1.7 FIELD CONDITIONS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 - PRODUCTS AND MATERIALS

2.1 DUCT ASSEMBLIES

- A. Ducts: Galvanized steel, unless otherwise indicated. Provide sheet metal in thickness indicated (minimum 26 gauge), packaged and marked as specified in ASTM A700.
- B. General Exhaust: 2 inch w.g. pressure class, galvanized steel.

2.2 MATERIALS

- A. Sheet Metal, General: Provide sheet metal in thickness indicated (minimum 26 gauge), packaged and marked as specified in ASTM A 700.
- B. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, lock-forming quality with G90/Z275 coating.. Provide mill phosphatized or galvanized finish for surfaces of ducts exposed to view that is to be field painted. Provide bright galvanized finish for ductwork that is exposed to view and not field painted.
- C. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.

1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
2. Surface Burning Characteristics: Sealants shall be ASTM E84 or UL 723 listed with a flame spread index not more than 25 and a smoke-developed index not more than 50.
3. For Use with Flexible Ducts: UL labeled.
4. The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics. Duct tape shall not be used as a sealant on any ducts.
5. Joint and Seam Tape: 2 inches wide, glass-fiber-reinforced fabric.
6. Tape Sealing System: Woven-fiber tape impregnated with a gypsum mineral compound and a modified acrylic/silicone activator to react exothermically with the tape to form a hard, durable, airtight seal.
7. Solvent-Based Joint and Seam Sealant: One-part, non-sag, solvent-release-curing, polymerized butyl sealant complying with FS TT-S-001657, Type I; formulated with a minimum of 65 percent solids. Approved products: Design Polymerics DP 1090, Duro Dyne SGD, Fosters 32-14, or approved equal.
8. Water-Based Joint and Seam Sealant: Non-Fibrated, UL 181 listed, rated to minimum SMACNA Pressure Class of ± 10 inches w.g and SMACNA Seal Class A. Sealant shall have a minimum service temperature range of 20 to 200 F and be freeze/thaw stable through 5 cycles. Approved products: Childers CP-146, Design Polymerics DP 1010, Ductmate Proseal, Duro Dyne Duroseal EDS-RS, Fosters 32-18, Hardcast Iron-Grip 601, Red Devil D-Seal and United McGill United Duct Seal WB.
9. Water-Based Joint and Seam Sealant: Fiber reinforced, UL 181 listed, rated to minimum SMACNA Pressure Class of ± 10 inches w.g and SMACNA Seal Class A. Sealant shall have a minimum service temperature range of 20 to 200 F and be freeze/thaw stable through 5 cycles. Approved products: Childers CP-146, Design Polymerics DP 1030, Ductmate Fiberseal, Duro Dyne Duroseal EDS-RF, Fosters 32-17, Hardcast CCWI-181, Red Devil F-Seal 181 or United McGill Uni-Mastic.
10. Flanged Joint Mastics: One-part, acid-curing, silicone elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.
11. Flanged Gasket Tapes: Butyl gasket shall be UL 181 classified. Gasket size shall be minimum 5/8 inch x 3/16 inch and have nominal 100 percent solid content. It shall be non-oxidizing, non-skinning and have a service temperature of -25 to 180 F. Approved Products: Design Polymerics DP 1040, Ductmate 440, and Hardcast 1104.

D. Hangers and Supports

1. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
2. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
 - a. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.

- b. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 - c. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 - d. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
 - e. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
- 3. Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials. Do not use powder actuated concrete fasteners for lightweight aggregate concrete or for slabs less than 4 inches thick.
- 4. Hangers: Galvanized sheet steel, or round, uncoated steel, threaded rod.
 - a. Hangers Installed In Corrosive Atmospheres: Electro-galvanized, all-thread rod or hot-dipped-galvanized rods with threads painted after installation.
 - b. Straps and Rod Sizes: Conform with SMACNA HVAC Duct Construction Standards, 2005 Edition, for sheet steel width and gauge and steel rod diameters.
- 5. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- 6. Trapeze and Riser Supports: Steel shapes conforming to ASTM A 36.
 - a. Where galvanized steel ducts are installed, provide hot-dipped-galvanized steel shapes and plates.
- E. Reinforcement Shapes and Plates: Unless otherwise indicated, provide galvanized steel reinforcing where installed on galvanized sheet metal ducts. For aluminum and stainless steel ducts provide reinforcing of compatible materials.
- F. Tie Rods: Same material as the duct, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 DUCTWORK FABRICATION

- A. Fabricate and support duct in accordance with latest edition of SMACNA (DCS).
- B. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
 - 1. Fabricate rectangular ductwork of minimum 26 gauge sheet metal.
 - 2. Fabricate ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
- C. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.
- D. Cross breaking or Cross Beading: Cross break or bead duct sides that are 19 inches and larger and are 20 gauge or less, with more than 10 sq. ft. of unbraced panel area, as indicated in SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figure 2-9, unless they are lined or are externally insulated.

- E. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA "HVAC Metal Duct Construction Standard," 2005 Edition, Figures 4-1 through 4-8. Unless otherwise noted on drawings, provide prefabricated 45 degree, high efficiency, rectangular/round branch duct takeoff fittings with manual balancing damper, 3/8 inch square shaft, U-bolt, nylon bushings, locking quadrant, and 2 inch insulation build-out for branch duct connections and take-offs to individual diffusers, registers and grilles. 45 degree, high efficiency, rectangular/round branch duct takeoff fittings shall be Flexmaster STO with model BO3 damper or equal.
- F. Provide radius elbows, turns, and offsets with a minimum centerline radius of 1-1/2 times the duct width. Where space does not permit full radius elbows, provide short radius elbows with a minimum of two continuous splitter vanes. Vanes shall be the entire length of the bend. The use of square throat, radius heel elbows is prohibited. Remove and replace all installed elbows of this type with an approved elbow at no additional cost to the owner.
- G. Provide mitered elbows where space does not permit radius elbows, where shown on the drawings, or at the option of the contractor with the engineer's approval. The contractor shall obtain approval to substitute mitered elbows in lieu of radius elbows prior to fitting fabrication. Mitered elbows less than 45 degrees shall not require turning vanes. Mitered elbows 45-degrees and greater shall have single thickness turning vanes of same material and gauge as ductwork, rigidly fastened with guide strips in ductwork. Vanes for mitered elbows shall be provided in all supply and exhaust ductwork and in return and outside air ductwork that has an air velocity exceeding 1000 fpm. Do not install vanes in grease ductwork. Refer to Section "Ductwork Accessories" for turning vane construction and mounting.
- H. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Install products in accordance with manufacturer's instructions.
- C. Install ducts with the fewest possible joints.
- D. Seal duct joints with the appropriate sealing material.
- E. Use fabricated fittings for all changes in directions, changes in size and shape, and connections.
- F. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.
- G. Locate ducts, except as otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install duct systems in shortest route

that does not obstruct useable space or block access for servicing building and its equipment.

- H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Provide clearance of 1 inch where furring is shown for enclosure or concealment of ducts, plus allowance for insulation thickness, if any.
- J. Install insulated ducts with 1-inch clearance outside of insulation.
- K. Conceal ducts from view in finished and occupied spaces by locating in mechanical shafts, hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown.
- L. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
- M. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- N. Non-Fire-Rated Partition Penetrations: Where ducts pass interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gauge as duct. Overlap opening on 4 sides by at least 1-1/2 inches.
- O. Cover ducts openings during construction with duct caps or three-mil plastic to protect inside of (installed and delivered) ductwork from exposure to dust, dirt, paint and moisture. Do not use duct tape on ducts that will be exposed or painted.
- P. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- Q. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- R. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.
- S. Seam and Joint Sealing
 - 1. General: Seal duct seams and joints as follows:
 - a. All transverse joints, longitudinal seams, and duct wall penetrations shall be sealed to meet SMACNA Seal Class A.
 - b. Seal class shall apply to all supply, return, outdoor air, and exhaust ductwork, regardless if the duct is positively or negatively pressurized. Transfer air ducts and sound boots do not need to be sealed.
 - 2. Seal externally insulated ducts prior to insulation installation.

T. Hanging and Supporting

1. Install rigid round, rectangular, and flat oval metal duct with support systems per SMACNA standards.
2. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.
3. Support vertical ducts at a maximum interval of 16 feet and at each floor.
4. Upper attachments to structures shall have an allowable load not exceeding 1/4 of the failure (proof test) load but are not limited to the specific methods indicated. Hangers and supports shall be fastened to building joists or beams. Do not attach hangers and supports to the above floor slab or roof with sheet metal screws.
5. Provide double nuts and lock washers on threaded rod supports.
6. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

U. Connections

1. Equipment Connections: Connect equipment with flexible connectors in accordance with Division 23 Section "Air Duct Accessories."
2. Branch Connections: Comply with SMACNA "HVAC Duct Construction Standards".
3. Outlet and Inlet Connections: Comply with SMACNA "HVAC Duct Construction Standards". Where a 90-degree elbow is required at the connection to air devices, provide a rigid duct elbow or, at Contractor's option, a flexible elbow assembly as specified in Division 23 Section "Air Duct Accessories."
4. Fan Connections: Comply with SMACNA "HVAC Duct Construction Standards".

3.2 ADJUSTING, STARTUP

- A. Adjust volume control devices as required by the testing and balancing procedures to achieve required air flow. Refer to Division 23 Section "Testing, Adjusting and Balancing for HVAC" for requirements and procedures for adjusting and balancing air systems.
- B. Remove temporary protection devices over ductwork prior to starting equipment and turning the system over to the owner.
- C. If permanent HVAC equipment is used during the construction period, provide temporary filters at all openings in the ductwork and at inside equipment to protect the system from dust, dirt, paint, and moisture. Replace and maintain filters when needed, but not less than every month. On the day of substantial completion, clean the duct system and provide a new set of filters in the HVAC unit.

END OF SECTION 233113

SECTION 233713 – DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Registers and grilles.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:
 - 1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.
 - 2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details. Indicate selections on product data.
 - 3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings at specified airflows.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.
- C. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.

1.3 QUALITY ASSURANCE

- A. Test and rate air outlets and inlets in accordance with ASHRAE 70 “Method of Testing the Performance of Air Outlets and Inlets”.
- B. Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 “Certification, Rating and Test Manual”.
- C. Provide air outlets and inlets bearing ADC Certified Rating Seal.
- D. Test and rate sound data for air outlets and inlets in accordance with AHRI 885 “Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets (with Addendum 1)”.
- E. Install air outlets and inlets in accordance with NFPA 90A “Standard for the Installation of Air Conditioning and Ventilating Systems”.

1.4 SPARE PARTS

- A. Furnish to Owner, with receipt, 3 operating keys for each type of air outlet and inlet that require them.

PART 2 - PRODUCTS

2.1 REGISTERS AND GRILLES

- A. Manufacturers
 - 1. Carnes Co.
 - 2. Greenheck.
 - 3. Krueger Mfg. Co.
 - 4. Metalaire; Metal Industries, Inc.
 - 5. Nailor Industries, Inc.
 - 6. Price Industries, Inc.
 - 7. Titus HVAC
 - 8. Tuttle & Bailey; Div. of Air Systems Components, Inc.
- B. General: Except as otherwise indicated, provide manufacturer's standard registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and provided with accessories as required for a complete installation.
- C. Performance: Provide registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device and listed in manufacturer's current data.
- D. Ceiling Compatibility: Provide registers and grilles with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of register and grille.
- E. Wall Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall construction which will contain each type of wall register and grille.
- F. Types: Provide registers and grilles of type, capacity, and with accessories and finishes as scheduled on the drawings.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which air outlets and inlets are to be installed for compliance with installation tolerances and conditions that would affect the performance of the equipment. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install air outlets and inlets in accordance with manufacturer's written instructions, design drawings, referenced standards, and in accordance with recognized industry practices to ensure that products serve intended function.
- B. Coordinate with other work, including ductwork and duct accessories, to interface installation of air outlets and inlets with other work.
- C. Where a 90-degree elbow is required at the connection to air devices, provide a rigid duct elbow.
- D. Locate ceiling grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling module.

3.3 ADJUSTING

- A. After installation, adjust grilles to air patterns indicated, or as directed, before beginning air balance.

3.4 CLEANING

- A. After installation of grilles, inspect exposed finish. Clean exposed surfaces to remove dirt and smudges. Replace any air device that has damaged finishes.

END OF SECTION 233713

SECTION 238200 – TERMINAL HEATING AND COOLING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fan-Coil units

1.2 SUBMITTALS

- A. Product Data: Submit product data for terminal heating and cooling units showing capacities, ratings, performance characteristics, and gages and finishes of materials.
 - 1. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to terminal heating and cooling units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- B. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, construction details, and field connection details.
 - 1. Indicate length and number of pieces of elements and enclosures.
 - 2. Show corner pieces, end caps, cap strips, access doors and pilaster covers.
 - 3. Show support points and fastening methods.
- C. Manufacturer's Instructions: Indicate installation instructions and recommendations.
- D. Operation and Maintenance Data: Submit maintenance instructions, including lubrication instructions, filter replacement, motor and drive replacement, and spare parts lists.
- E. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. AHRI Compliance: Comply with the following AHRI standards for the applicable components specified herein.
 - 1. AHRI 210/240 "Performance Rating of Unitary Air-conditioning & Air-Source Heat Pump Equipment".
 - 2. AHRI 350 "Sound Performance Rating of Non-Ducted Indoor Air Conditioning Equipment".
 - 3. AHRI 410 "Forced-Circulation Air-Cooling and Air-Heating Coils".
 - 4. AHRI 440 "Performance Rating of Room Fan-Coil".
 - 5. AHRI 840 "Performance Rating of Unit Ventilators".

- C. I=B=R Compliance: Test and rate baseboard and finned tube radiation in accordance with I=B=R, provide published ratings bearing emblem of I=B=R.
- D. ISO Compliance: Fan coil units shall be manufactured in accordance with standard ISO 9001, Quality Management Systems, most current edition.
- E. NFPA Compliance:
 - 1. NFPA 70 "National Electric Code".
 - 2. NFPA 90A "Standard for the Installation of Air-Conditioning and Ventilating Systems".
- F. UL compliance:
 - 1. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
 - 2. UL 674 "Electrical Motors and Generators for Use in Hazardous (Classified) Locations".
 - 3. UL 723 "Standard for Test for Surface Burning Characteristics of Building Materials, Underwriter's Laboratory".
 - 4. UL 1995 "Heating and Cooling Equipment.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Handle terminal heating and cooling units and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged terminal heating and cooling units or components; replace with new.
- B. Store terminal heating and cooling units and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.
- C. Comply with Manufacturer's rigging and installation instructions for unloading terminal heating and cooling units, and moving them to final location.

1.5 SPARE PARTS

- A. General: Furnish to Owner, with receipt, the following spare parts for terminal heating and cooling units.
 - 1. One set of matched fan belts for each belt driven fan.
 - 2. One set of spare filters of each type required for each unit. Obtain receipt from Owner that spare filters have been provided. In addition to the spare set of filters, install new filters at completion of installation work, and prior to testing, adjusting, and balancing work.

PART 2 - PRODUCTS AND MATERIALS

2.1 VERTICAL STACKED FAN COIL UNITS

- A. Manufacturers:

1. Airtherm Manufacturing Company.
 2. American Aldes.
 3. Carrier Corporation.
 4. Daikin Applied.
 5. Enviro-Tec by Johnson Controls, Inc.
 6. International Fan Coils.
 7. Johnson Controls, Inc.
 8. The Whalen Company.
 9. Williams.
 10. Zendher Rittling.
- B. General: Provide unit with a casing including a riser enclosure, drain pan, supply air grille, motor, fan, water coil(s), electric heat (if scheduled), piping risers, thermostat and fan switch, valve packages and return air/access door. Provide individual unit size and capacities as scheduled on the drawings.
1. Provide 10% extra motors and thermostats to the owner.
 2. Units shall be listed according to UL 1995.
 3. Units shall be listed according to CSA C22.2 No. 236.
 4. Units shall be certified according to AHRI 440.
 5. Units shall be manufactured in accordance with ISO 9001.
- C. Configuration: Provide vertical stacked fan coil units with configuration as scheduled on the drawings and accessories as specified herein.
1. Exposed Models: Furnish unit with double deflection supply grilles and removable return grille for access to internal components. Provide double supply arrangement where indicated on the drawings. Fabricate casing with no exposed fasteners and provide factory-applied, baked-on enamel finish, color as selected by the Architect.
 2. Floor mounted units: Provide adjustable leveling legs.
- D. Casing: Fabricate unit casing of minimum 20 gauge galvanized steel with minimum 18 gauge fan deck. All Construct cabinets of single piece sides to maintain trueness of plumb during field installation of the fan coil unit. Insulate all surfaces in contact with the air stream with minimum 1/2" thick insulation for quiet operation and thermal efficiency.
1. Provide elastomeric closed cell foam conforming to UL 181, NFPA 90A, and ASTM E-84 or UL 723.
- E. Riser Enclosure: Provide piping riser enclosure, fabricated of minimum 20 gauge galvanized or stainless steel as an integral part of the unit casing. The enclosure shall completely enclose the risers and shall be capable of having the wall material attached directly to the sheet metal where required. Dual units shall share a common riser chase.
- F. Risers: Ship risers loose, labeled by floor, room, and riser number. Pressure test risers prior to installing units.

- G. Drain Pan: Construct the drain pan of one piece 18 gauge galvanized steel with welded uncut corners and insulated with closed cell, fire retardant, foamed in place insulation. Provide a drain pipe and trap factory connected to the riser.
- H. Supply Air Grille: Provide supply air grille(s) of adjustable double deflection type constructed of aluminum and painted (color to be selected by the owner). Ship grille separate for contractor installation (except on exposed cabinet units).
- I. Return Air Grille: Provide panel with return air grille constructed of minimum 18 gauge galvanealed or cold rolled steel material and provided with quarter turn fasteners. Paint panel and grille with powder coat finish to match the supply air grille (color to be selected by owner). Ship panel separate for contractor field installation.
- J. Filter: Provide factory-installed, minimum one inch thick, throwaway, pleated glass fiber type filter, easily accessed for removal by simple removal of the return air/access panel. Provide filters with minimum MERV rating per ASHRAE 52.2 of MERV 8 or as scheduled on the drawings.
- K. Fan Motor: Provide resilient mounted, quiet, high efficient, permanent split capacitor, three speed type fan motor with thermal overload protection, wired to the unit electrical control panel. Provide permanently lubricated sleeve type bearings. Provide a quick connect plug for easy removal and servicing.
- L. Fan: Provide a centrifugal, forward curved, double width, double inlet, direct driven type fan. Fan wheel shall be galvanized steel enclosed in a galvanized steel or painted steel housing. The fan shall be statically and dynamically balanced. The fan and coil shall be arranged in a draw-through configuration. The complete fan and motor assembly shall be easily removed through the return air/access door.
- M. Water Coils: Provide water coils constructed of minimum 1/2" OD copper tubes with aluminum fins mechanically bonded to the tubes. Design for minimum 200 psi working pressure, and factory pressure test at minimum 300 psi under water. Arrange coils such that the air is directed across the entire face of the coil. Provide manual air vents on all coils.
- N. Unit Piping:
1. Provide supply, return and drain risers with interconnecting piping fabricated of a minimum of type L copper tubing. Provide expansion loops on the heating riser to coil connection designed for movement of at least 1" in either direction for thermal expansion. Provide valve package consisting of a two-way or three-way electric control valve with removable actuator, strainer, automatic balancing valve with ports, Pete's plug, and a ball valve on the inlet and outlet for isolation. Factory assemble piping packages including interconnecting pipe and factory tested for leaks. Locate valve packages in a serviceable location over the coil and primary drain pan. Refer to drawings for type of control valve.
 2. Factory insulate the unit risers and condensate drain line with minimum 1/2" thick closed cell flexible foam insulation with all joints tightly sealed. Factory cut the risers to length to fit building floor to floor dimensions and include a 3" long swaged fitting at the top of each riser to accommodate joining the risers in the field. Factory install pipe reducers (see drawings for size requirements)

3. Provide minimum 450 PSI rating stainless steel flexible hoses for connection to supply and return risers.
- O. Controls: Provide thermostat designed for wall mounting (line voltage) with heat-cool-off system switch and automatic changeover with temperature settings . Mount thermostat on the same wall as the return/air access panel and provide with a plug-in wiring connector to match the plug provided within the units' control box. Include a fan control switch with off-low-medium-high control in the sub base for the thermostat. . Provide the sequence of operation specified on the drawings.
- P. Electrical Service Switch: Factory wire all unit power wiring from the unit electrical components to a unit junction box. Provide supply voltage as scheduled on the drawings.
- Q. Access: shall provide access to all internal components including motor-blower assembly, filters, piping, valves and wiring including terminal connections by removal of the return air grille, supply air grilles and/or front decorator panel.
- R. Accessories: Provide the following accessories with each fan coil unit:
 1. Factory-mounted disconnect switch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive terminal heating and cooling units for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install terminal heating and cooling units in accordance with manufacturer's written instructions.
- B. Arrange installation of units to provide access space around units for service and maintenance.
- C. Fan Coil Units
 1. Install fan coil units level and plumb.
 2. Install fan coil units to comply with NFPA 90A.
 3. Provide supports as required for wall mounting of the fan coil unit in the existing wall opening.

3.3 PIPING CONNECTIONS

- A. Piping: Piping installation requirements are specified in other Division 23 sections. The Drawings indicate the general arrangement of piping, valves, fittings, and specialties. The following are specific connection requirements:

1. Arrange piping installations adjacent to units to allow unit servicing and maintenance.
2. Connect water supply piping to the air leaving side of water coils.
3. Connect condensate drain piping to the unit with appropriate trap. Verify that the piping material and installation is in accordance with Division 22 requirements.

3.4 ELECTRICAL WIRING

- A. General: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electric Installer.
 1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 Sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

3.5 ADJUSTING AND CLEANING

- A. General: Just prior to substantial completion clean unit's exposed surfaces and vacuum clean internal components including fan wheel, fan cabinet, all heat exchange surfaces, cooling/heating coil sections, filter sections, access sections, etc.
- B. Retouch any marred or scratched surfaces of factory-finished surfaces, using finish materials furnished by manufacturer.
- C. Install new filters in terminal heating and cooling units requiring same. Do not operate units without filters installed.

3.6 STARTUP

- A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:
 1. Remove shipping, blocking, and bracing.
 2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
 3. Perform cleaning and adjusting specified in this Section.
 4. Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
 5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
- B. Start-Up Services: Start-up terminal heating and cooling units in accordance with manufacturer's written start-up instructions. Do not operate units without filters installed. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

1. Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
 - a. Replace fan and motor pulleys as required to achieve design conditions.
 - b. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for procedures for system testing, adjusting, and balancing.

3.7 TRAINING

- A. At a time mutually agreed upon between the Owner and Contractor, engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain terminal heating and cooling units.
- B. Content: Training shall include but not be limited to:
 1. Overview of the system and/or equipment as it relates to the facility as a whole.
 2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
- C. Review data included in the operation and maintenance manuals.

END OF SECTION 238200

SECTION 260010 – GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and to all following sections within Division 26.

1.2 SECTION INCLUDES

- A. This Division requires providing complete functioning systems, and each element thereof, as specified, indicated, or reasonably inferred, on the Drawings and in these Specifications, including every article, device, or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the Work include, but are not limited to, materials, labor, supervision, supplies, tools, equipment, transportation and utilities.
- B. Division 26 of these Specifications, and Drawings numbered with prefixes E, generally describe these systems, but the scope of the electrical work includes all such work indicated in all of the Contract Documents, including, but not limited to: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing and Electrical Drawings and Specifications; and Addenda.
- C. Drawings are graphic representations of the Work upon which the Contract is based. They show the materials and their relationship to one another, including sizes, shapes, locations, and connections. They also convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, outlets and circuits without showing all of the exact details as to elevations, offsets, control lines, and other installation requirements. Use the Drawings as a guide when laying out the Work and to verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers' requirements, will ensure a complete, coordinated, satisfactory and properly operating system.
- D. Specifications define the qualitative requirements for products, materials, and workmanship upon which the Contract is based.

1.3 DEFINITIONS

- A. Whenever used in these Specifications or Drawings, the following terms shall have the indicated meanings:
 - 1. Furnish: "To supply and deliver to the project site, ready for unloading, unpacking, assembling, installing, and similar operations."
 - 2. Install: "To perform all operations at the project site, including, but not limited to, and as required: unloading, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, testing, commissioning, starting up and similar operations, complete, and ready for the intended use."

3. Provide: “To furnish and install complete, and ready for the intended use.”
 4. Furnished by Owner (or Owner-Furnished) or Furnished by Others: “An item furnished by the Owner or under other Divisions or Contracts, and installed under the requirements of this Division, complete, and ready for the intended use, including all items and services incidental to the Work necessary for proper installation and operation. Include the installation under the warranty required by this Division.
 5. Engineer: Where referenced in this Division, “Engineer” is the Engineer of Record and the Design Professional for the Work under this Division.
 - a. A Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the “Architect”.
 6. Contract Administrator: Where referenced in this Division, “Contract Administrator” is the primary liaison between the Owner and the Contractor. Specifically, for this project this is the “Engineer”.
 7. AHJ: The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
 8. NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other NRTLs that are acceptable to the AHJ, and standards that meet the specified criteria.
 9. Substitution: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.
 - a. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - b. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
 10. Value Engineering: A systematic method to improve the “value” of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.
 11. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified
- B. When 'furnish', 'install', 'perform', or 'provide' is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.

- C. The terms "approved equal", "equivalent", or "equal" are used synonymously and shall mean "accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified". The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.
- D. Manufacturers: The listing of specific manufacturers does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed are not relieved from meeting these specifications in their entirety.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - 3. Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference, unless otherwise noted.

1.4 REFERENCE STANDARDS

- A. Execute all work in accordance with, and comply at a minimum with, National Fire Protection Association (NFPA) codes, state and local building codes, and all other applicable codes and ordinances in force, governing the particular class of work involved, for performance, workmanship, equipment, and materials. Additionally, comply with rules and regulations of public utilities and municipal departments affected by connection of services. Where conflicts between various codes, ordinances, rules, and regulations exist, comply with the most stringent. Wherever requirements of these Specifications, Drawings, or both, exceed those of the above items, the requirements of these Specifications, Drawings, or both, shall govern. Code compliance, at a minimum, is mandatory. Construe nothing in these Construction Documents as permitting work not in compliance, at a minimum, with these codes. Bring all conflicts observed between codes, ordinances, rules, regulations and these documents to the Contract Administrator's and Engineer's attention in sufficient time, prior to the opening of bids, to prepare the Supplementary Drawings and Specifications Addenda required to resolve the conflict.
- B. If the conflict is not reported timely, prior to the opening of bids, resolve the conflict and provide the installation in accordance with the governing codes and to the satisfaction of the Contract Administrator and Engineer, without additional compensation. Contractor will be held responsible for any violation of the law.
- C. Obtain timely inspections by the constituted authorities having jurisdiction; and, upon final completion of the Work, obtain and deliver to the Owner executed final certificates of acceptance from these authorities having jurisdiction.
- D. All material, manufacturing methods, handling, dimensions, methods of installation, and test procedures shall conform to industry standards, acts, and codes, including, but not limited to the following, except where these Drawings and Specifications exceed them:

IBC	International Building Code
IECC	International Energy Conservation Code
ANSI	American National Standards Institute
ASTM	American Society of Testing Materials
AWS	American Welding Society
ADA	Americans with Disabilities Act

AWWA	American Water Works Association
ICEA	Insulated Conductors Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
NBFU	National Board of Fire Underwriters
NEC	National Electrical Code, NFPA 70
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers' Association
NETA	InterNational Electrical Testing Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Act
UL	Underwriter's Laboratories

- E. Comply with rules and regulations of public utilities and municipal departments affected by connections of services.
- F. Perform all electrical work in compliance with applicable safety regulations, including OSHA regulations. All safety lights, guards, and warning signs required for the performance of the electrical work shall be provided by the Contractor.
- G. Obtain and pay for all permits, licenses and fees that are required by the governing authorities for the performance of the electrical work.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with other divisions for electrical work included in them but not listed in Division 26 or indicated on electrical Drawings.
- B. Visit the site and ascertain the conditions to be encountered in installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provisions for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, and incorrect or faulty installation of any of the Work under this Division or for additional compensation for any work covered by this Division.
- C. Refer to Drawings and divisions of the other trades and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. Make all offsets required to clear equipment, beams and other structural members, and to facilitate concealing conduit in the manner anticipated in the design.
- D. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
- E. Provide materials with trim that will fit properly the types of ceiling, wall, or floor finishes installed.
- F. Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

- G. Maintain an electrical foreman on the jobsite at all times to coordinate this work with other trades so that various components of the electrical systems is installed at the proper time, fits the available space, and allows proper service access to all equipment. Carry on the Work in such a manner that the Work of the other trades will not be handicapped, hindered, or delayed at any time.
- H. Work of this Division shall progress according to the "Construction Schedule" as described in Division 01 and as approved by the Contract Administrator. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of all schedule dates.

1.6 MEASUREMENTS AND LAYOUTS:

- A. The Drawings are schematic in nature but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the Work. Figured dimensions take precedence to scaled dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. Correct, at no additional costs to the Owner, errors that could have been avoided by proper checking and inspection.

1.7 SUBMITTALS

- A. Refer to Division 01 and General Conditions for submittal requirements in addition to requirements specified herein.

1.8 SUBSTITUTIONS

- A. Refer to Division 01 and General Conditions for substitutions in addition to requirements specified herein.
- B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.
- C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.

1.9 ELECTRONIC DRAWING FILES

- A. In preparation of shop drawings or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of \$200 for a drawing set up to 12 sheets and \$15 per sheet for each additional sheet.
- B. Contractor shall request and complete the Electronic File Release Agreement form from the Engineer. Send the form along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form.
- C. Contact the Contract Administrator for written authorization.

- D. The following must be received before electronic drawing files will be sent:
 - 1. Contract Administrator's written authorization
 - 2. Engineer's release agreement form
 - 3. Payment

1.10 QUALITY ASSURANCE

- A. Execute all work under this Division in a thorough and professional manner by competent and experienced workmen duly trained to perform the work specified.
- B. Install all work in strict conformance with all manufacturers' requirements and recommendations, unless these Documents exceed those requirements. Install all equipment and materials in a neat and professional manner, aligned, leveled, and adjusted for satisfactory operation, in accordance with NECA guidelines.
- C. Unless indicated otherwise on the Drawings, provide all material and equipment new, of the best quality and design, free from defects and imperfections and with markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Provide all material and equipment of the same type from the same manufacturer whenever practicable.
- D. Unless specified otherwise, manufactured items of the same types specified within this Division shall have been installed and used, without modification, renovation, or repair for not less than one year prior to date of bidding for this Project.

1.11 OPERATION AND MAINTENANCE MANUALS

- A. Refer to Division 01 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.

1.12 RECORD DRAWINGS

- A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.

1.13 DELIVERY, STORAGE AND HANDLING

- A. Refer to Division 01 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.

1.14 WARRANTIES

- A. Refer to Division 01 and General Conditions for Warranties in addition to requirements specified herein.

1.15 FIELD CONDITIONS

- A. Conditions Affecting Work In Existing Buildings: The following project conditions apply:

1. The Drawings describe the general nature of remodeling to the existing building; however, visit the site prior to submitting bid to determine the nature and extent of work involved.
2. Schedule work in the existing building with the Owner.
3. Perform certain demolition work prior to the remodeling. Perform the demolition that involves electrical systems, Light fixtures, equipment, raceways, equipment supports or foundations and materials.
4. Remove articles that are not required for the new work. Unless otherwise indicated, remove each item removed during this demolition from the premises and dispose in accordance with applicable federal, state and local regulations.
5. Relocate and reconnect electrical facilities that must be relocated in order to accomplish the remodeling shown in the Drawings or indicated in the Specifications. Where electrical equipment or materials are removed, cap unused raceways below the floor line or behind the wall line to facilitate restoration of finish.
6. Finish material will be installed under other divisions.
7. Obtain permission from the Contract Administrator for roof penetrations and channeling of floors or walls not specifically noted on the Drawings.
8. Protect adjacent materials indicated to remain. For work specific to this Division, install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
9. Locate, identify, and protect electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, provide temporary services for affected areas.

B. Use of explosives is not permitted.

PART 2 - PRODUCTS AND MATERIALS

(Not Used)

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

3.2 EXISTING CONDITIONS

- A. Existing conditions indicated on the Drawings are taken from the best information available from the Owner, existing record drawings, and from limited, in-situ, visual site observations; and, they are not to be construed as "AS BUILT" conditions. The information is shown to help establish the extent of the new work.

- B. Verify all actual existing conditions at the project site and perform the Work as required to meet the existing conditions and the intent of the Work indicated.
- C. Notify Contract Administrator immediately of any dangerous conditions that exist on the job site, as they are discovered, before demolition, during selective demolition or before remodel work begins.

3.3 WORK IN EXISTING FACILITIES

- A. The Drawings describe the general nature of remodeling to the existing facilities; however, visit the site prior to submitting a bid, to determine the nature and extent of work involved.
- B. Schedule work in the existing facility with the Owner.
- C. Certain demolition work shall be performed prior to the remodeling. Perform the demolition that involves electrical systems, fixtures, conduit, wiring, equipment, equipment supports or foundations and materials.
- D. Remove all of these articles that are not required for the new work. Unless otherwise indicated, each item removed during this demolition shall be removed from the premises and disposed of in accordance with all state and local regulations.
- E. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner, or others, unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Contract Administrator and the Owner no fewer than 7 days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Contract Administrator and the Owner's written permission.
 - 3. Owner reserves the right to require Contractor to cease work in any area Owner requires access to on an emergency basis.
 - 4. Make every effort to schedule outages during non-business or off-peak business hours to minimize disruptions to business operations.
- F. Relocate and reconnect all electrical facilities that must be relocated in order to accomplish the remodeling shown in the Drawings or indicated in the Specifications. Where electrical fixtures or equipment are removed, cap all unused raceways behind the floor line or wall line to facilitate restoration of finish, and, remove all existing wiring from abandoned raceways.
- G. Finish materials are specified in other divisions.
- H. Where removal of existing wiring interrupts electrical continuity of circuits that are to remain in use, provide necessary wiring, raceways, junction boxes, etc., to ensure continued electrical continuity.

- I. Penetrate roofs, channel walls and floors as required to produce the desired result; however, obtain permission from the Contract Administrator for all penetrations and channeling not specifically noted on the Drawings.
- J. Provide new, typewritten card directory for distribution equipment (including but not limited to load centers, panelboards, switchboards and switchgear) where changes occur under this scope of work. Indicate exact loads served by each existing circuit breaker or switch. Where circuit designations are not specifically indicated on the Drawings, provide a unique identifier for each updated circuit within the directory.
- K. Coordinate work with Architectural phasing drawings to properly stage transitions of work to provide power to existing, new and temporary loads. Monitor loads on distribution system to ensure shifting of loads does not overload electrical equipment.
- L. Work in common areas, shafts or other Owner owned and/or operated spaces must be reviewed and approved by the Contract Administrator and Owner prior to commencement of the work.
 - 1. Contractor shall minimize any disruption and disturbances to other tenants. All work within other tenant spaces must be coordinated with and approved by the Landlord and Owner.

3.4 PERMITS

- A. Secure and pay for all permits required in connection with the installation of the Electrical Work. Arrange with the various utility companies for the installation and connection of all required utilities for this facility and pay all charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

3.5 TEMPORARY ELECTRICAL SERVICE AND WIRING

- A. In existing facilities, with Owner's approval, Contractor may utilize the existing electrical system as the source of temporary power. Coordinate the point of connection and method of connection to the existing system with the Owner's Representative.
- B. Work for the temporary power shall consist of all labor and materials, including, but not limited to conduit, wiring, panelboards, fuse blocks, fused disconnecting switches, fuses, pigtails, receptacles, wood panel switch supports, and other miscellaneous materials required to complete the power system.
- C. Install all temporary wiring in accordance with applicable codes, and maintain in an OSHA-approved manner.

3.6 SELECTIVE DEMOLITION

- A. Refer to Division 01, Division 02, and General Conditions for Selective Demolition requirements in addition to the requirements specified herein.
- B. General: Demolish, remove, demount, and disconnect abandoned electrical materials and equipment indicated to be removed and not indicated to be salvaged or saved.

- C. Materials and Equipment To Be Salvaged: remove, demount, disconnect existing electrical materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.
- D. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.
- E. Electrical Materials and Equipment: Demolish, remove, demount, and disconnect the following items:
 - 1. Inactive and obsolete raceways, fittings, supports and specialties, equipment, wiring, controls, fixtures, and insulation:
 - a. Raceways and outlets embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Cut embedded raceways to below finished surfaces, seal, and refinish surfaces as specified or as indicated on the Architectural Finish Drawings. Remove materials above accessible ceilings. Cap raceways allowed to remain.
 - b. Perform cutting and patching required for demolition in accordance with Division 01, General Conditions and "Cutting and Patching" portion of this Section in Division 26.

3.7 ACCESS TO EQUIPMENT

- A. Locate all pull boxes, junction boxes and controls to provide easy access for operation, service inspection and maintenance. Provide an access door where equipment or devices are located above inaccessible ceilings. Refer to Division 26 Section "Common Work Results for Electrical".
- B. Maintain all code required clearances and clearances required by manufacturers.

3.8 PENETRATIONS

- A. Unless otherwise noted as being provided under other divisions, provide sleeves, box frames, or both, for openings in floors, walls, partitions and ceilings for all electrical work that passes through construction. Refer to Division 26 Section "Common Work Results for Electrical".
- B. Provide sleeves, box frames, or both, for all conduit, cable, and busways that pass through masonry, concrete or block walls.
- C. The cutting of new and/or existing construction will not be permitted except by written approval of the Contract Administrator.

3.9 CUTTING AND PATCHING

- A. Cut walls, floors, ceilings, and other portions of the facility as required to install work under this Division.
- B. Obtain permission from the Architect prior to cutting. Do not cut or disturb structural members without prior approval from the Architect and Structural Engineer.

- C. Penetrations shall be made as small as possible while maintaining required clearances between the building element penetrated and the system component.
- D. Patch around openings to match adjacent construction, including fire ratings, if applicable.
- E. Repair and refinish areas disturbed by work to the condition of adjoining surfaces in a manner satisfactory to the Architect.

3.10 PAINTING

- A. Refer to Division 09 Section "Painting" for painting requirements.
- B. Paint exposed ferrous surfaces, including, but not limited to, hangers, equipment stands and supports using materials and methods as specified under individual sections and Division 09 of the Specifications; colors shall be as selected by the Contract Administrator.
- C. Re-finish all field-threaded ends of galvanized conduits and field-cut ends of galvanized supports with a cold-galvanizing compound approved for use on conductive surfaces. Follow closely manufacturer's instructions for pre-cleaning surfaces and application.
- D. Factory finishes and shop priming and special finishes are specified in the individual equipment Specification sections.
- E. Where factory finishes are provided and no additional field painting is specified, touch up or refinish, as required by, and to the acceptance of, the Contract Administrator, marred or damaged surfaces so as to leave a smooth, uniform finish. If, in the opinion of the Contract Administrator, the finish is too badly damaged to be properly re-finished, replace the damaged equipment or materials at no additional costs to the Owner.

3.11 CLEANING

- A. Refer to Division 01 and General Conditions for Cleaning requirements in addition to requirements specified herein.

3.12 ADJUSTING, ALIGNING AND TESTING

- A. Adjust, align and test all electrical equipment furnished and/or installed under this Division.
- B. Check motors for alignment with drive and proper rotation, and adjust as required.
- C. Check and test protective devices for specified and required application, and adjust as required.
- D. Check, test and adjust adjustable parts of all light fixtures and electrical equipment as required to produce the intended performance.
- E. Verify that completed wiring system is free from short circuits, unintentional grounds, low insulation impedances, and unintentional open circuits.

- F. After completion, perform tests for continuity, unwanted grounds, and insulation resistance in accordance with the requirements of NFPA 70 and NETA.
- G. Be responsible for the operation, service and maintenance of all new electrical equipment during construction and prior to acceptance by the Owner of the complete project under this Contract. Maintain all electrical equipment in the best operating condition including proper lubrication.
- H. Notify the Contract Administrator immediately of all operational failures caused by defective material, labor or both.
- I. Maintain service and equipment for all testing of electrical equipment and systems until all work is approved and accepted by the Owner.
- J. Keep a calibrated voltmeter and ammeter (true RMS type) available at all times. Provide service for test readings when and as required.
- K. Refer to individual sections for additional and specific requirements.

3.13 START-UP OF SYSTEMS

- A. Prior to start-up of electrical systems, check all components and devices, lubricate items appropriately, and tighten all screwed and bolted connections to manufacturers' recommended torque values using appropriate torque tools.
- B. Each power, lighting and control circuit shall be energized, tested and proved free of breaks, short-circuits and unwanted grounds.
- C. Balance all single phase loads at each panelboard, redistributing branch circuit connections until balance is achieved to plus or minus 10 percent.
- D. After all systems have been inspected and adjusted, confirm all operating features required by the Drawings and Specifications and make final adjustments as necessary.
- E. Demonstrate that all equipment and systems perform properly as designed per Drawings and Specifications.
- F. At the time of final review and tests of the power and lighting systems, all equipment and system components shall be in place and all connections at panelboards, switches, circuit breakers, and the like, shall be complete. All fuses shall be in place, and all circuits shall be continuous from point of service connections to all switches, receptacles, outlets, and the like.

3.14 TEST REPORTS

- A. Perform tests as required by these Specifications and submit the results to the Contract Administrator, for Engineer's review. Record the results, date and time of each test and the conditions under which the test was conducted. Include a copy of the finalized test results, with corrections made, in the operations and maintenance manuals. The tests shall establish the adequacy, quality, safety, and reliability for each electrical system installed. Notify the Contract Administrator and Engineer two working days prior to each test.

- B. For specific testing requirements of special systems, refer to the Specification section that describes that system. The Contractor shall provide the following to facilitate the testing of the electrical systems:
 - 1. Perform tests as described in the individual sections;
- C. Upon completing each test, record the results, date and time of each test and the conditions under which the test was conducted. Submit to the Contract Administrator, for Engineer's review, in duplicate, the test results for the following electrical items:
 - 1. Test all wiring devices for electrical continuity and proper polarity of connections.
- D. Promptly correct all failures or deficiencies revealed by these tests in accordance with the manufacturer's recommendations and as determined by the Engineer.

END OF SECTION 260010

SECTION 260500 – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section includes limited scope general construction materials and methods, electrical equipment coordination, and common electrical installation requirements as follows:
 - 1. Access doors in walls, ceilings, and floors for access to electrical materials and equipment.
 - 2. Sleeves and seals for electrical penetrations.
 - 3. Joint sealers for sealing around electrical materials and equipment, and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.

1.2 DEFINITIONS

- A. The following abbreviations apply to this and other Sections of these Specifications:
 - 1. AHJ: Authority(ies) having Jurisdiction
 - 2. ATS: Acceptance Testing Specifications
 - 3. EPDM: Ethylene-propylene-diene monomer rubber
 - 4. MC: Metal Clad
 - 5. N/A: Not Available or Not Applicable
 - 6. NBR: Acrylonitrile-butadiene rubber
 - 7. NRTL: Nationally Recognized Testing Laboratory
 - 8. PCF: Pounds per Cubic Foot
- B. The following definitions apply to this and other Sections of these Specifications:
 - 1. Homerun: That portion of an electrical circuit originating at a junction box, termination box, receptacle or switch with termination at an electrical panelboard. Note: Where MC Cable is utilized for receptacle and/or lighting branch circuiting loads, the originating point of the homerun shall be at the first load in the circuit or at a junction box in an accessible ceiling space immediately above the first load.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping, ducts, and other systems installed at required slopes and/or elevations.

4. So connecting raceways, cables, and wireways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.
- D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 26 Section “General Electrical Requirements”:
 1. Product data for the following products:
 - a. Joint sealers
 2. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26
 - a. Accurately record actual locations of firestopped penetrations and access panel/door locations. Indicate dimensions from fixed structural elements.

PART 2 - PRODUCTS AND MATERIALS

2.1 ACCESS TO EQUIPMENT

- A. Manufacturers:
 1. Bar-Co., Inc.
 2. Elmdor Stoneman.
 3. JL Industries
 4. Jay R. Smith Mfg. Co.
 5. Karp Associates, Inc.
 6. Milcor
 7. Nystrom Building Products
 8. Wade
 9. Zurn
- B. Access Doors:
 1. Provide access doors for all concealed equipment, except where above lay-in ceilings. Refer to Section “Identification for Electrical Systems” for labeling of access doors.

2. Access doors shall be adequately sized for the devices served with a minimum size of 18 inches x 18 inches, furnished by the respective Contractor or Subcontractor and installed by the General Contractor.
3. Access doors must be of the proper construction for type of construction where installed.
4. The exact location of all access doors shall be verified with the Contract Administrator prior to installation.
5. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
6. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
 - a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1-inch-wide exposed perimeter flange and adjustable metal masonry anchors.
 - b. For installation in gypsum wallboard or plaster: perforated flanges with wallboard bead.
 - c. For installation in full-bed plaster applications: galvanized, expanded metal lath and exposed casing bead, welded to perimeter of frame.
7. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
8. Locking Devices:
 - a. Flush, screwdriver-operated cam locks.

2.2 SEALANTS

A. JOINT SEALERS

1. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
2. Colors: As selected by the Contract Administrator from manufacturer's standard colors.

B. FIRESTOPPING

1. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with UL 2079 or ASTM E 814, by Underwriters' Laboratories, Inc., or other NRTL acceptable to AHJ. Subject to compliance with requirements, provide one of the following:
 - a. Manufacturers:
 - 1) 3M Corp., Fire Barrier Sealant
 - 2) Hilti, Inc.

- 3) Tremco, Tremstop Fyre-Sil
- 4) Pecora, AC-20 FTR
- 5) RectorSeal
- 6) Specified Technologies Inc. Firestop
- 7) USG, SHEETROCK Firecode Compound
- 8) Owens Corning Firestopping Insulation

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Comply with NECA 1.
- C. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items, unless indicated otherwise.
- D. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- E. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- F. Right of Way: Yield to raceways and piping systems installed at a required slope.

3.2 ACCESS DOORS

- A. Verify the exact location, sizes, and types of all access doors with the Contract Administrator prior to purchase.
- B. Provide access doors for all concealed electrical equipment, except where above lay-in ceilings.
- C. Coordinate with architectural finishes to set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- D. Adjust hardware and panels after installation for proper operation.
- E. Label all access doors with a nameplate as described in Division 26 Section "Identification for Electrical Systems".

3.3 JOINT SEALERS

- A. Preparation for Joint Sealers

1. Clean surfaces of penetrations, sleeves, or both, immediately before applying joint sealers, to comply with recommendations of joint sealer manufacturer.
2. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

B. Application of Joint Sealers

1. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
 - a. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
 - b. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.
2. Tooling: Immediately after sealant application and prior to time shining or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

END OF SECTION 260500

SECTION 260502 – EQUIPMENT WIRING SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section includes limited scope for electrical connections to equipment specified under other sections or divisions, or furnished under separate contracts or by the Owner.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Unless otherwise noted, perform all electrical work required for the proper installation and operation of equipment, furnishings, devices and systems specified in other divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this contract.
 - A. Coordinate with work described in Division 11 Sections for equipment requiring electrical connection.
 - B. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections.
 - C. Determine connection locations and rough-in requirements based on shop drawings.
 - D. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
 - E. Sequence electrical connections to coordinate with start-up schedule for equipment.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories:
 - 1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to Authorities Having Jurisdiction.
 - 2. Marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS AND MATERIALS

2.1 CORDS AND CAPS

- A. Attachment Plugs: Conform to NEMA WD 1.
- B. Configuration: NEMA WD 6, matching receptacle configuration at outlet provided for equipment, or as required by the equipment manufacturer.
- C. Cord: See Paragraph “Flexible Cords” in Division 26 Section “Low-voltage Electrical Power Conductors and Cables”.

- D. Provide cord size suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify conditions of equipment and installation prior to beginning work.
- B. Verify that equipment is ready for connecting, wiring, and energizing.

1.2 INSTALLATION, GENERAL

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

3.2 ELECTRICAL DEVICES

- A. Install disconnect switches, controllers, control stations, and control devices (other than temperature control devices) as indicated, specified in other divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this Contract.

3.3 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturers' instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquid tight flexible conduit with watertight connectors in damp or wet locations.
- C. Make wiring connections using conductors 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 on the Drawings.
- E. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- F. Provide interconnecting conduit and wiring between devices and equipment where indicated on the Drawings.

3.4 EQUIPMENT

- A. When equipment is delivered in separate parts and field assembled, internal wiring, indicated on Shop Drawings as field wiring, will be provided by the equipment supplier, unless otherwise noted.
- B. Provide power connection to all equipment as required and as indicated in the equipment supplier's installation drawings.
- C. Provide all control and interlock wiring for all equipment that is not included within the responsibility of Division 22 or 23.

END OF SECTION 260502

SECTION 260519 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Conductors, cables, and cords rated 600V and less.
- B. Connectors and terminations rated 600V and less.

1.2 DEFINITIONS

- A. The following abbreviations apply to this and other Sections of these specifications:
 - 1. MC: Metal Clad
 - 2. NBR: Acrylonitrile-butadiene rubber
 - 3. NETA ATS: Acceptance Testing Specification.
- B. The following definitions apply to this and other Sections of these Specifications:
 - 1. HOMERUN: That portion of an electrical circuit beginning at a junction box, termination box, receptacle or switch with termination at an electrical panelboard.
 - a. Note: Where MC Cable is allowed to be utilized for receptacle and/or lighting branch circuiting loads, the originating point of the homerun shall be at the first load in the circuit or at a junction box in an accessible ceiling space immediately above the first (most upstream) load.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop and temperature deration.
 - 2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
 - 3. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.
- B. Notify Contract Administrator of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 26 Section “General Electrical Requirements”:
 - 1. Product data for the following products:

- a. Conductors, cables, and cords rated 600V and less.
 - b. Metal Clad (MC) cable and fittings.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
- D. Qualification Data: For testing agency.
- E. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.
- F. Operation and Maintenance Data: For cable and all accessories to include in operation and maintenance manuals.
- G. Follow-up service reports.

1.5 QUALITY ASSURANCE

- A. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 3 years.
- B. Provide products listed and classified by Underwriters Laboratories, Inc (UL) as suitable for the purpose specified and indicated.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Contract Administrator and obtain direction before proceeding with work.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner, or others, unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Contract Administrator and the Owner no fewer than 7 days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Contract Administrator and the Owner's written permission.
 - 3. Owner reserves the right to require Contractor to cease work in any area Owner requires access to on an emergency basis.

- C. Make every effort to schedule outages during non-business or off-peak business hours to minimize disruptions to business operations.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

PART 2 - PRODUCTS AND MATERIALS

2.1 CONDUCTORS AND CABLES - GENERAL

- A. Conductor Material: Annealed (soft) copper complying with ICEA S-95-658/NEMA WC70 and UL Standards 44 or 83, as applicable.
 - 1. Solid conductors for No. 10 AWG and smaller; concentric, compressed stranded for No. 8 AWG and larger
 - 2. Stranded for all flexible cords, cables, and control wiring.
 - 3. As noted otherwise below.
- B. Aluminum conductors are not allowed.
- C. Conductor Insulation: Type THHN/THWN-2 complying with ICEA S-95-658/NEMA WC70.
- D. Sizes of conductors and cables indicated or specified are American Wire Gage (Brown and Sharpe).
- E. Conductors shall not be smaller than No. 12 AWG, with the exception of wiring for signal and pilot control circuits; and pre-manufactured whips for light fixtures which may be No. 14 AWG.
- F. Conductors installed for site electrical work shall be no smaller than No. 10 AWG CU. All site electrical branch circuit wiring shall be sized such that the maximum branch circuit voltage drop is less than 3 percent.
- G. Unless indicated otherwise, special purpose conductors and cables, such as low voltage control and shielded instrument wiring, shall be as recommended by the system equipment manufacturer.
- H. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

2.2 SINGLE CONDUCTORS

- A. Manufacturers:
 - 1. Alan Wire
 - 2. Cerrowire
 - 3. Colonial Wire & Cable Co., Inc.

4. Encore Wire Corporation
5. General Cable (Prysmian Group)
6. Northern Cables Inc.
7. Okonite Company
8. Southwire Company

B. 600V, insulated conductors as noted above shall be color-coded as follows, unless noted otherwise:

PHASE	120/240V	240Δ/120V	208Y/120V	480Y/277V
A	Black	Black	Black	Brown
B	Red	Orange	Red	Orange
C	N/A	Red	Blue	Yellow
Neutral	White	White	White	Gray**
Equipment Ground	Green	Green	Green	Green
Isolated Ground	N/A	N/A	Green/Yellow Stripe	Green/Yellow Stripe

**Except as provided in NFPA 70.

2.3 METAL CLAD CABLE; TYPE MC

A. MC Cable (with insulated green grounding conductor, no bonding conductor):

1. Manufacturers:
 - a. Atkore/AFC Cable Systems
 - b. Cerrowire
 - c. Encore Wire Corporation (MC)
 - d. Kaf-Tech
 - e. Northern Cables, Inc.
 - f. Southwire Company (Amorlite)
2. 600V, Unjacketed and/or PVC-jacketed UL Standard 83, UL Standard 1569 for Type MC, UL Standard 1685, Federal Specification A-A59544, IEEE 1202 Vertical Cable Tray Flame Test and NFPA 70. Type MC Cable shall be listed for use in UL 1, 2, and 3 Hour Through-Penetration Firestop Systems.
3. Armor Assembly: Aluminum interlocked armor (aluminum color).
4. Phase Conductors: Solid soft-drawn copper, THHN-insulated single conductors, color code: ICEA Method 1.
5. Grounding Conductor: Solid soft-drawn copper, THHN/THWN-2 green insulated grounding conductor sized per NFPA 70.
6. Marking: Cable markings shall comply with the requirements of NFPA 70.

B. MC Cable (with 0-10V dimming control wiring):

1. Manufacturers:

- a. Atkore/AFC Cable Systems
 - b. Cerrowire
 - c. Encore Wire Corporation (MC- LED)
 - d. Southwire Company (MC – PCS Duo)
 - 2. 600V, Unjacketed and/or PVC-jacketed UL Standard 83, UL Standard 1569 for Type MC, UL Standard 1685, Federal Specification A-A59544, IEEE 1202 Vertical Cable Tray Flame Test and NFPA 70. Type MC Cable shall be listed for use in UL 1, 2, and 3 Hour Through-Penetration Firestop Systems.
 - 3. Armor Assembly: Aluminum interlocked armor (aluminum color).
 - 4. Phase Conductors: Solid soft-drawn copper, THHN-insulated single conductors, color code: ICEA Method 1.
 - 5. Grounding Conductor: Solid soft-drawn copper, THHN/THWN-2 green insulated grounding conductor sized per NFPA 70.
 - 6. Control Conductors: Color-coded Class 2/Class 3 twisted jacketed pairs
 - 7. Marking: Cable markings shall comply with the requirements of NFPA 70.
- C. MC Cable Fittings:
- 1. Manufacturers:
 - a. ABB/T&B
 - b. Arlington
 - c. Eaton/Crouse-Hinds
 - d. Emerson/O-Z Gedney
 - 2. Fittings used for connecting Type MC cable to boxes, cabinets, or other equipment shall be UL listed and identified for such use with an MCI-A marking on the fitting carton or package.
 - 3. Fittings shall be insulated type not requiring the use of anti-short bushings.
 - 4. Romex style, clamp type fittings are not acceptable.

2.4 FLEXIBLE CORDS

- A. Manufacturers:
 - 1. Cerrowire
 - 2. Southwire
 - 3. Atkore/AFC Cable Systems
- B. 600V, multi-conductor (2, 3, or 4 as indicated on the Drawings), oil-resistant black jacket, extra-hard-usage; Type SEO or SO for indoor dry and damp locations; SEOW or SOW for damp, wet, and outdoor locations; or as required by the manufacturer of the equipment to which the cords are connected.

- C. 300V, multi-conductor (2, 3, or 4 as indicated on the Drawings), oil-resistant black jacket, hard-usage; Type SJEO or SJO for indoor dry locations; SJEOW or SJOW for damp, wet, and outdoor locations; or as required by the manufacturer of the equipment to which the cords are connected.

2.5 CONTROL WIRING

- A. Unless otherwise noted, all control wiring will be the responsibility of the Section or Division in which the control system is specified.

2.6 CONNECTORS

- A. Manufacturers:
 - 1. AMP; Tyco
 - 2. FCI-Burndy
 - 3. Gould
 - 4. Ideal Industries, Inc.
 - 5. IlSCO
 - 6. NSI Industries, Inc.
 - 7. O-Z/Gedney
 - 8. Panduit
 - 9. Thomas and Betts
 - 10. 3-M Electrical Products Division
- B. Compression connectors for conductors No. 8 AWG and larger: Long-barreled, UL 486-listed, circumferential compression type (Burndy "Hylug", or equal), insulated with clamp-on, cold-shrink, or molded covers, or wrapped with multiple over-lapping layers of 3-M Scotch electrical tape.
 - 1. Termination fittings for copper conductors: Bare copper, 1-hole pad and inspection port.
- C. Mechanical connections for conductors No. 8 AWG and larger: UL-listed, dual-rated, mechanical type, insulated with clamp-on, cold-shrink, or molded covers, or wrapped with multiple over-lapping layers of 3-M Scotch electrical tape.
 - 1. Termination fittings: Bare copper, 1-hole pad and inspection port.
- D. Connectors for solid conductors No. 10 AWG and smaller: Insulated winged wire nuts. Color-coded for size, except use green only for grounding connections.
- E. Connectors for stranded conductors No. 10 AWG and smaller: Tinned copper, insulated-sleeve, compression type, UL-listed, with wire insulation grip. Terminations: ring-tongue type.

- F. Connectors and terminations for aluminum conductors and cables No. 1 and larger: UL 486B listed and marked AL7CU for 75 deg C rated conductors and AL9CU for 90 deg C rated conductors.
- G. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- H. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate seals with wall, ceiling, roof or floor materials and rating of the surface (sound, fire, waterproofing, etc.)
- B. Electrical conductor and cable work is schematically represented on the Drawings. Unless otherwise indicated, conductor sizes shown on the Drawings are based on not more than three single current-carrying conductors in a raceway in free air. Current ratings are based on copper at 75 degrees C temperature rating for all power circuits. Modify raceway and conductor sizing as may be necessitated by any deviation from these conditions. Do not decrease the indicated conductor size due to the use of conductors having a temperature rating of 90 degrees C.
- C. Conductor sizes shown are minimum based on code requirements, voltage drop, and/or other considerations. Where approved by the Engineer and at no extra cost to the Owner, larger conductor sizes may be installed at Contractor's option in order to utilize stock sizes, provided raceway sizes are increased where necessary to conform with NFPA 70 (determine the effect of the use of larger conductors on the short circuit current ratings of the electrical equipment, and provide increased short circuit current rated equipment as required).
- D. Where anticipated conductor installed lengths exceed the lengths indicated on the Drawings, notify Contract Administrator. Provide tabulated list of exceeded lengths for review. Increase conductor size, circuit ground size, and conduit size accordingly to meet maximum voltage drop indicated within the calculations.

3.2 INSTALLATION

- A. General
 - 1. Unless otherwise indicated on the Drawings or in other Sections, install all conductors in raceway. Install continuous conductors between outlets, devices and boxes without splices or taps. Do not pull connections into raceways. Leave at least 12 inches of conductor at outlets for fixture or device connections.
 - 2. Install in accordance with manufacturer's instructions.
 - 3. Use manufacturer-approved pulling compound or lubricant where necessary; compound used shall not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

4. Use pulling means, including fish tape, cable, rope, and basket weave conductor/cable grips that will not damage conductors/cables or raceway.
5. Where parallel conductors are shown, install each set of conductors in separate raceways of essentially the same length.
6. Wiring at Outlets: Install conductors at each outlet with at least 6 inches of slack.
7. Common or Shared Neutrals are not allowed unless shown on the plans or specifically noted to be allowed.
8. Multi-wire branch circuits are not allowed unless noted otherwise on the drawings.
9. Where multi-wire branch circuits are utilized (i.e., shared neutral), shall be provided with a means that will simultaneously disconnect all ungrounded conductors at the point the branch circuit originates. Multi-pole breakers or 3 single pole breakers with a handle tie are two examples.
10. When multiple home runs are combined into a single raceway such that the number of conductors exceeds four (conductor count is made up of any combination of phase and neutral conductors), the following restrictions apply, which are in addition to those in NFPA 70:
 - a. Normal or Non-Essential circuits.
 - 1) Maximum of 16 conductors in a single raceway. For up to eight conductors in a raceway, minimum raceway size: 3/4 inch. For greater than eight conductors, minimum raceway size: 1 inch. Do not install any other type of circuit in this raceway.
 - 2) The minimum wire size for all conductors in this raceway: No. 10 AWG.
 - 3) Only 15A and 20A branch circuit homeruns may be combined into one raceway.
 - b. GFCI-protected circuits.
 - 1) Do not use multi-conductor circuits, with a shared neutral, for any GFCI circuit breaker or receptacle circuit.
11. Where the number of conductors for branch circuits is not shown on the Drawings, determine the number of conductors in accordance with NFPA 70. Provide adequate conductors so as to allow performance of all functions of the device.
12. Branch circuit conductors shall be copper.
13. Provide all conductors with 600V insulation of the following types, unless otherwise noted on the Drawings or in these Specifications:
 - a. Wet or dry locations, in raceways:
 - 1) Feeders and branch circuits: Type THWN, THHN/THWN-2, or XHHW.
 - 2) Conductors No. 6 AWG and smaller: Types THWN or THHN/THWN-2.

B. Metal Clad Type MC Cable:

1. Securing and Supporting:

- a. Support per NFPA 70 for MC cable
 - b. Secure cable within 12 inches of every box or fitting.
 - c. Secure/supporting intervals shall not exceed six (6) feet for MC cable.
 - d. Utilize steel cable hangers, Arlington SMC series or equivalent, for MC cable support wherever possible so as to provide for cable routing in a neat and workmanship like manner.
2. Type MC cable may only be used:
- a. In lieu of flexible conduit and wiring from light fixtures in accessible ceilings to junction boxes (attached to building structure) above the ceiling. Provide cable whips of sufficient lengths to allow for relocating each light fixture within a 5-foot radius of its installed location, but not exceeding 6 feet in unsupported lengths.
 - b. For vertical drops and horizontal wiring in stud walls.
 - c. In lieu of metal raceway, only for 15A and 20A branch circuits with up to four (4) conductors, not including grounding and/or bonding conductor(s), and only in dry concealed locations above grade, except where specifically not permitted by NFPA 70.
3. MC cable shall not be used for any use not listed in the paragraph above. Examples of those uses include, but are not limited to:
- a. Unjacketed MC:
 - 1) In locations not permitted by NFPA 70.
 - 2) When specifically not allowed by the local AHJ.
 - 3) Where exposed to view.
 - 4) Where subject to physical damage.
 - 5) Corrosive or Hazardous locations.
 - 6) Wet locations.
 - 7) Branch circuits serving HVAC, elevator/escalator, medical and kitchen equipment loads.
 - 8) Within mechanical, electrical or telecommunication equipment rooms.
 - b. PVC Jacketed MC:
 - 1) In locations not permitted by NFPA 70.
 - 2) When specifically not allowed by the local AHJ.
 - 3) Where exposed to view.
 - 4) Where subject to physical damage.
 - 5) Branch circuits serving HVAC, elevator/escalator, medical and kitchen equipment loads.
 - 6) Within mechanical, electrical or telecommunication equipment rooms.

C. Flexible Cords

1. Refer to Division 26 Section, "Equipment Wiring Systems", for electrical connections to equipment.

D. Control Wiring

1. Unless otherwise indicated on the Drawings or in other sections, install all control wiring in raceway, regardless of voltage. A qualified Electrician shall install all control wire operating at 120V nominal and above. Control wiring operating at less than 120V (e.g., 12V and 24V) may be installed under the Division furnishing it.
2. Open wiring in air-handling plenums: UL listed and classified for use in air plenums without raceway. Where indicated on the Drawings or otherwise specified, and permitted by local codes, only cable for communication or fire alarm systems and low voltage control wiring may be installed without raceways.
 - a. Low voltage wiring not routed in a race way shall be supported by cable tray or j-hooks secured independently of ceiling supports. Cabling shall not be supported directly by the ceiling system.

E. Connections:

1. Apply a zinc based, anti-oxidizing compound to connections.
2. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
3. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
4. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
5. Use only resin pressure splices and splicing kits that totally encapsulate the splice for splices in underground junction boxes. Arrange the splicing kit to minimize the effects of moisture.
6. Use connectors as indicated in equipment schedules. Where not indicated use connections as noted below.
 - a. Compression – Conductors No. 8 AWG and larger to panelboards, switchboards and apparatus
 - b. Compression – splices, terminals
 - c. Mechanical – where temporary removal is required
7. Do not use terminals on wiring devices to feed through to the next device.

3.3 IDENTIFICATION

- A. General: Provide all identification per Division 26 "Identification for Electrical Systems".

- B. Single Conductors: Identify and color-code conductors to indicate voltage and phase according to Part 2 of this Section. Identification method shall be either:
 - 1. Factory provided colored insulation
 - 2. Color-Coding Conductor Tape.
- C. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in the same junction or pull box identify each ungrounded conductor according to voltage, source and circuit number.
- D. Conductors to Be Extended in the Future: Attach identification device to conductors and list source and circuit number.
- E. Conductors for controls (lighting, controls): Label each conductor with Markers for Conductor and Control Cables. – identify conductors using method as noted in Division 26 Section “Identification for Electrical Systems”. Note conductor identification on record Drawings.

3.4 FIELD QUALITY CONTROL

- A. Do not perform insulation resistance tests of the distribution wiring to equipment with the surge protective devices installed. Disconnect surge protective device before conducting insulation resistance tests and reconnect immediately after the testing is over.
- B. Testing: Perform the following field quality-control testing:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements. Test all wiring prior to energizing to ensure that it is free from unintentional grounds and shorts, is properly phased, and that all connectors are tight.
 - 2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3. Certify compliance with test parameters.

END OF SECTION 260519

SECTION 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.
- B. This Section includes:
 - 1. Grounding Conductors
 - 2. Connector Products
 - 3. Miscellaneous Grounding Materials and Products

1.2 DEFINITIONS

- A. The following apply to this and other Sections of these Specifications:
 - 1. Ground ring: Bare underground grounding conductor encircling the building or structure.
 - 2. NETA ATS: Acceptance Testing Specification.
 - 3. PSF: Pounds per Square Foot
 - 4. EMT: Electrical metallic tubing.
 - 5. ENT: Electrical nonmetallic tubing.
 - 6. FMC: Flexible metal conduit.
 - 7. GRS: Galvanized Rigid Steel Conduit
 - 8. IMC: Intermediate metal conduit.
 - 9. LFMC: Liquidtight flexible metal conduit.
 - 10. LFNC: Liquidtight flexible nonmetallic conduit.
 - 11. RAC: Rigid Aluminum Conduit
 - 12. RMC: Rigid Metal Conduit
 - 13. RNC: Rigid nonmetallic conduit.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 26 Section “General Electrical Requirements”:
 - 1. Product data for the following products:
 - a. Mechanical and compression connectors.

1.4 QUALITY ASSURANCE

- A. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 3 years.
- B. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."
- C. Electrical Components, Devices, and Accessories:
 - 1. Listed and labeled as defined in NFPA 70, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 2. Marked for intended use.
 - 3. Comply with UL 467.
- D. Comply with NFPA 70.

PART 2 - PRODUCTS AND MATERIALS

2.1 GROUNDING CONDUCTORS, CONNECTORS, AND ELECTRODES:

- A. Manufacturers:
 - 1. ABB, Inc.
 - 2. Advanced Lightning Technology (ALT)
 - 3. AFL Global
 - 4. Boggs, Inc.
 - 5. Burndy; Hubbell.
 - 6. Cooper Power; Eaton.
 - 7. Copperweld Corp.
 - 8. ECN/Korns; Division of Robroy Industries.
 - 9. Erico; nVent.
 - 10. Galvan Industries, Inc.
 - 11. Greaves Corp.
 - 12. Harger.
 - 13. Hastings Fiber Glass Products, Inc.
 - 14. Heary Brothers Lightning Protection Co.
 - 15. Ideal Industries, Inc.
 - 16. ILSCO.
 - 17. Lightning Master Corp.
 - 18. Lyncole XIT Grounding; Division of VFC.

19. O-Z/Gedney Co.; Emerson.
20. Panduit, Inc
21. RACO; Hubbell, Inc.
22. Robbins Lightning, Inc.
23. Superior Grounding Systems, Inc.

2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".
- B. Material:
 1. Copper.
- C. Equipment Grounding Conductors: Insulated and identified as indicated in Part 3 of this section.
- D. Bare Copper Conductors:
 1. Solid Conductors: Comply with Conductors: ASTM B 8.
 2. Tinned Conductors: Comply with ASTM B 33.
- E. Copper Bonding Conductors:
 1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
 3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches (wide and 1/16 inch thick.

2.3 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors.
- C. Cast connectors: copper base alloy according to ASTM B 30.
- D. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine areas and conditions under which electrical grounding connections are to be made and notify the Contract Administrator and the Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:
 - 1. Provide all materials, labor and equipment for an electrical grounding system in accordance with applicable portions of NFPA 70 and NECA. Coordinate electrical work as necessary to interface installation of electrical grounding systems with other work.
 - 2. Accomplish grounding and bonding of electrical installations and specific requirements for systems, circuits and equipment required to be grounded for both temporary and permanent construction.
 - 3. Where the size of the grounding conductors are not shown, size in accordance with NFPA 70. Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Application:
 - 1. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- C. Equipment Grounding Conductors:
 - 1. Comply with NFPA 70, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
 - 2. Install equipment grounding conductors in all feeders and branch circuits.
 - 3. In branch circuit and feeder raceways, use insulated equipment grounding conductors.
- D. Bonding: Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70:
 - 1. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps

directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

3.3 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible. Provide electrical bonding plates, connectors, terminals, lugs and clamps as recommended by the manufacturers for indicated applications. Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, and bonding straps as recommended by the manufacturers for types of service indicated.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- C. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

3.4 IDENTIFICATION

- A. Provide identification as specified in Division 26 “Low-Voltage Electrical Power Conductors and Cables” and “Identification for Electrical Systems”.

3.5 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
 - 1. Inspect and test in accordance with NETA ATS, except Section 4.
 - 2. Perform inspections and tests listed in NETA ATS, Section 7.13.

3.6 EXISTING INSTALLATIONS

- A. Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.
- B. Where applicable, verify the neutral and ground are properly bonded at the point of service entrance. Notify the Owner and the Engineer of any existing deficiencies.

END OF SECTION 260526

SECTION 260529 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.

1.2 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 5. Notify Contract Administrator of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Structural members in path of conduit groups with supports.
 - 2. HVAC items, plumbing items and architectural features in the paths of conduit groups with common supports.
- C. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - 1.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 QUALITY ASSURANCE

- A. Comply with NFPA 70 and applicable building code.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. General:
 - 1. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
- B. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly. Use corrosion resistant materials suitable for the environment where installed.
 - 1. Manufacturers:
 - a. Allied Tube & Conduit; Atkore International.
 - b. Eaton
 - c. Erico; nVent.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Atkore International.
 - g. Wesanco, Inc.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
 - 1. Conduit Straps: One-hole or two-hole type.
 - 2. Conduit Clamps: Bolted type unless otherwise indicated.

- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Mechanical-Expansion Anchors: Insert-wedge-type, steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. [Available]Manufacturers:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 - 2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 5. Toggle Bolts: All-steel springhead type.
 - 6. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Unless specifically indicated or approved by the Contract Administrator and Structural Engineer, do not support from roof deck.
- C. Where support wires are permitted, identify independent electrical component support wires above accessible ceilings with color distinguishable from ceiling support wires in accordance with NFPA 70.
- D. Steel Components: Use corrosion resistant materials suitable for the environment where installed.

1. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
- E. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway:
 1. Minimum rod size shall be 1/4 inch (6 mm) in diameter, unless otherwise indicated.
 - a. Equipment Supports: 1/2 inch diameter minimum.
 - b. Single Conduit larger than 1 inch (27 mm) trade size: 3/8 inch diameter minimum.
 - c. Trapeze Support for Multiple Conduits: 3/8 inch diameter minimum.
 2. Space supports for EMT, IMC, and RMC as required by NFPA 70.
- F. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with:
 - a. two-bolt conduit clamps
 - b. single-bolt conduit clamps
- G. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Install in accordance with manufacturer's instructions.
- E. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- F. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
 1. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 1.5. Include consideration for vibration, equipment operation, and shock loads where applicable.

- G. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
- H. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- I. Remove temporary supports when no longer required.
- J. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- K. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Steel:
 - a. Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69
 - 5. To Light Steel: Sheet metal screws.
 - 6. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate
- L. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.
- D. Minimize overhanging materials and protrusions, and provide protective caps and fittings on exposed material ends where:
 - 1. Accessible to untrained personnel.
 - 2. Located within confined spaces.

3.4 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Comply with requirements in Division 09 "Finishes" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.
- D. Inspect support and attachment components for damage and defects. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 260529

SECTION 260533 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL REQUIREMENTS

1.1 SECTION INCLUDES

- A. This Section includes:
 - 1. Raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.2 DEFINITIONS

- A. Terminology used in this specification is as defined below:
 - 1. EMT: Electrical Metallic Tubing
 - 2. FMC: Flexible Metal Conduit
 - 3. GRS: Galvanized Rigid Steel Conduit
 - 4. LFMC: Liquidtight Flexible Metal Conduit
 - 5. RAC: Rigid Aluminum Conduit
 - 6. RMC: Rigid Metal Conduit

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of raceway, boxes, or other potential obstructions within the dedicated equipment spaces and working clearances for equipment installed by other trades in accordance with the codes and manufacturer requirements.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
 - 4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
 - 5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
 - 6. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated. Coordinate the work with other trades to preserve insulation integrity.

1.4 SUBMITTALS

- A. Shop Drawings: Conduit routing plans, drawn to scale.

- B. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26 Section “General Electrical Requirements”:

1.5 QUALITY ASSURANCE

- A. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 3 years.
- B. Electrical Components, Devices, and Accessories:
 - 1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to AHJ.
 - 2. Marked for intended use.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS AND MATERIALS

2.1 CONDUITS, SURFACE MOUNTED RACEWAYS AND ACCESSORIES

- A. Metal Conduit
 - 1. Manufacturers:
 - a. ABB, Inc.
 - b. Atkore
 - c. American Conduit
 - d. Anamet Electrical, Inc.
 - e. Electri-Flex Co.
 - f. Hubbell (Fittings).
 - g. Nucor Tubular Products.
 - h. O-Z/Gedney Co.; Emerson.
 - i. Southwire Company, LLC
 - j. Western Tube and Conduit Corporation.
 - k. Wheatland Tube Co.
 - 2. RMC:
 - a. GRS: Hot-dip galvanized: ANSI C80.1, UL 6.
 - 3. EMT and Fittings: ANSI C80.3, UL 797. Only steel products allowed. Reduced wall EMT is not allowed.
 - a. Fittings: Set-screw type.
 - 4. FMC: Zinc-coated steel: UL 1. Reduced wall FMC is not allowed.
 - 5. LFMC: Flexible steel raceway with PVC jacket: UL 360.
 - a. Fittings: NEMA FB 1; compatible with raceway and tubing materials.

2.2 BOXES, ENCLOSURES AND CABINETS

A. General

1. Manufacturers:
 - a. ABB, Inc.
 - b. American Midwest Power
 - c. Appleton/O-Z Gedney Co.; Emerson.
 - d. BEL Products, Inc.
 - e. Cooper Crouse-Hinds; Eaton.
 - f. Erickson Electrical Equipment Co.
 - g. FSR, Inc.
 - h. Hoffman.
 - i. Hubbell, Inc.
 - j. Legrand.
 - k. Molex; Koch Industries.
 - l. Robroy Industries, Inc.; Enclosure Division.
 - m. Spring City Electrical Manufacturing Co.
2. Provide products listed, classified, and labeled as suitable for the purpose intended. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
3. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:

1. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
2. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
3. Boxes for Ganged Devices: Use multi-gang boxes of single-piece construction. Do not use field-connected gangable boxes.
4. Minimum Box Size, Unless Otherwise Indicated:
 - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.

5. Do not use "through-wall" boxes designed for access from both sides of wall.
 6. Wall Plates: Comply with Division 26 Section "Wiring Devices".
- C. Junction and Pull Boxes Larger Than 100 cubic inches:
1. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1, and list and label as complying with UL 514A.
 2. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
 3. Receptacles:
 - a. Provide receptacles complying with requirement of Division 26 section "Wiring Devices"
 - b. Duplex: Include a minimum of one Convenience Receptacle, or quantity as indicated on schedule, with features as noted on schedule.
 - c. GFCI: Include quantity of GFCI Receptacles as indicated on schedule, with features as noted on schedule.

2.3 FACTORY FINISHES

- A. Interior Finish: All interior components shall be factory finished; manufacturer's standard grey unless otherwise noted.
- B. Exterior Finish: For metal wireway and surface raceway, enclosure, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.
- C. Exterior Finish: For metal wireway and surface raceway, enclosure, or cabinet components, provide manufacturer's standard paint applied to factory-assembled metal wireway and surface raceways, enclosures, and cabinets before shipping.

PART 3 - EXECUTION

3.1 INSTALLATION

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

3.2 RACEWAYS

- A. General
1. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on drawings or in this article are stricter.
 2. Provide sizes and types of raceways as indicated on the Drawings. Sizes are based on THWN insulated copper conductors, except where noted otherwise. Where sizes are not shown on the Drawings or in the Specifications, size raceways in accordance with NFPA 70 requirements for the number, size and type of conductors installed. Minimum raceway size: 1/2 inch (concealed and exposed); 1 inch (underground and under slab).

- a. 1/2-inch conduit shall contain maximum (5) #12AWG conductors or (3) #10AWG conductors.
 - b. 3/8-inch flexible conduit may be used for light fixture whips.
3. Provide all raceways, fittings, supports, and miscellaneous hardware required for a complete electrical system as described by the Drawings and Specifications.
4. Install a green-insulated, equipment-grounding conductor, which is bonded to the electrical system ground, in all raceways, with the exception of Service Entrance raceways.
5. Install grounding bushings or other code compliant connections on all conduit terminations and bond to the enclosure, which connects to the equipment grounding conductor and electrical system ground.
6. Install raceways concealed in walls or above suspended ceilings in finished areas. When approved by the Contract Administrator, raceways may be installed concealed in elevated floor slabs. Do not install raceways horizontally within slabs on grade.
7. Make bends and offsets so inside diameters are not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
8. Install raceways:
 - a. To meet the requirements of the structure and the requirements of all other Work on the Project.
 - b. To clear all openings, depressions, ducts, pipes, reinforcing steel, and so on.
 - c. Within or passing through the concrete structure in such a manner so as not to adversely affect the integrity of the structure. Become familiar with the Architectural and the Structural Drawings and their requirements affecting the raceway installation. If necessary, consult with the Contract Administrator.
 - d. Parallel or perpendicular to building lines or column lines.
 - e. Tight to structure.
 - f. When concealed, with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
9. Where masonry, brick, CMU or concrete walls are left unfinished, coordinate raceway installations with other trades so that the raceways and boxes are concealed and the wall will have a neat and smooth appearance.
10. Where masonry, brick, CMU or concrete walls in public spaces are left unfinished, coordinate raceway installations with other trades so that the raceways and boxes are concealed and the wall will have a neat and smooth appearance.
11. Support raceways from structural elements of the building as required by NFPA 70, Division 26 Section "Hangers and Supports for Electrical Systems". Do not support raceways by hangers used for any other systems foreign to the electrical

systems; and, do not attach to other foreign systems. Do not lay raceways on top of the ceiling system.

- a. Raceways on roof shall be supported from structure not from the roof deck.
12. Provide support spacing in accordance with NFPA 70 requirements, and at a minimum in accordance with NEMA standards. Support by the following methods:
 - a. Attach single raceway directly to structural steel with beam clamps.
 - b. Attach single raceway directly to concrete with one-hole clamps or clips and anchors. Outdoors and wherever subject to dampness or moisture, offset raceways from the surface by using galvanized clamps and clamp backs, to mitigate moisture entrapment between raceways and surfaces.
 - c. Attach groups of raceways to structural steel with slotted support system attached with beam clamps. Attach raceway to slotted channel with approved raceway clamps.
 - d. Attach groups of raceways to concrete with cast-in-place steel slotted channel fabricated specifically for concrete embedment. Attach raceway to steel slotted channel with approved raceway clamps.
 - e. Hang plumb horizontally suspended single raceway using a threaded rod. Attach threaded rods to concrete with anchors and to structural steel with beam clamps. Attach raceway to threaded rod with approved raceway clamps.
 - f. Hang horizontally suspended groups of raceways using steel slotted support system suspended from threaded rods. Attach threaded rods to concrete with anchors and to structural steel with beam clamps. Attach raceway to steel slotted channel with approved raceway clamps.
 - g. Support conductors in vertical raceway in accordance with NFPA 70 requirements.
 - h. Cross-brace suspended raceway to prevent lateral movement during seismic activity.
 - i. Use pre-fabricated non-metallic spacers for parallel runs of underground or under-slab conduits, either direct buried or encased in concrete.
13. Install electrically and physically continuous raceways between connections to outlets, boxes, panelboards, cabinets, and other electrical equipment with a minimum possible number of bends and not more than the equivalent of four 90-degree bends between boxes. Make bends smooth and even, without flattening raceway or flaking the finish.
14. Protect all electrical Work against damage during construction. Repair all Work damaged or moved out of line after rough-in, to meet the Contract Administrator's approval, without additional cost to the Owner. Cover or temporarily plug openings in boxes or raceways to keep raceways clean during construction. Clean all raceways prior to pulling conductors or cables.
15. Align and install raceway terminations true and plumb.
16. Complete raceway installation before starting conductor installation.

17. Install a pull cord in each empty raceway that is left empty for installation of wires or cables by other trades or under separate contracts. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull cord.
18. Route raceway through roof openings for piping and ductwork or through roof seals approved by the Contract Administrator, the roofing contractor, or both. Obtain approval for all roof penetrations and seal types from the Contract Administrator, Owner, roofing contractor, or all three as required to maintain new or existing roofing warranties.
19. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces or from building exterior to building interior.
 - b. Where otherwise required by NFPA 70.
20. Maintain 2" minimum spacing from bottom of roof deck to prevent raceway penetrations from above.
21. Do not route conduits across skylights, access panels, hatched tiles, HVAC diffusers, or equipment working space.
22. Route conduits serving rooftop equipment concealed inside the equipment curb and minimize roof penetrations and exterior conduit runs where practicable.
23. Install all underground conduits/raceways a minimum of 24" below the bottom of slab/paving/grade, unless noted otherwise, where practicable.

B. RMC

1. Use GRS in the following areas:
 - a. Where indicated.
 - b. For Emergency Feeders.
 - c. Exterior applications where above grade and exposed.
 - d. Below grade when concrete-encased, plastic-coated, or provided with a corrosion resistant approved mastic coating.
 - e. All raceways penetrating slabs on grade (use plastic-coated raceway or provide with a corrosion resistant approved mastic coating). This shall include the 90-degree elbow below grade and the entire vertical transition to above grade.
 - f. Concealed within masonry walls.
 - g. Damp or wet locations.
 - h. Crawl spaces
 - i. Interior spaces where exposed to damage. Includes but is not limited to the following areas.

- 1) Loading dock
 - 2) Corridors used for traffic of mechanized carts, forklifts and pallet handling units.
 - 2. Do not use RAC:
 - a. Below grade.
 - b. Imbedded in concrete or other areas corrosive to RAC.
- C. EMT
 - 1. Use EMT in the following areas:
 - a. Where indicated.
 - b. Interior concealed locations for:
 - 1) Branch circuits.
 - 2) Feeders.
 - 3) Emergency branch circuits.
 - 4) Low-voltage control, security, and fire alarm circuits
 - c. Exposed where not subject to physical damage
 - 1) Mechanical rooms
 - 2. Do not use EMT:
 - a. Below grade.
 - b. In exterior applications when exposed.
- D. FMC and LFMC
 - 1. Use FMC or LFMC:
 - a. For the final 24 inches of raceway to all motors, transformers, and other equipment subject to vibration or movement.
 - b. From outlet boxes (attached to building structure) to recessed light fixtures. Install sufficient length to allow for relocating each light fixture within a 5-foot radius of its installed location.
 - c. Use FMC only in dry locations
 - d. Use LFMC in damp, wet, corrosive, outdoor locations.
 - 2. Do not use FMC or LFMC:
 - a. For branch circuits, homeruns or feeders.
 - b. In lengths exceeding 6 feet.

3.3 RACEWAY FITTINGS:

- A. Compatible with raceways and suitable for use and location.
- B. RMC: Use threaded rigid steel conduit fittings, unless otherwise indicated.

- C. Join raceways with fittings designed and approved for that purpose and make joints tight.
- D. Use insulating bushings to protect conductors at raceway terminations:
 - 1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
 - 2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

3.4 BOXES:

- A. General
 - 1. Verify locations of device boxes prior to rough in.
 - 2. Set boxes at elevations to accommodate mounting heights as specified or indicated on the Drawings.
 - 3. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Adjust box locations to accommodate intended purpose.
 - 4. Install boxes to preserve fire ratings of walls, floors, and ceilings.
 - 5. Install flush wall-mounted boxes without damaging wall insulation or reducing its effectiveness.
 - 6. Support boxes independently of raceway.
 - 7. Clean the interior of boxes to remove dust, debris, and other material. Clean exposed surfaces and restore finish.
 - 8. Adjust flush-mounted boxes to make front edges flush with finished wall material.
 - 9. Provide boxes of the depth required for the service, device and the application, and with raised covers set flush with the finished wall surface for boxes concealed in plaster finishes. Select covers with the proper openings for the devices being installed in the boxes. Install boxes flush unless otherwise indicated.
 - 10. Install outlet boxes in firewalls complying with UL requirements, with box surface area not exceeding 16 square inches; and, when installed on opposite sides of the wall, separate by a distance of at least 24 inches.
- B. NEMA Enclosure ratings, Suitable for the environment in which it is installed. At a minimum, provide the following ratings:
 - 1. NEMA 250, type 1
 - a. Provide at interior and dry locations
- C. Outlet Boxes
 - 1. Locations of outlets on Drawings are approximate; and, except where dimensions are shown, determine exact dimensions for locations of outlets from plans, details, sections, or elevations on Drawings, or as directed by Contract Administrator.

Locate outlets generally from column centers and finish wall lines or to centers or joints of wall or ceiling panels.

2. Locate outlet boxes so they are not placed back-to-back in the same wall, and in metal stud walls, so they are separated by at least one stud space, to limit sound transmission from room to room. Install outlet boxes in accessible locations and do not install outlets above ducts or behind furring.
3. Install all electrical devices, such as plug receptacles, lamp receptacles, light switches, and light fixtures in or on outlet boxes. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
4. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit is used.
5. Use raised covers suitable for the type of wall construction and device configuration where required.
6. Use shallow boxes where required by the type of wall construction.
7. Install extension and plaster rings as required by NFPA 70.
8. Carefully set outlet boxes concealed in non-plastered block walls so as to line up with wall joints. Coordinate the box and raceway installation with the wall construction as required for a flush and neat appearing installation. Outlet box extensions may be used where necessary.
9. Do not exceed allowable fill per NFPA 70.
10. Where multiple devices are shown grouped together, gang mount with a common cover plate.

D. Junction and Pull Boxes

1. Install junction and pull boxes above accessible ceilings and in unfinished areas.
2. Provide boxes set flush in painted walls or ceilings with primer coated cover.
3. Where junction and pull boxes are installed above an inaccessible ceiling, locate so as to be easily accessible from a ceiling access panel.

3.5 IDENTIFICATION

- A. Refer to Division 26 Section “Identification for Electrical Systems” for identification materials.
- B. Raceway Identification:
 1. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size. Use the following means of identification:
 - a. Snap-Around Labels
 2. Color for Printed Legend:
 - a. Power Circuits: Black letters on an orange field.
 - b. Legend: Indicate system or service and voltage, if applicable

- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A: Identification device shall be:
 - 1. Snap around label
- D. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
- E. Junction Boxes and Pull Boxes:
 - 1. The junction box where a homerun ends and the circuit is distributed shall be marked. Junction boxes shall be marked approximately every 100 feet along homerun path to panel.

END OF SECTION 260533

SECTION 260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section includes the following:
 - 1. Labels for raceways and metal-clad cable.
 - 2. Labels for junction boxes and pull boxes.
 - 3. Labels for wiring devices and lighting control devices.
 - 4. Markers for conductors, and control cables.
 - 5. Miscellaneous identification products.
 - 6. Painted Identification.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Where a facility identification standard already exists, that standard shall be continued. Where an identification standard does not exist, color-coding and identification shall be as described herein.
- B. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- C. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- D. Coordinate installation of identifying devices with location of access panels and doors.
- E. Install identifying devices before installing acoustical ceilings and similar concealment.

1.3 QUALITY ASSURANCE

- A. Electrical Equipment, Components, Devices, and Accessories:
 - 1. Listed and labeled as defined in NFPA 70, by an NRTL as defined by OSHA in 29 CFR 1910.7 and that are acceptable to authorities having jurisdiction.
 - 2. Marked for intended use.
- B. Comply with requirements of NFPA 70.
- C. Comply with 29 CFR 1910.145.

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL

- A. Location, text, and method of identification to be used is noted in individual sections. Refer to other sections for additional identification requirements.

2.2 LABELS FOR RACEWAYS AND METAL-CLAD CABLE

- A. Factory Painted Raceways:
 - 1. Metal Raceways: Continuous, rust-inhibiting paint factory applied.
- B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.3 LABELS FOR JUNCTION BOXES AND PULL BOXES

- A. Junction box and pull box covers shall be spray painted to identify the voltage and system. Circuit numbers and the panel they originate from shall be listed on the cover using permanent, waterproof, black ink marker.

2.4 LABELS FOR WIRING DEVICES AND LIGHTING CONTROL DEVICES

- A. Self-laminating Computer Printable Labels: Clear over-laminate to protect legend for permanent, clean identification. Self-laminating Polyester material with white print-on area.

2.5 MARKERS FOR CONDUCTOR AND CONTROL CABLES

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
 - 1. Minimum Width: 3/16 inch (5 mm).
 - 2. Tensile Strength: 50 lb (22.6 kg), minimum.
 - 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 - 4. Color: Black, except where used for color-coding.
- B. Fasteners for Nameplates, Labels and Signs
 - 1. Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat lock washers unless otherwise noted.

2.7 PAINTED IDENTIFICATION

- A. Paint materials and application requirements are specified in Division 09 painting Sections.

1. Exterior Concrete, Stucco, and Masonry (Other Than Concrete Unit Masonry):
 - a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Exterior concrete and masonry primer.
 - 2) Finish Coats: Exterior semi-gloss acrylic enamel.
2. Exterior Concrete Unit Masonry:
 - a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a block filler.
 - 1) Block Filler: Concrete unit masonry block filler.
 - 2) Finish Coats: Exterior semi-gloss acrylic enamel.
3. Exterior Ferrous Metal:
 - a. Semi-gloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Exterior ferrous-metal primer.
 - 2) Finish Coats: Exterior semi-gloss alkyd enamel.
4. Exterior Zinc-Coated Metal (Except Raceways):
 - a. Semi-gloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Exterior zinc-coated metal primer.
 - 2) Finish Coats: Exterior semi-gloss alkyd enamel.
5. Interior Concrete and Masonry (Other Than Concrete Unit Masonry):
 - a. Semi-gloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Interior concrete and masonry primer.
 - 2) Finish Coats: Interior semi-gloss alkyd enamel.
6. Interior Concrete Unit Masonry:
 - a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a block filler.
 - 1) Block Filler: Concrete unit masonry block filler.
 - 2) Finish Coats: Interior semi-gloss acrylic enamel.
7. Interior Gypsum Board:
 - a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Interior gypsum board primer.
 - 2) Finish Coats: Interior semi-gloss acrylic enamel.
8. Interior Ferrous Metal:
 - a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Interior ferrous-metal primer.
 - 2) Finish Coats: Interior semi-gloss acrylic enamel.
9. Interior Zinc-Coated Metal (Except Raceways):
 - a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Interior zinc-coated metal primer.

- 2) Finish Coats: Interior semi-gloss acrylic enamel.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify identity of each item before installing identification products.
- B. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.
- C. Provide identification product listed for the location in which it is to be installed.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Painted Identification: Prepare surface and apply paint according to Division 09 painting sections.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. For surfaces that require finish work, apply identification devices after completing finish work. Do not install identification products until final surface finishes and painting are complete.
- C. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed. Replace labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.
- D. Location: Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance without interference with operation and maintenance of equipment. Unless otherwise indicated, locate products as follows:
 5. Branch Devices: Adjacent to device.
 6. Interior Components: Legible from the point of access.
 7. Conduits: Legible from the floor.
 8. Boxes: Outside face of cover.
 9. Conductors and Cables: Legible from the point of access.
 10. Devices: Outside face of cover.
- E. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
 1. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- F. Install identification products centered, level, and parallel with lines of item being identified.

- G. Mark all handwritten text, where permitted, to be neat and legible.

END OF SECTION 260553

SECTION 260923 – LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section includes the following lighting control devices:
 - 1. Line-voltage wall switch occupancy sensors.
 - 2. Stand-Alone Low-voltage switches.
 - 3. Conductors and Cables for Lighting Control Devices.

1.2 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR Type: Passive infrared. Occupancy sensor detection type that detects occupancy by sensing a combination of infrared heat and movement.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

1.4 SUBMITTALS

- A. Product data for the following products:
 - 1. Catalog cut sheets, including major and minor motion coverage patterns sensors, time delay and sensitivity adjustability settings, load restrictions, and performance specification items indicating compliance with this specification for all lighting control devices.
- B. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.
 - 1. Occupancy sensors and photoelectric switches:
 - a. Manufacturer's installation instructions, including instructions for storage, handling, protection, examination, preparation, start-up calibration and installation.
 - b. Product data clearly showing sensor field adjustments, including dip switch setting definitions and location of settings within sensors.
 - c. Manufacturer's maintenance, including operating and adjustment instructions.
 - 2. Timeclocks
 - a. Description of programmed timeclock settings at time of substantial completion.

3. Line-voltage wall box dimming switches
 - a. Provide operating instructions for each type of dimmer.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 WARRANTY

- A. Manufacturers shall provide a five (5) year warranty for sensors and accessories from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL INFORMATION

- A. PIR type requirements:
 1. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
 2. Sensor shall utilize pulse count processing and digital signature analysis to respond only to those signals caused by human motion.
 3. Sensor shall provide high immunity to false triggering from RFI and EMI.
 4. Sensor shall have a multiple-segmented fresnel lens in a multiple-tier configuration, with grooves to eliminate dust and residue buildup. Sensor shall be capable of accepting mask inserts to mask specific portions of the lens to prevent false triggering.

2.2 LINE VOLTAGE WALL SWITCH OCCUPANCY SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.
- B. General Requirements for Sensors:
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C), unless indicated elsewhere for specific model and application.
 3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
 4. Operations: Refer to drawings for Sequence of Operations or other operational instructions. If none appear on drawings, the follow shall apply.

- a. Occupancy Sensor (auto-on): Upon occupancy of space, loads shall be energized. If occupancy is not detected within the time delay period, loads shall be de-energized.
 - b. Vacancy Sensor (manual-on): Upon occupancy of space, loads are enabled such that manual operation of the switch shall energize loads. If occupancy is not detected within the time delay period, loads shall be de-energized.
- 5. Operation adjustment: Concealed, field-adjustable for auto-on or manual-on operation.
- 6. Time Delay adjustment:
 - a. Concealed, field-adjustable.
 - b. Time delay for de-energizing loads shall be adjustable with multiple increments from 30 seconds up to 30 minutes.
- 7. Adaptive technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false “off” switching.
- 8. Mounting: Single-gang wall box switch
- 9. Finish: Sensor finish shall be whiteSensor:
 - a. Vandal-resistant lens
 - b. Integral sliding blinders or pre-cut tape strips to block sensor views
 - c. Protrudes no greater than 0.50 inches from wall.
 - d. 180-degree field of view
 - e. Major and minor motion coverage patterns confirmed per Nema WD7 guidelines.
 - f. Detection types: Provide type or types indicated in Lighting Control Device Schedule. Refer to Section 2.1 General Information above for more information.
- 10. Indicators:
 - a. LED indicator for visual detection of motion
 - b. audible and/or visual alerts for pending shut-off
- 11. Suitable for switching load types used, including LED, fluorescent, incandescent, magnetic and electronic low voltage and motor load types. UL listed and labeled, zero-cross relay, no minimum load requirement, ground wire.
- 12. Wall switch shall have no leakage of current to load and integral service switch to permit a maintained off for servicing of lamps for safety purposes
- 13. Buttons/Relays: Provide control relay and push button quantities as indicated by model listed in Lighting Control Device Schedule.
- 14. Restriction on leakage to grounding conductor.
 - a. For remodel projects and where indicated specifically on plans, dual-technology wall switch sensors, where the manufacturer does not require a neutral conductor to device and does not have more than 0.5ma leakage

of current to ground per UL requirements, are not required to have a neutral conductor connected to them. Manufacturers that do not comply with the abovementioned UL requirements are not acceptable.

2.3 STAND-ALONE LOW-VOLTAGE SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified in the Lighting Control Device Schedule on the Drawings and complying with all requirements listed.
- B. General Requirements for switches: Wall-mounted, solid-state indoor manual switch, for use with a separate stand-alone low-voltage power pack, containing a line-voltage relay.
 - 1. Switches and all other associated system components shall be provided by the same manufacturer and compatible with each other such that the final installation meets all operational and functional requirements in addition to those listed in this specification.
 - 2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 3. UL Listed for dry locations and complies with local codes.
 - 4. Operations: Refer to drawings for Sequence of Operations or other operational instructions. If none appear on drawings, the follow shall apply. Manual push of any button shall energize or de-energize loads.
 - 5. Mounting: Suitable for mounting in any position on a standard outlet box.
 - 6. Indicator: LED, for each button to indicate when loads are energized and de-energized.
 - 7. Finish: Sensor finish shall be white.
 - 8. Operating temperatures of 32 degree F through 104 degree F, and relative humidity of 0%-95%.

2.4 CONDUCTORS AND CABLES FOR LIGHTING CONTROL DEVICES

- A. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables.
- B. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG.
- C. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG.
- D. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG.
- E. Provide all necessary conductor and cabling required for operation of the controls and control systems specified. This includes power and control wiring required for the controls to operate as described.

PART 3 - EXECUTION

3.1 INSTALLATION

A. GENERAL

1. Install devices and associated power packs and wiring in accordance with manufacturer's instructions and applicable codes.

B. OCCUPANCY/VACANCY SENSORS

1. Arrange a pre-installation meeting with manufacturer's factory authorized field representative, at Owner's facility, to verify placement of sensors and installation criteria.
2. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage areas specified in manufacturer's literature. The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms or areas that are to be provided with sensors. Provide additional sensors as required to properly and completely cover the respective areas.
3. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems and partition assemblies.
4. Adjust time delay setting of occupancy sensors to de-energize loads after space has been unoccupied for period of time indicated on the Drawings.
5. Install devices and auxiliary equipment in compliance with manufacturer's instructions and recommendations.
6. Install relay units where concealed from view and where accessible.
7. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
8. Install switchbox mounted occupancy sensors at same elevation as other lighting control switches.

C. WIRING

1. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
2. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
3. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
4. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.2 IDENTIFICATION

- A. General: Provide identification complying with requirements specified in Division 26 Section "Identification for Electrical Systems."
- B. Cover plates: Refer to drawings for labeling requirements of certain cover plates for manual switches, or similar devices, requiring labeling for user information.

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Test all occupancy sensors in test mode to confirm sensor coverage and sensitivity of sensor per manufacturer's instructions. Upon completion of tests, set sensor time delay as indicated on Lighting Control Device Schedule. Follow testing and adjustment procedures as written in the manufacturer's installation instructions for each sensor model.
- B. Lighting control devices that fail tests and inspections are defective work. Remove, replace, and retest devices that fail tests.

3.4 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.5 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 26 Section "Lighting Control Systems."

END OF SECTION 260923

SECTION 262726 – WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles: duplex, ground-fault circuit interrupters (GFCI), and tamper resistant (TR).
 - 2. Device Wall Plates.

1.2 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. TR: Tamper Resistant

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 26 Section “General Electrical Requirements”.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated cover plate from a single manufacturer and through one source. Where practical and possible, obtain all wiring devices and associated cover plates from a single manufacturer and one source.
- B. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 10 years.
- C. Electrical Components, Devices, and Accessories:
 - 1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that are acceptable to authorities having jurisdiction.
 - 2. Marked for intended use.
- D. Comply with NFPA 70.

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL

- A. Wiring devices are defined as single discrete units of electrical distribution systems, such as convenience receptacles, switches, special purpose receptacles, and similar, which are intended to carry, but not use electrical energy. Install wiring devices as required by the Specifications and where indicated on the Drawings.

2.2 MANUFACTURERS

A. Manufacturers:

1. Receptacles and Switches:
 - a. Eaton.
 - b. Hubbell Incorporated.
 - c. Legrand.
 - d. Leviton.

B. In other Part 2 articles below, where manufacturers and device catalog numbers are included, the following additional requirements apply to product selection:

1. Product manufacturer and model numbers listed are to establish the quality of the wiring devices. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include manufacturers listed in individual articles below, in addition to those listed in Paragraph "Manufacturers" above.
2. Coordinate the proper suffixes in order to provide the correct color as specified below.

2.3 FINISHES

A. Color:

1. Wiring devices connected to normal power systems: As selected by Architect, unless otherwise indicated or required by NFPA 70. Cover plates: As selected by the Architect.

2.4 CONVENIENCE RECEPTACLES

2.5 GFCI RECEPTACLES

- ### **A. Ground fault circuit interrupter type receptacles: Specification Grade UL listed and labeled complying with UL 943, Class A and NEMA WD-1-1.10, 125V, 20A, trip at 4-6mA within 0.025 second, and feed-thru type with integral heavy duty NEMA 5-20R receptacle arranged to protect receptacles down stream on the same circuit.**
- Basis of Design: Legrand 2097

2.6 COVER PLATES

- ### **A. Other locations: Single and combination types to match corresponding wiring devices and manufacturer of wiring devices specified herein.**
1. Plate securing screws: Metal with head color to match finish plate.
 2. Material for Finished Spaces: Brushed stainless steel Type 302.
 3. Material for Unfinished Spaces and surface mounted wiring devices: Galvanized steel.

4. Masonry walls and oversized wall openings: Jumbo size plates with same material as indicated above.

PART 3 - EXECUTION

3.1 GENERAL

- A. Outlets are only approximately located on the small scale Drawings. Use great care in the actual location by consulting the various large scale detailed Drawings used by other Division trades, and by securing definite locations from the Contract Administrator.

3.2 EXAMINATION

- A. Verify existing conditions prior to beginning work.
- B. Verify that outlet boxes are installed at proper height and are flush with the finished surface.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

3.3 PREPARATION

- A. If required, provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from in and around outlet boxes.

3.4 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install all wiring devices plumb, level, and square with building lines. Wiring device bodies shall extend to the finished surface of the walls, ceiling or floor, as applicable, without projecting beyond them.
- C. Connect wiring devices by wrapping conductors around screw terminals. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- D. Unless dimensioned otherwise, install wiring devices a minimum of 24 inches from the closest edge of any sink.
- E. Install cover plates on all switches, receptacles, and blank outlets.
- F. Locate wiring devices so that the cover plate does not have to be cut to be installed.
- G. Where devices are shown near wall openings, coordinate location if corner guards are to be installed so that cover plates do not require cutting.
- H. Install cover plates after the wall has been finished (painted, wall paper, etc).

- I. Install device boxes in brick or block walls such that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
- J. Provide ground fault circuit interruption capability for all 120V receptacles 50A or less and all 208/240V receptacles 100A or less in code required locations. Locations include, but are not limited to: bathrooms, kitchens/food prep areas, exterior locations and within 6' or sinks. Interruption capability can be achieved via a GFCI circuit breaker or a GFCI receptacle.
- K. Install wiring devices shown back-to-back on a common wall offset a minimum of 12" horizontally to reduce sound transmission between rooms.

3.5 MOUNTING HEIGHTS

- A. Coordinate locations of outlet boxes provided under Division 26 Section "Common Work Results for Electrical".
- B. Unless noted otherwise, install wiring devices at mounting heights indicated in the Electrical Symbols Legend on the construction drawings.
 - 1. Receptacles:
 - a. General:
 - 1) Unless indicated otherwise, install vertically with the ground slot mounted at the top.
 - 2) Where Installed horizontally, install neutral slot mounted at the top.

3.6 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems."
 - 1. Receptacles and Switches: Identify panelboard and circuit number from which served, using:
 - a. Adhesive film label, but with letter/number height of 1/4 inch, on face of plate.

3.7 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Verify that each receptacle device is energized. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
- C. Test all wiring devices for electrical continuity and proper polarity of connections.
- D. Test each GFCI receptacle device for proper operation.
- E. Correct wiring devices incorrectly installed.
- F. Repair or replace all damaged items or damaged finishes at no expense to the Owner.

3.8 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.9 CLEANING

- A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION 262726

SECTION 265100 – INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Included in the work of this section are labor, material, and appurtenances required to complete the work of this Section as specified herein, including, but not limited to:
 - 1. Interior light fixtures, lamps, LEDs, reflectors, lenses or faceplates, ballasts, transformers, drivers and power supplies (includes exterior light fixtures normally installed on exterior surfaces of buildings).
 - 2. Light fixture supports.
 - 3. Coordination.
 - 4. Quality assurances.
 - 5. Specific requirements.

1.2 SUBMITTALS

- A. General:
 - 1. Only those light fixtures and manufacturers per each fixture type designated and listed in the Light Fixture Schedule or on the Drawings, and approved in accordance with paragraph 1.4-SUBSTITUTIONS of this Section, or both, will be accepted. Where the Light Fixture Schedule indicates an allowance to be made for a specific light fixture, the price is a contractor price and monies shall be allotted for freight, installation, and lamping (if designated). Alternate manufacturers presented at bid shall be disqualified.
 - 2. Submit all light fixtures, specified for use on this Project, in a single submittal package of portfolios, so that all light fixtures can be reviewed at one time.
 - 3. Prepare portfolios from manufacturer's standard specification sheets, and include the fixture tag indicated on the Light Fixture Schedule to identify each light fixture. Do not combine more than one light fixture type on a single sheet.
 - 4. Fixture or other materials shall not be shipped, stored, or installed into the work without approval of shop drawings.
 - 5. Modifications to fixtures shall be in accordance with Architect's comments.
- B. Product Data: For each type of light fixture, collated and bound in sets, and arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
 - 1. Summary page with the following for each light fixture type
 - a. The number, type and wattage of the light fixture lamps or LEDs (including, but not limited to, assemblies, arrays, bars or modules).
 - b. Light fixture ballast, driver or auxiliary device manufacturer, number and type.

2. Fixture cut sheets with name of manufacturer and options to be provided marked, including, but not limited to, voltage, lensing, and finish/color.
 - a. Descriptive information providing physical characteristics of light fixture, including, but not limited to, materials, dimensions, fixture efficacy and/or efficiency, and verification of indicated parameters.
 - b. For LED fixtures, include also L70 lifetime and wattage of luminaire including driver/power supply losses.
 - 1) Include MacAdam ellipse step information for:
 - a) All interior light fixtures
 - b) Exterior luminaires installed on exterior building surfaces specified with 80 CRI or greater.
3. Light fixture mounting details, including non-standard outlet boxes.
4. Construction of light fixture housing and door (if applicable).
5. Ballast cut sheet with options marked, providing physical description of ballast including, but not limited to, voltage, lamp, ballast factor, power factor, amperage and wattage.
6. Power supply, transformer, and/or driver cut sheet with options marked, providing physical description of auxiliary device including, but not limited to, voltage, power factor, amperage, wattage, and maximum remote distance charts between device and light fixture.
7. Light fixture finish and color (if applicable).
8. Lamp cut sheet with options marked, providing physical description of lamps, including, but not limited to, voltage, wattage, efficacy, CCT, CRI, lumens, and life expectancy.
 - a. For LED lamps, include also number of MacAdam ellipse steps and L70 lifetime.
9. Photometric data, in IESNA format, including LM-79 for LED luminaires, based on laboratory tests of each light fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the light fixture as applied in this Project.
 - a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
 - b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.

C. Submittal Schedule

1. Within 30 days of Division 26 contractor award, shop drawings covering all light fixtures within this section shall be forwarded to architect to begin approval process. Any shop drawings submitted after the required time frame will require the contractor to submit only the 1st named manufacturer and associated

specification data listed on the fixture schedule as the only approved manufacturer. No substitutions will be allowed after the specified time frame.

2. Within 15 days of “approved” and “approved as noted” shop drawings, contractor shall forward to Architect a guaranteed ship date for each specified fixture.
 3. Within 15 days after contractor’s receipt of “reject and resubmit” or “not approved” shop drawings, contractor shall provide Architect with resubmitted shop drawings for only those fixtures deemed unacceptable.
 4. Contractor is responsible to call to the attention of the Architect any submittals that have not been returned to him in a timely manner that may affect delivery of fixtures or as otherwise affecting Section 1.4.D of this specification.
- D. Qualification Data: For agencies providing photometric data for light fixtures.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For lighting equipment and fixtures to include in operation and maintenance manuals.
- G. Warranties: Special warranties specified in this Section.

1.3 SUBSTITUTIONS

- A. Prior to the Bid Date, substitutions will not be considered unless the Architect/Engineer have received written request for approval at least ten calendar days prior to the date for receipt of Bids. Include in each such request the Light Fixture Schedule designation, name of the material or equipment for which it is to be substituted and complete Product Data for the proposed substitute, as defined in SUBMITTALS above, and all other information necessary for an evaluation. Provide interior point-by-point photometric calculations, under both normal and emergency lighting conditions, as applicable, if required by the Engineer. Submit a \$100.00 review fee to the Engineer with each such point-by-point calculation for use of electronic base files. The fee will be returned if the substitution is added to the specification.
- B. During the Bid
1. Any proprietary, sole-sourced light fixture listed in the fixture schedule shall be unit priced only. Unit prices shall be clearly identified on the bid form.
 2. Representative agents shall be allowed to offer mini-lot pricing (MLP). MLP shall be defined as:
 - a. Agents can group only specified fixtures they represent, and
 - b. Only represent in the region where the specification originated, and
 - c. Exclude all fixtures outside their represented lines from the MLP, and
 - d. Sole-sourced (proprietary) light fixtures shall not be included in the MLP.
 3. Packaging of light fixtures will not be considered nor approved. Packaging is defined as: distributor(s) providing a single price for a light fixture package made up of specified and non-specified light fixtures. Any submittal package containing

non-specified light fixtures or inclusion of lighting control systems will be immediately rejected in its entirety.

- C. After the Bid Date, proposals to substitute light fixtures for those shown on the Drawings or specified herein, will only be considered as a deduct. Submit proposed substitutions separately, in Submittal form, with a list of proposed substitutions together with a deduct price for each substitution. Proposed substitutions will then be reviewed by the Architect/Engineer.
- D. During the construction period, no substitutions shall be considered if product delay is due to contractor's failure to order products in a timely manner after presentation of fixture schedules and specifications. Additional costs associated with air freight or special factory runs to meet schedule due to contractor's error shall be at the expense of contractor.
- E. The Architect/Engineer has the final authority as to whether the light fixture is an acceptable replacement to the specified item. The proposed substitution may also be rejected for aesthetic reasons if felt necessary or desirable. In the event the proposed substitutions herein described are rejected, provide the specified item(s).

1.4 DEFINITIONS

- A. BF: Ballast factor.
- B. CCT: Correlated color temperature
- C. CFL: Compact Fluorescent
- D. CRI: Color-rendering index.
- E. CU: Coefficient of utilization.
- F. EISA: Energy Independence and Security Act of 2007.
- G. HID: High-intensity discharge.
- H. L70: minimum 70% maintained initial-rated lumens at average rated life for LEDs
- I. LED: Light Emitting Diode
- J. LED Lamp: Replaceable LED light source with an integral driver within envelope of lamp. Lamp/Base types may include MR16/bi-pin, PAR/medium base, etc.
- K. LED Module: Light source that contains LEDs, and may include additional components such as lenses, reflectors, or refractors, however do not include drivers.
- L. LER: Light fixture (Luminaire) efficiency rating.
- M. Light Fixture: Complete light fixture, including ballast housing if provided.
- N. RCR: Room cavity ratio.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories:
 - 1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 2. Marked for intended use.
- B. Comply with NFPA 70.
- C. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.
- D. Regulatory Agencies: Provide fixtures conforming to nationally- or internationally-recognized accredited testing agencies, such as U.S., ETL, ARL, or others in acceptance with local code enforcement policy.
- E. Electrical Components and Devices: Provide only fixtures that comply with National Electric Code (NEC), and in particular to Section 410. All ceiling recessed fixtures, whether indicated in a catalog number or not, shall be equipped with an integral thermal protection device.

1.6 COORDINATION

- A. Unless otherwise noted, perform all electrical Work required for the proper installation and operation of equipment, furnishings, devices and systems specified in other Divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this Contract.
- B. Coordinate layout and installation of light fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including, but not limited to, HVAC equipment, fire-suppression system, and partition assemblies. Contractor shall arrange his installation in proper relation to other work so that there shall be no interference, damage or delay to other trades' work
- C. Give ample notice of any special openings or rough-in work required for placing electrical/lighting work so as to avoid cutting or removal of completed work.
- D. Where work of this Section is to be flush or concealed, install it so it does not project beyond finished lines of walls, ceilings or floor surface.
- E. Verify all ceiling systems and coordinate light fixture type and accessories prior to ordering light fixtures. Coordinate and cooperate with ceiling installer in regards to the location and installation of light fixtures.

1.7 WARRANTY

- A. General Guarantee: For a period of one year after Owner's initial acceptance and establishment of the beginning date of the guarantee period, and at no cost to the Owner, Contractor shall promptly furnish and install replacements for any fixtures or components

deemed by the Owner as defective in workmanship under normal operating conditions, excluding lamp replacement as noted in Section 1.10.A.1. Contractor shall repair installed equipment on the job site to Owner's satisfaction. For any time during said guarantee period that fixtures are not fully functional due to defects in material or workmanship, Contractor shall provide or pay for suitable temporary light fixtures, and shall remove said temporary fixtures upon installation of replacement elements. Contractor shall furthermore guarantee replacement fixtures for a period of one year following replacement.

- B. Contractor shall not be held responsible for damage of fixtures or equipment components occurring after the beginning of the guarantee period due to acts of vandalism, acts of war, or acts of God.
- C. LED Warranties: Shall be free from defects in materials and workmanship for the period indicated from date of factory shipment.
 - 1. LED Luminaires, including LED modules, arrays and drivers: Five years.
 - 2. LED Lamps: Three years.

1.8 SPARES

- A. Furnish spare materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Downlights: (4) spare Type D1's for attic stock.
 - 2. Ballasts and/or Drivers: (4) spare drivers for Type D1 for attic stock.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. In Light Fixture Schedule, the following requirements apply to product selection:
 - 1. Basis-of-Design Product: The design for each light fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by available manufacturers that meets or exceeds performance characteristics of the named product.

2.2 LIGHT FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. Provide light fixtures as shown on the drawings and/or specified. This shall include all lamps, material and labor to securely hang light fixtures, clean them and make them completely ready for use. Provide all hangers, supports, and miscellaneous hardware required to install light fixtures. Provide additional tie wires connected to structure to conform to applicable seismic requirements where required.
- B. Light fixture models scheduled on the Drawings are to show the manufacturer, grade and style of light fixtures required. Regardless of the manufacturer's catalog number suffixes indicated, provide all options and features as described in the Light Fixture Schedule.

- C. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures. Manufacturer of recessed fixtures shall provide mounting brackets suitable for connection to ceiling system structure. Modifications to standard mounting brackets shall be coordinated with contractor and delivered with fixture so that no delays to product delivery shall be allowed.
- D. Metal Parts: Free of burrs and sharp corners and edges.
- E. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- G. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metallized Film: 90 percent.
- H. Plastic Diffusers, Covers, and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
 - b. UV stabilized.
 - 2. Glass: Annealed crystal glass, unless otherwise indicated.
- I. Where located within structural concrete, light fixture housing and any other luminaire components in direct contact with concrete shall be effectively coated and/or covered to prevent chemical reactions with the concrete in accordance with the American Concrete Institute Code.
- J. Fixture Finishes:
 - 1. Apply fixture finishes after fabrication in a manner that assures a durable wear-resistant surfacing. Give exposed metal surfaces (brass, bronze, aluminum and others) and finished castings, except chromium-plated or stainless steel parts, an even coat of high-grade meth/acrylate lacquer or transparent epoxy.
 - 2. For corrosive or salt water environments, manufacturer shall provide fixtures with low copper/zinc cast aluminum (AB-47100 aluminum with less than 0.6% copper – classified for corrosive areas) housings to prevent salts from “pitting” aluminum housing. Manufacturer shall provide, in addition to or in lieu of, AB-47100 aluminum, ion added or pre-anodized polyester powder cast finish for “marine

grade” applications. Manufacturer shall otherwise provide all stainless steel housing in conjunction with stainless steel hardware.

3. Recessed downlights in corrosive or salt water interior environments shall be equipped with a “natatorium” finish comprised of a zinc-chromated and phosphated process, then powder-coated on the exterior of the housing.

K. Reflectors:

1. Provide aluminum reflectors or reflecting cones for downlight style fixtures comprised of #12 aluminum reflector sheet, 0.57 inch (15 gauge) or heavier and free of tool-making indentations, including spinning lines caused by assembly techniques. All reflectors shall be of first-quality, anodized finish :Alzak” with specular or semi-specular finish and color as selected. Provide specular reflectors with no apparent brightness above 45 degrees from Nadir and semi-specular, diffuse reflectors with no apparent brightness above 75 degrees from Nadir.

L. Mounting hardware and trims:

1. Coordinate as need to suit ceiling conditions.
2. Light fixtures near or in contact with insulation shall comply with code.
3. Maintain a 3” minimum working clearance between non-IC rated light future housings and insulation on all adjacent ductwork, piping, walls and ceilings.

M. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps, LEDs, ballasts and/or drivers. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp, LEDs, ballast and/or driver characteristics:
 - a. "USE ONLY" and include specific lamp or LED type.
 - b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
 - c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires. Indicate maximum allowed wattage.
 - d. LED type, wattage, beam angle (if applicable) for LED luminaires. Indicate maximum allowed wattage.
 - e. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
 - f. ANSI ballast type (M98, M57, etc.) for HID luminaires.
 - g. CCT and CRI for all luminaires.

2.3 DRIVERS FOR LED LUMINAIRES

A. Description: Designed for type and quantity of LED diodes of light fixture. Drivers shall tolerate sustained open circuit and short circuit output conditions without damage. Driver shall be designed for full light output unless dimmer or bi-level control is indicated:

1. Sound Rating: A.

2. Total Harmonic Distortion Rating: Less than 20 percent. Shall comply with ANSI C82.77.
 3. Transient Voltage Protection: IEEE C62.41, Category A or better.
 4. Power Factor: 0.90 or higher at full load.
 5. Interference: Comply with 47 CFR, Chapter 1, Part 15, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
 6. Driver shall operate with maximum sustained variations of +/-10% input voltage and frequency with no damage to driver.
 7. Driver output shall be regulated to maximum +/- 5% published load range or requirements of downstream LED fixture.
 8. LED Current Crest Factor: 1.5 or less.
 9. LED drivers shall not over-drive LEDs at a current or voltage above LED rated values in order to increase LED lumen output.
 10. Meets EN610000 for input harmonics.
 11. ROHS Compliant.
- B. Dimming Drivers:
1. Dimming Range: Visually flicker-free, strobe-free, continuous dimming of source as follows, unless specifically noted otherwise in the Light Fixture Schedule whichever is more stringent:
 - a. Luminaires: 100 to 10 percent of rated lumens.
 - b. Lamps: 100 to 20 percent of rated lumens.
 2. 0-10V dimming drivers: Compliant with IEC 60929 standard for 4-wire dimming.
 3. Compatibility: Certified by manufacturer for use with specific dimming control system and LED indicated.
 4. Control: Coordinate to ensure that the dimming driver, power supply, controller, dimming module, and/or wallbox dimmer and connecting wiring are compatible.

2.4 LED LAMPS AND LUMINAIRES

- A. LED binning specification tolerance to be within 3 MacAdam ellipses of rated values or as indicated in the Light Fixture Schedule, whichever is more stringent. All LEDs used for same fixture type throughout the project to originate from same production bin.
- B. Unless indicated otherwise in the Light Fixture Schedule, minimum 70% maintained initial-rated lumens at average rated life of as follows:
 1. LED lamps: 20,000 hours
 2. LED luminaires: 50,000 hours
- C. ROHS compliant
- D. Manufacturer of LED chips will be evaluated based on the manufacturer's product literature and data. At a minimum, LED fixtures or lamps will incorporate Bridgelux, Cree,

Nichia, Osram or Xicato LEDs; additional manufacturers may be considered however the Architect or Engineer has the authority to reject other manufacturers for technical or aesthetic reasons if felt necessary or desirable.

2.5 LIGHT FIXTURE SUPPORT COMPONENTS

- A. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- B. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- C. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gauge.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify conditions of equipment and installation prior to beginning work.
- B. Verify that equipment is ready for connecting, wiring, and energizing.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Light Fixtures: All work shall be executed to present a neat appearance. Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- C. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- D. Connect wiring according to Section "260519 - Low-Voltage Electrical Power Conductors and Cables."
- E. Through wiring of recessed light fixtures, in suspended ceilings, is not permitted. Connect each light fixture by a whip to a junction box. The whip shall be of sufficient length to allow the light fixture to be relocated within a 6-foot radius.
- F. Contractor shall construct light coves according to architectural details. Contractor shall ensure, unless otherwise directed, that top of fixture lamp is flush with top of cove lip. Contractor shall provide blocking as needed under fixture to ensure stated requirement.

3.3 COORDINATION

- A. Light fixtures shown on the Electrical Drawings represent general arrangements only. Refer to Architectural Drawings for exact locations.
- B. Coordinate the installation and location of light fixtures with other work and all other trades before installation to avoid conflicts. Coordinate light fixture locations in mechanical rooms with final installed piping and ductwork layouts.
- C. Verify all ceiling systems and coordinate light fixture type and accessories prior to ordering light fixtures. Coordinate and cooperate with ceiling installer in regards to the location and installation of light fixtures.

3.4 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Clean light fixtures of dirt and debris upon completion of the installation. Protect installed light fixtures from damage during the remainder of the construction period.
- C. Upon completion of the installation of light fixtures, and after building circuits have been energized, energize lighting branch circuits to demonstrate capability and compliance with the requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.
- D. At the time of final acceptance of this project by the Owner, ensure that all lamps are in working order and all light fixtures are fully lamped.
- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265100

SECTION 284600

FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 26 Section "Common Work Results for Electrical," for materials and methods for coordination, sleeves and common installation requirements.

1.2 DESCRIPTION OF WORK

- A. This Section requires the Contractor to furnish all materials required to install the fire alarm system. The Contractor shall be responsible for installing, testing, and start-up of a complete functioning fire alarm system, and each element thereof, as specified or indicated on the Drawings or reasonably inferred, including every article, device or accessory (whether or not specifically called for by item) necessary to facilitate each system's function as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation and utilities.
- B. Division 28 of the Specifications and Drawings numbered with prefixes FA generally describe these systems, but the scope of the Fire Alarm work includes all such work indicated in the Contract Documents: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Fire Suppression, Mechanical, Plumbing, Fire Alarm and Electrical Drawings and Specifications; and Addenda.
- C. The Drawings have been prepared diagrammatically and are intended to convey the scope of work, indicating the general location and arrangement of the major equipment, devices, appliances, etc. without showing all the exact details as to elevations, circuits, routing, and other installation requirements. Use the Drawings as a guide when laying out the system and verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers' requirements, will ensure a complete, coordinated, satisfactory and properly operating system.
- D. The scope of work in this section includes:
 - 1. Notification appliances

1.3 QUALITY ASSURANCE

- A. All work under this division shall be executed in a thorough professional manner by competent and experienced workmen licensed to perform the Work specified.
- B. All work shall be installed in strict conformance with manufacturer's requirements and recommendations. Equipment and materials shall be installed in a neat and professional manner and shall be aligned, leveled, and adjusted for satisfactory operation.

- C. Material and equipment shall be new, shall be of the best quality and design, shall be current model of the manufacturer, shall be free from defects and imperfections and shall have markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Material and equipment of the same type shall be made by the same manufacturer whenever practicable.
- D. Installation of devices shall be performed or supervised by a National Institute for Certification of Engineering Technologies (NICET) Level 2 or higher Fire Alarm Technician. Submit copies of the certification for employees through shop drawing submittals.

1.4 APPLICABLE CODES AND STANDARDS

- A. Execute Work in accordance with the National Fire Protection Association Standards and all Local, State, and National codes, ordinances and regulations in force governing the particular class of Work involved. Obtain timely inspections by the constituted authorities. Upon final completion of the Work obtain and deliver to the Owner executed final certificates of acceptance from the Authority Having Jurisdiction.
- B. Any conflict between these Specifications and accompanying Drawings and the applicable Local, State and Federal codes, ordinances and regulations shall be reported to the Architect in sufficient time, prior to the opening of Bids, to prepare the Supplementary Drawings and Specification Addenda required to resolve the conflict.
- C. The governing codes are minimum requirements. Where these Drawings and Specifications exceed the code requirements, these Drawings and Specification shall prevail.
- D. All material, manufacturing methods, handling, dimensions, method or installation and test procedure shall conform to but not be limited to the following industry standards and codes.
 - 1. NFPA 70, "National Electrical Code", 2016 Edition.
 - 2. NFPA 72, "National Fire Alarm and Signaling Code", 2016 Edition.
 - 3. Underwriters Laboratories, "Fire Protection Equipment Directory", Latest Edition.
 - 4. International Building Code (IBC) 2018 Edition with local amendments.
 - 5. International Fire Code (IFC) 218x Edition with local amendments.
- E. Contractor shall comply with rules and regulations of public utilities and municipal departments affected by connections of services.

1.5 DEFINITIONS

- A. General:
 - 1. Furnish: The term "furnish" is used to mean "supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations."
 - 2. Install: The term "install" is used to describe operations at the project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."

3. Provide: The term “provide” means “to furnish and install, complete and ready for the intended use.”
 4. Furnished by Owner or Furnished by Others: The item will be furnished by the Owner or Others. It is to be installed and connected under the requirements of this Division, complete and ready for operation, including items incidental to the Work, including services necessary for proper installation and operation. The installation shall be included under the guarantee required by this Division.
 5. AHJ: The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
 6. NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the AHJ over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other listed Manufacturers and models that meet the specified criteria.
 7. FACP: Fire Alarm Control Panel.
 8. NICET: National Institute for Certification in Engineering Technologies.
- B. The terms "approved equal", “equivalent”, or "equal" are used synonymously and shall mean “accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified”. The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.

1.6 COORDINATION

- A. The Contractor shall visit the site and ascertain the conditions to be encountered while installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provision for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, incorrect or faulty installation of Work under this Division or for additional compensation for Work covered by this Division.
- B. The Contractor shall refer to Drawings of the other disciplines and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. The Contractor shall make offsets required to clear equipment, beams and other structural members; and to facilitate concealing piping in the manner anticipated in the design.
- C. The Contractor shall maintain a foreman on the jobsite at all times to coordinate their work with other contractors and subcontractors so that various components of the Fire Alarm systems will be installed at the proper time, will fit the available space, and will allow proper service access to the equipment. Carry on the work in such a manner that the work of the other contractors and trades will not be handicapped, hindered, or delayed at any time.
- D. Work of this Division shall progress according to the "Construction Schedule" as established by the Prime Contractor and their subcontractors and as approved by the Architect. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of schedule dates.

- E. Where coordination and interfacing with other systems or equipment is required, it shall be the responsibility of the fire alarm system installer (contractor) to either provide the relays, contacts, power supplies and other necessary hardware or see to it that such hardware is provided with the other systems or equipment.
- F. The contractor shall coordinate work in this section with all related trades. Work and/or equipment provided in other sections and related to the fire alarm system shall include, but not be limited to:
 - 1. Sprinkler waterflow and valve tamper switches shall be provided by the fire sprinkler installer, but wired and connected by the fire alarm installer.
 - 2. Conduit shall be by Division 26 "Common Work Results for Electrical".
- G. System shall be complete and operational with power and control wiring provided to meet the design intent shown on the drawings and specified within the specification sections.

1.7 MEASUREMENTS AND LAYOUTS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Figured dimensions shall be taken in preference to scale dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing the Contract Documents. The Contractor will be held responsible for errors which could have been avoided by proper checking and inspection.

1.8 SUBMITTALS

- A. Refer to Division 1 and General Conditions for submittal requirements, in addition to requirements specified herein. Submittals not complying fully with the submittal requirements will be rejected.
- B. Contractor shall prepare installation drawings (working shop drawings) based upon this design. Requests for deviations from the approved design shall be submitted in writing to the Engineer of Record for approval.
- C. Shop drawings shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that it will conform to the provisions of this code and relevant laws, ordinances, rules and regulations. Drawings that are not legible, or that do not contain sufficient detail to verify compliance with applicable codes and standards, will be rejected without further review.
- D. Submittals and shop drawings shall not contain HEI's firm name or logo, nor shall it contain the HEI's engineers' seal and signature. They shall not be copies of HEI's work product. If the contractor desires to use elements of such product, the license agreement for transfer of information at the end of this section must be used.
- E. Submit Shop Drawings as early as required to support the project schedule. Allow for two weeks Engineer review time plus mailing time plus a duplication of this time for resubmittal if required. Submit Shop Drawings as soon as possible before construction starts.

- F. Before submitting Shop Drawings and material lists, the Contractor shall verify that the equipment submitted is mutually compatible and suitable for the intended use. Contractor shall verify that the equipment will fit the available space and allow ample room for maintenance. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.
- G. Refer to Division 1 for acceptance of electronic submittals for this project. For electronic submittals, Contractor shall submit the documents in accordance with the procedures specified in Division 1. Contractor shall notify the Architect and Engineer that the shop drawings have been posted. If electronic submittal procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives. Contractor shall allow the Engineer review time as specified above in the construction schedule. Contractor shall submit only the documents required to purchase the materials and/or equipment in the electronic submittal and shall clearly indicate the materials, performance criteria and accessories being proposed. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.
- H. The Engineer's checking and subsequent acceptance of such submittals shall not relieve the Contractor from responsibility for deviations from Drawings or Specifications unless the Contractor has, in writing, called the Engineer's and Architect's attention to such deviations at the time of submission, and secured written acceptance; nor shall it relieve the Contractor from responsibility for errors in dimensions, details, sizes of members, or quantities; or for omissions of components or fittings; or for not coordinating items with actual building conditions and adjacent work.
- I. Product Data: Provide a bill of materials and product cutsheets showing material specifications, electrical characteristics and connection requirements. Highlight or indicate specific product options and accessories as applicable to the project.
- J. Shop Drawings:
 - 1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - 2. Shop drawings shall be prepared by a NICET Level 3 or higher certified technician. Submit copies of the certification for the designer with submittal.
 - 3. The fire alarm system equipment vendor shall provide shop drawings showing fire alarm floor plans and a full building riser diagram. Fire alarm floor plans and riser diagram shall show fire alarm control panel, annunciator, all fire alarm initiating devices and notification appliances. Show typical wiring diagrams of control panel/s, annunciator and each device and wiring connections required. Show all interfaces to other systems, such as temperature control systems, and security systems.
 - 4. The fire alarm floor plans and riser diagram shall show wiring to all fire alarm devices/appliances, indicating wire sizes and quantities as well as conduit/raceway sizes and locations of end-of-line (EOL) resistors. The fire alarm floor plans and riser diagram shall clearly show the routing of all fire alarm system wiring, including all horizontal routing and vertical routing (in chases).
 - 5. Routing of all fire alarm wiring shall comply with the "Survivability" requirements of NFPA 72.

6. Provide a Sequence of Operations Matrix that explains how the submitted fire alarm system functions.
 7. Include voltage drop calculations for notification-appliance circuits.
 8. Include battery-size calculations.
 9. Shop drawing scale shall match the Engineer's drawings where possible. Scale shall not be less than $3/32" = 1'-0"$.
 10. Shop drawings shall be produced using computer-aided design. Hand drawn documents will not be reviewed or approved.
- K. Indicate within the submittal all applicable UL listings and all applicable approvals or certifications.
- L. Qualification Data: Submit copies of the certification for the Installer.
- M. 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.

1.9 OPERATION AND MAINTENANCE DATA

- A. Refer to Division 1 and General Conditions for Operational and Maintenance Manuals.

1.10 RECORD DRAWINGS

- A. A set of prints shall be kept on the jobsite during construction for the purpose of noting changes to location of all fire alarm equipment, devices, appliances and circuits as finally installed. During the course of construction, the Contractor shall indicate on these drawings, changes made from the Contract Drawings. Particular attention shall be made to those items which need to be located for servicing.
- B. The record drawings shall show actual locations of initiating devices, notification appliances, and end-of-line devices. Show the approximate location, size and type of all wiring and routing of wiring. Drawings should also include one-line riser diagrams showing all devices.
- C. The Contractor shall sign-off on the Record Drawings as being an accurate representation of the completed installation.
- D. Refer to Division 1 and General Conditions for Record Drawings
- E. At the completion of the project, the Contractor shall obtain at their expense, reproducible copies of the drawings and incorporate changes noted on the jobsite work prints onto these sheets. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", with date. The drawings and associated system calculations shall be delivered to the Architect.

1.11 SPARE PARTS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Provide 5% of the total or a minimum of two (2) of each horn type. Combination horn/strobe units matching the units installed are acceptable.
2. Keys and Tools: One extra set for access to locked or tamper proofed components.

1.12 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products indicated in this section with minimum three years documented experience.
- B. Installer: Company specializing in installing the products indicated in this section with minimum three years documented experience. Shall be bondable and licensed Contractor and employ full-time factory-trained and certified installers and technicians. Installers shall provide with the fire alarm submittal proof of factory training for each installer.
- C. Final checkout and verification: Shall be conducted by a technician certified by the National Institute for Certification in Engineering Technologies (NICET) registered as level 2 or higher in the fire protection technology certification program. Provide certification information with fire alarm submittal.
- D. The equipment manufacturer's service department shall be fully stocked in standard parts and components and engaged in the maintenance of fire alarm systems. On-the-premises service shall be available within 4 hours of notification, 7 days a week, 24 hours a day.

1.13 GUARANTEES AND WARRANTIES

- A. Refer to Division 1 and General Conditions for Guarantees and Warranties.

1.14 PROJECT CONDITIONS

- A. Conditions Affecting Work In Existing Buildings: The following project conditions apply:
 1. The Drawings describe the general nature of remodeling to the existing building. However, the Contractor shall visit the Site prior to submitting a bid to determine the nature and extent of work involved.
 2. Work in the existing building shall be scheduled with the Owner.
 3. Certain demolition work must be performed prior to the remodeling. The Fire Alarm Contractor shall perform the demolition which involves fire alarm system equipment and materials.
 4. Fire Alarm Contractor shall remove articles which are not required for the new work. Unless otherwise indicated, each item removed by the Contractor during this demolition shall be removed from the premises and disposed of in accordance with applicable federal, state and local regulations.
 5. Fire Alarm Contractor shall relocate and reconnect fire alarm equipment that must be relocated in order to accomplish the remodeling shown in the Drawings or indicated in the Specifications. General Contractor shall install finish material.
 6. Obtain permission from the Architect for channeling of floors or walls not specifically noted on the Drawings.

7. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
 8. Locate, identify, and protect Fire alarm services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.
- B. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.
 - C. Interruption of Existing Fire alarm Service: Do not interrupt fire alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fire watch service according to local Fire Department requirements:
 1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of fire alarm service.
 2. Do not proceed with interruption of fire alarm service without Construction Manager's written permission.
 - D. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.15 SEQUENCING AND SCHEDULING

- A. Existing Fire alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service, and label existing fire alarm equipment "NOT IN SERVICE" until removed from the building.
- B. Equipment Removal: After acceptance of new fire alarm system, remove all unused fire alarm equipment, wiring and installation materials not necessary for system functionality or spare parts.

PART 2 - PRODUCTS AND MATERIALS

2.1 SYSTEM DESCRIPTION

- A. Noncoded, UL-listed addressable system, with multiplexed signal transmission and horn/strobe evacuation.
- B. All components provided shall be listed for use with the selected system.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Source Limitations for Fire alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system

manufacturer's certification that all components provided have been tested, and will operate, as a system.

2.2 MANUFACTURER

- A. Subject to compliance with requirements, provide products that are compatible with existing system.
 - 1. SimplexGrinnell
 - 2. Approved Equal
 - a. Approved equals will not be considered unless formally submitted during the bidding process as an RFI.

2.3 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire alarm signal initiation shall be by one or more of the following devices:
 - 1. Manual pull stations.
 - 2. Heat detectors.
 - 3. Flame detectors.
 - 4. Smoke detectors.
 - 5. Air-sampling smoke-detection system.
 - 6. Carbon monoxide detectors.
 - 7. Automatic sprinkler system water flow.
 - 8. Fire extinguishing system operation.
- B. Fire alarm signal shall initiate the following actions:
 - 1. Identify alarm and specific initiating device at fire alarm control unit and remote annunciators (if provided).
 - a. A pulsing alarm tone shall occur within the control panel until acknowledged.
 - b. The alarm LED shall flash on the control panel and remote annunciator panel until the alarm has been acknowledged at the control panel/remote annunciator panel. Once acknowledged, this same LED shall latch on and the custom label for the address in alarm shall be displayed on the alphanumeric LCD readout. A subsequent alarm received from another address after acknowledged shall flash the alarm LED on the control panel showing the new alarm information.
 - 2. Transmit an alarm signal to the alarm supervising station.
 - 3. The audible and visible alarm signal shall operate until it is manually silenced or acknowledged.
 - 4. Record events in the system memory.
 - 5. Unlock electric door locks in designated egress paths.
 - 6. Release fire and smoke doors held open by magnetic door holders.
 - 7. Activate voice/alarm communication system.

8. All fan-powered air-handling equipment shall shutdown and remain down until the fire alarm control panel is reset.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
 2. Duct-smoke detectors
 3. Independent fire detection and suppression systems.
 4. User disabling of zones or individual devices.
 5. Loss of communication with any panel on the network.
- D. System Supervisory Signal Actions:
1. Identify specific device causing supervisory signal fire alarm control unit and remote annunciators (if provided).
 - a. Visible and audible supervisory alarm indicated by address at fire alarm control panel.
 - b. Manual acknowledge function at fire alarm control panel and remote annunciator panel silences audible supervisory alarm; visible alarm is displayed until device is returned to its normal position/supervisory condition is cleared.
 2. Record events in the system memory.
 3. After a time delay of 90 seconds transmit a supervisory signal to the alarm supervising station.
 4. Transmit system status to building management system.
 5. Display system status on graphic annunciator.
 6. Duct-mounted smoke detectors shall shutdown their respective unit upon detection of smoke and remain down until manually reset.
 7. Individual fan-powered air distribution equipment less than 2,000 cfm that is not provided with duct detection shall shutdown when the respective air handling unit is shutdown.
- E. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
 4. Loss of primary power at fire alarm control unit.
 5. Ground or a single break in internal circuits of fire alarm control unit.
 6. Abnormal ac voltage at fire alarm control unit.
 7. Break in standby battery circuitry.

8. Failure of battery charging.
 9. Abnormal position of any switch at fire alarm control unit or annunciator.
 10. Voice signal amplifier failure.
- F. System Trouble Signal Actions:
1. Identify specific device causing trouble signal fire alarm control unit and remote annunciators (if provided).
 - a. Visible and audible trouble alarm indicated by address at fire alarm control panel.
 - b. Manual acknowledge function at fire alarm control panel and remote annunciator panel silences audible trouble alarm; visible alarm is displayed until device is returned to its normal position/trouble condition is cleared.
 2. Record events in the system memory.
 3. After a time delay of 90 seconds, transmit a trouble signal to the alarm supervising station.
 4. Transmit system status to building management system.
 5. Display system status on graphic annunciator.

2.4 FIRE ALARM SYSTEM CONTROL UNIT

- A. General Requirements for Fire alarm Control Panel that is existing to remain:
1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
 - a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
 - b. Include a real-time clock for time annotation of events on the event recorder and printer.
 - c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
 - d. The FACP shall be listed for connection to a central-station signaling system service.
 - e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.
 - f. The control unit shall have dedicated alarm, supervisory and trouble LED's and dedicated alarm, supervisory and trouble acknowledge, and alarm silence switches.
 - g. Lamp Test: Manual lamp test function causes each LED to function at fire alarm control panel.

- h. Drill Sequence of Operation: Manual drill function causes alarm mode operation as described above.
 - i. The FACP shall be provided with surge protection.
 - j. The fire alarm system control unit shall be UL listed for releasing service.
- a. The fire alarm system control unit shall be UL listed for smoke control service.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
 - 1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
 - 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands. Note: Circuit Classes were modified in NFPA 72 in 2007. Styles were removed from the standard. The most common classes are listed below. Refer to NFPA 72 for additional classes available for more advanced systems. Refer to the appendix of NFPA 72 for comparison of old class/style method to new class designation. Class A and B are the same performance as in previous code editions.
- C. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals and digital alarm communicator transmitters shall be powered by 24-V dc source.
 - 1. The location of the dedicated branch circuit disconnecting means shall be permanently identified at the control unit.
 - 2. The circuit disconnecting means shall have a red marking and be provided with a breaker lock or other approved method to avoid accidental operation.
 - 3. Alarm current draw of entire fire alarm system shall not exceed 80 percent of the power-supply module rating.
- D. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
 - 1. Batteries: Sealed lead acid.
 - 2. The secondary power system shall operate system in standby mode for 24 hours followed by alarm mode for 5 minutes.
- E. System Supervision: Automatically detects and reports open circuits, shorts, and grounds of wiring for initiating device, signaling line, and notification appliance circuits. Alarm, supervisory and trouble signals shall be monitored by the supervising station over a Digital Alarm Communicator Transmitter (DACT), or other approved method.
- F. Fire Pump Control and Status: Provide supervised START (no STOP control shall be installed) controls and visible alarm status indication at the Fire Command Center and at the Remote Annunciator for the fire pump in accordance with NFPA 20. Coordinate with the fire pump controller supplier and provide the necessary conduit and wiring for the control and status indication. Refer to Division 21.

2.5 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
 - 1. Combination Devices: Factory integrated audible and visible devices in a single mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections. Minimum audible level and strobe intensity shall meet all requirements for separate appliances.
 - 2. Provide strobe synchronization as required per NFPA 72.
 - 3. Wall mounted notification appliances shall match existing..
 - 4. Ceiling mounted notification appliances shall match existing.
- B. Alarm Horns: Comply with UL 464. Electric vibrating polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.
- C. Visible Alarm Notification Appliances (Strobes): Xenon strobe lights complying with UL 1971, unfiltered or clear filtered white light, with candela ratings as indicated on drawings. Strobes shall meet all requirements of the Americans with Disabilities Act.

2.6 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for smoke detectors, notification appliances, or other device requiring protection as indicated on the plans.
 - 1. Factory fabricated and furnished by device manufacturer.
 - 2. Finish: Factory finished to match the color of the protected appliance or device.

2.7 FIRE ALARM WIRE AND CABLE

- A. Fire Alarm Power Branch Circuits: Building wire as specified in Division 26.
- B. Fire alarm Wire and Cable: NRTL listed and labeled as complying with NFPA 70 (NEC) Article 760. All wiring, including wiring to existing modified devices and appliances shall be new.
- C. Signaling Line, Initiating Device and Notification Appliance Circuits: Power limited fire protective signaling cable, solid copper conductor, 300 volts insulation, suitable for temperature, conditions and location installed. Minimum wire size for initiating device circuits, control circuits and notification appliance circuits shall be determined by calculations and manufacturer's requirements or recommendations. Wire and cable shall be twisted and shielded if recommended by the system manufacturer.
- D. The type of cable chosen should be based on fire alarm system requirements, specification requirements and applicable code requirements. Consideration should also be given to the length of cable runs and potential interference.

- E. Initiating, notification, and control circuits shall be sized based on 20% additional power consuming devices.
- F. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems.
- G. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket and red identifier stripe, NTRL listed for fire alarm and cable tray installation, plenum rated.
- H. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits: Provide circuitry, which meets the performance requirements during abnormal conditions, based upon the class of the circuitry selected.
 - 1. Initiating Device Circuits: Match existing circuits>.
 - a. Pathway Survivability: <Level 0>.
 - 2. Notification Appliance Circuits: Match existing circuits.
 - b. Pathway Survivability: Level 0
 - 3. Signaling Line Circuits: Match existing circuits.
 - c. Pathway Survivability: Level 0
 - 4. Any circuits interconnecting fire alarm control panels between separate buildings shall be provided with surge protection.

2.8 ACCESS TO EQUIPMENT

- A. All detectors, modules, equipment, etc. shall be located so as to provide easy access for operation, service inspection and maintenance.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall install, program and test all new equipment identified in this contract and revise existing equipment as noted in accordance with the applicable codes, standards, and manufacturer's instructions.
- B. The installation supervisor shall be on the job site during the entire installation. The installation supervisor shall maintain marked up copies of the drawings at the job site showing as-built conditions. These drawings shall be updated daily and available for Owner review.
- C. The Contractor shall provide all required conduit and all associated hardware, and shall install (pull), connect, and test all cable for a complete fire alarm system. All wiring shall be installed in accordance with the guidelines of these specifications and documents as well as the NFPA codes and standards listed in these specifications.

3.2 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 and requirements of authorities having jurisdiction for installation and testing of fire alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
 - 1. Devices placed in service before all other trades have completed cleanup shall be replaced.
 - 2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
- B. Connecting to Existing Equipment: Verify that existing fire alarm system is operational before making changes or connections.
 - 1. Connect new equipment to existing control panel.
 - 2. Expand, modify, and supplement existing control/monitoring equipment as necessary to extend existing functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
- C. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.
- D. Install ceiling mounted visible and audible/visible notification appliances in areas with exposed structure to bottom of floor/roof structure or at 30 ft AFF, whichever is lower.
- E. Install ceiling mounted visible and audible/visible notification appliances in areas with finished ceilings flush with bottom of ceiling or at 30 ft AFF, whichever is lower.
- F. Install wall mounted visible and audible/visible notification appliances with visible element (strobe) between 80 inches and 96 inches above finished floor unless noted otherwise on drawings.
- G. Install wall mounted audible devices with the top of the device at least 90 inches above finished floor or 6 inches below the ceiling, whichever is lower, unless noted otherwise on Drawings. If combination devices are installed, they shall be installed per the visible signal device requirements.

3.4 PATHWAYS

- A. Pathways above suspended ceilings and in nonaccessible locations may be routed exposed where permitted by NFPA 70 & 72.
 - 1. Exposed pathways located less than 96 inches above the floor shall be installed in conduit.

3.5 CONNECTIONS

- A. All wiring shall be terminated at devices or panels using terminal connectors for screw type terminals. All terminal connectors for conductors shall be pre-insulated ring type or pre-insulated spade type. Pre-insulated terminal connectors shall include a vinyl sleeve, color coded to indicate conductor size. Pre-insulated terminal connectors shall include a metallic support sleeve bonded to the vinyl-insulating sleeve and designed to grip the conductor insulation.

3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. All conduits and junction boxes shall be labeled as specified in Division 26 (red).
- C. The location of end-of-line resistors shall be identified with a label indicating "EOL."

3.7 GROUNDING

- A. Ground fire alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire alarm control unit.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.8 FIELD QUALITY CONTROL

- A. Systems shall be checked and tested in accordance with the instructions provided by the manufacturer to insure that the system functions as required and is free of grounds, opens, and shorts. Each device shall be tested.
- B. Upon completion of the system installation and before the Date of Final Acceptance, a factory-trained technician shall perform all necessary tests and adjustments and shall then file a Letter of Certification and a Certificate of Completion (NFPA 72) with the Owner indicating that the system functions and conforms to the Fire Alarm System Specifications.
- C. Upon completion of the system installation, a factory-trained technician shall perform all necessary tests and adjustments in the presence of the Owner's designated personnel. Test in accordance with NFPA 72 and requirements of the authority having jurisdiction. Perform the following tests at a minimum:
 - 1. Visual Inspection: Conduct visual inspection prior to testing. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.

- 2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - a. Test audible appliances for the public operating mode according to manufacturer's written instructions. .
 - b. Test visible appliances for the public operating mode according to manufacturer's written instructions.
- D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- E. Fire alarm system will be considered defective if it does not pass tests and inspections.

3.9 DEMONSTRATION

- A. The equipment supplier's factory trained technician shall train the Owner's personnel in the proper use and maintenance of the system. Training sessions shall be conducted as needed, not to exceed a total of 2 sessions, with each session lasting a maximum of 4 hours each.
- B. Demonstrate normal and abnormal modes of operation, and required responses to each.

END OF SECTION 284600

SECTION 330130.72 – SANITARY SEWER RENOVATION USING CURED-IN-PLACE PIPE (CIPP)

PART 1 - GENERAL

1.1 SUMMARY

- A. The work this section consists of the renovation of pipelines by the installation of a cured-in-place pipe (CIPP) consisting of a thermosetting resin-impregnated flexible felt tube coated on one side with an impermeable plastic which is inverted into the original conduit by the use of a hydrostatic head or pressurized air. Curing is accomplished by circulating hot water or controlled steam throughout the length of the inverted tube to cure the resin into a hard, impermeable pipe with the plastic coating on the internal surface of the CIPP. The final product shall extend the entire length of the original pipe segment providing a continuous, tight-fitting and joint-less CIPP.
 - 1. No pull-in method will be allowed
- B. References: This specification references the following Industry Standards which are made a part hereof by such reference and shall be the latest edition and revision thereof. Where conflicts exist between the referenced standard and this specification, this specification will govern.
 - 1. ASTM International (Formerly American Society of Testing and Materials):
 - a. ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics
 - b. ASTM D5813 – Standard Specification for Cured-in-Place Thermosetting Resin Sewer Piping Systems
 - c. ASTM F1216 – Standard Practice for Renovation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

1.2 SUBMITTALS

- A. Submit under provisions of Section 013300. Include shop drawings, ASTM standards, and manufacturer's data for the following items:
 - 1. Lining materials to be installed.
 - 2. Thermosetting resin to be utilized in producing the CIPP in accordance with these specifications.
 - 3. Bypass plan layout.
 - 4. Safety plan.
 - 5. Design calculations for CIPP thickness of the liner system.
 - 6. Procedures for preparing CIPP samples and testing of physical properties.
 - 7. Pre-installation inspection reports.

8. Facility representative notification plan.

1.3 QUALITY ASSURANCE

- A. Product and Contractor Qualification Requirements: The provided product shall have a 50-year design life, and in order to minimize the Owner's risk, only proven products with substantial long- term track records will be approved. In order for products and contractors to be deemed Commercially Acceptable and approved for this project they must meet the following criteria:
 1. For a Manufacturer's inversion liner product to be considered commercially proven, a minimum of 1,000,000 linear feet or 4,000 manhole-to-manhole line sections of successful wastewater collection system installations in the U.S. must be documented to the satisfaction of the Owner.
 2. The Manufacturer of the inversion liner product must operate under a quality management system that is third party certified to ISO 9001:2000 or other internationally recognized organization standards. Proof of certification shall be required for approval.
 3. Third party test results for the sewer renovation product resin system supporting the long- term performance and structural strength of the product shall be submitted for approval, and such data shall be satisfactory to the Owner. No product will be approved without independent third-party testing verification.
 4. For a Contractor to be approved by the Owner, the Contractor must satisfy all insurance, financial, and bonding requirements of the Owner, and must have successfully installed at least 200,000 linear feet of CIPP in wastewater collection systems.
 5. For a Contractor to be approved by the Owner, the Contractor must submit with their bid correspondence from the Manufacturer stating that the Contractor is certified to install the Manufacturer's inversion liner product.
- B. Bidders must submit proof that they meet the above product and installer requirements with their bid.
- C. Safety: The Contractor shall carry out their operations in strict accordance with OSHA and NIOSH and the manufacturer's safety requirements. Particular attention is drawn to those safety requirements involving working with scaffolding and entering confined spaces.

1.4 BASIS OF PAYMENT

- A. Measurement: Complete product in place lump sum.
- B. Items Included: As indicated and required for a complete installation including, but not limited to, cleaning, flow control, CIPP liner, end seals, trimming, post-CCTV inspections, reinstatement of branch connections, and incidentals.

PART 2 - PRODUCTS

2.1 LINER TUBE

- A. The tube shall consist of one or more layers of absorbent non-woven felt fabric and meet the requirements of ASTM F1216, Section 5. The tube shall be constructed to withstand installation pressures, have sufficient strength to bridge missing pipe, and stretch to fit irregular shaped pipe sections.
- B. The wet-out tube shall have a uniform thickness that when compressed at installation pressures will meet or exceed the calculated minimum design CIPP wall thickness.
- C. The tube shall be manufactured to a size that when installed will tightly fit the internal circumference and length of the original pipe. In the event that under-sized pipe is present, the liner tube shall be manufactured so that overlap folds or wrinkles do not occur. Allowances shall be made for circumferential stretching during inversion.
- D. The outside layer of the tube (before wet-out) shall be coated with a translucent, impermeable polyurethane or polyethylene plastic coating. This coating shall be an impermeable, flexible membrane that will contain the resin and facilitate monitoring of resin saturation during the resin impregnation (wet-out) process. This coating shall form the inner layer of the finished pipe and is required for enhancement of corrosion resistance, flow, and abrasion properties.
- E. The tube shall be homogenous across the entire wall thickness containing no intermediate or encapsulated layers of any material. Additionally, no material shall be included in the tube that may cause delamination in the cured liner, and no dry or unsaturated layers shall be evident.
- F. The wall color of the interior liner surface after installation shall be a light reflective color so that a clear detailed inspection with closed-circuit television equipment may be conducted.
- G. The outside of the tube shall be marked for distance at regular intervals not to exceed 10 feet. Such markings shall include the Manufacturer's name or identifying symbol. The tubes must be manufactured in the USA.
- H. The minimum length shall be that deemed necessary by the Contractor to effectively span the distance between manhole sections of the segment to be lined unless otherwise specified. The Contractor is solely responsible for field verification of all pipe diameters and lengths prior to fabrication, wet-out and installation.

2.2 RESIN

- A. The resin system shall be a corrosion resistant polyester or vinyl ester catalyst system that when properly cured, with the tube composite, meets the requirements of ASTM F1216, the physical properties herein, and those which are to be utilized in the design of the CIPP for this project. The resin shall produce a CIPP that will comply with the structural and chemical resistance requirements of this specification.

- B. The resin shall be shipped directly from the resin manufacturer's facility to the CIPP wet-out facility. The resin shall not be sent to any intermediate mixing facility.
- C. When requested by the Owner, the Contractor shall submit a Certificate of Authenticity from the resin manufacturer for each shipment to the wet-out facility to include the date of manufacture.

2.3 CIPP PRODUCT

A. Structural Requirements:

1. The CIPP shall be designed as per ASTM F1216, Appendix X1. The CIPP design shall assume no bonding to the original pipe wall.
2. Long-term testing must have been performed for flexural creep of the CIPP pipe material to be installed. Such testing results are to be used to determine the long-term, time dependent flexural modulus to be utilized in the product design. This is a performance test of the materials (tube and resin) and general workmanship of the installation and curing as defined within the relevant ASTM standard. A percentage of the instantaneous flexural modulus value (as measured by ASTM D790 testing) will be used in design calculations for external buckling. The percentage, or the long-term creep retention value utilized, will be verified by this testing. Retention values exceeding 50% of the short-term test results shall not be applied unless substantiated by qualified third party test data to the Owner's satisfaction. The materials utilized for the contracted project shall be of a quality equal to or better than the materials used in the long-term test with respect to the initial flexural modulus used in the CIPP design.
3. The layers of the cured CIPP shall be uniformly bonded. It shall not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly, or the probe or knife blade moves freely between the layers. If separation of the layers occurs during field sample testing, new samples will be required to be obtained from the installed pipe. Any reoccurrence may cause rejection of the work.
4. The cured pipe material (CIPP) shall conform to the structural properties, as listed below.

Minimum CIPP Physical Properties		
<u>Property</u>	<u>Test Method</u>	<u>Results</u>
Modulus of Elasticity	ASTM D790	400,000 psi
Flexural Stress	ASTM D790	4,500 psi

5. The minimum acceptable nominal (wet) liner thickness shall be based on the design considerations of ASTM F1216 or 6 mm for pipe 12-inches in diameter and less, 7.5 mm for pipe 15-inches in diameter, and 9.0 mm for pipe 18-inches in diameter, whichever is greater.
 - a. Design Safety Factor (typically used value) = 2.0
 - b. Retention Factor for Long-Term Flexural Modulus to be used in Design = 50%

(As determined by long-term tests described in Part 2.03 A.2. and approved by the Owner)

- c. Ovality (Calculated from X1.1 of ASTM F1216) = Not Less than 2%
 - d. Groundwater Depth (above invert of pipe): Same as Soil Depth
 - e. Soil Depth (above crown of pipe): Field Verify
 - f. Soil Density = 120pcf
 - g. Live Load: H20 Highway
 - h. Design Condition: Fully Deteriorated
6. Any layers of the tube that are not saturated with resin prior to insertion into the existing pipe shall not be included in the structural CIPP wall thickness computation.
- B. Testing Requirements:
- 1. Chemical Resistance: The CIPP shall meet the chemical resistance requirements of ASTM F1216, Appendix X2. CIPP samples for testing shall be of tube and resin system similar to that proposed for actual construction. It is required that CIPP samples with and without plastic coating meet these chemical-testing requirements.
 - 2. Hydraulic Capacity: Overall, the hydraulic cross-section shall be maintained as large as possible. The CIPP shall have a minimum of the full flow capacity of the original pipe before renovation. Calculated capacities may be derived using a commonly accepted roughness coefficient for the existing pipe material taking into consideration its age and condition.
 - 3. CIPP Field Samples: When requested by the Owner, the Contractor shall submit test results from field installations of the same resin system and tube materials as proposed for the actual installation. These test results must verify that the CIPP physical properties specified in Part 2.03 A.4. herein have been achieved in previous field applications. Samples for this project shall be made and tested as described in Part 3.04 A. of this specification.

PART 3 - EXECUTION

3.1 INSTALLATION RESPONSIBILITIES FOR INCIDENTAL ITEMS

- A. Cleaning of Sewer Lines: The Contractor shall remove all internal debris out of the sewer line that will interfere with the installation of CIPP. The Owner shall also provide a dumpsite for all debris removed from the sewers during the cleaning operation. Unless stated otherwise, it is assumed this site will be at or near the sewage treatment facility to which the debris would have arrived in absence of the cleaning operation. Any hazardous waste material encountered during this project will be considered as a changed condition.
- B. Pre-CIPP Installation Inspection of Pipelines: Inspection of pipelines shall be performed by experienced personnel trained in locating breaks, obstacles, and service connections using close circuit television (CCTV) inspection techniques. The pipeline interior shall be carefully inspected to determine the location of any conditions that may prevent proper installation of CIPP. These shall be noted and corrected. A DVD and suitable written log for each line section shall be produced, complete with all “live” service

connections noted, for later reference by the Owner. Contractor shall utilize all techniques, as required, to distinguish between “live”, abandoned, and/or capped service connections. Each file name shall include the upstream manhole number of the line segment as the first identifier followed by the downstream manhole number of the line segment (e.g., 144 to 145). The Contractor shall utilize the most current manhole numbers as provided by the Owner.

- C. **Line Obstructions:** It shall be the responsibility of the Contractor to clear the line of obstructions such as solids and roots that will prevent the insertion of CIPP. If pre-installation inspection reveals an obstruction such as a protruding service connection, dropped joint, or a collapse that will prevent the installation process and cannot be removed by conventional sewer cleaning equipment, then the Contractor shall make a point repair excavation to uncover and remove or repair the obstruction. Such excavation shall be approved in writing by the Owner's representative prior to the commencement of the work. Owner reserves the right to perform necessary point repair excavations with its own work force.
- D. **Sewer Line Sags:** It shall be the responsibility of the Contractor to identify and make a point repair excavation of an existing sewer line when a pipe sag is greater than 25% of the cross-sectional area of the pipe. Such excavation shall be approved in writing by the Owner's representative prior to the commencement of the work. Owner reserves the right to perform necessary point repair excavations with its own work force.
- E. **Bypassing Sewage:** The Contractor, when required, shall provide for the flow of sewage around the section or sections of pipe designated for repair. Plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent system shall make the bypass. The pump(s) and bypass line(s) shall be of adequate capacity to accommodate the sewage flow. The Owner shall require a detail of the bypass plan to be submitted.
- F. **Facility Notification:** The Contractor shall make every effort to maintain sewer service usage throughout the duration of the project. Any sewer service interruptions shall be scheduled and coordinated with facility management and kept to an absolute minimum time frame. A notification program shall be implemented, and shall as a minimum, require the Contractor to be responsible for contacting Facility Representatives and informing them of the work to be conducted, and when the sewer will be off-line. The Contractor shall also provide the following:
 - 1. Written notice to be delivered to Facility Representatives three days prior to the beginning of work being conducted on the section, and a local telephone number of the Contractor they can call to discuss the project or any potential problems.
 - 2. Personal contact with Facility Representatives for any sewer service connection which cannot be reconnected within the time stated in the written notice.

3.2 INSTALLATION

- A. CIPP installation shall be in accordance with ASTM F1216, Section 7, with the following modifications.
1. Resin Impregnation: The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the potential loss of resin during installation through cracks and irregularities in the original pipe wall, as applicable.
 2. Tube Insertion: The wet-out tube shall be inverted into the pipeline using as defined within relevant ASTM standards previously stipulated. The tube should be inverted through an existing manhole or approved access point and fully extend to the next designated manhole or termination point.
 3. Temperature gauges shall be placed between the tube and the host pipe's invert position to monitor the temperatures during the cure cycle.
 4. Curing shall be accomplished by utilizing hot water under hydrostatic pressure or steam pressure in accordance with the manufacturer's recommended cure schedule. A cool-down process shall be conducted that complies with the resin manufacturer's specification. A liner curing and cool down log shall be maintained by the Contractor for each CIPP inversion.
- B. Sealing Liner at Ends: Prior to the installation of the CIPP, the Contractor shall install hydrophilic waterstops to the interior circumference of the existing sewer at the inlet and outlet of each manhole, or as otherwise directed by the City. The waterstop material shall be Insignia by LMK or an engineer approved equal. End seal shall be composed of neoprene rubber with a mechanical fastener composed of spring-loaded retaining rings. Install one end seal at each end of the existing line. Upon completion of CIPP installation the interface between the CIPP pipeline and the adjoining manhole shall be watertight.
- C. Liner Trimming: After the liner has been cured, the liner should be trimmed entering and exiting the manhole, so that 3" extends into the manhole. Also, a V-notch should be cut in the crown of the liner in the downstream manhole, so as to reduce future wear on television cables or cleaning equipment. For each inversion of two (2) or more line segments using a single liner, the liner should be cut flush with the trough at the intermediate manhole(s), so that there is no ponding on the bench of the manhole(s). If additional line segments enter these intermediate manhole(s), the liner should not obstruct the flow from these lines.

3.3 REINSTATEMENT OF BRANCH CONNECTIONS

- A. It is the intent of these specifications that branch connections to buildings be re-opened to 100% of the original diameter without excavation, utilizing a remotely controlled cutting device, monitored by CCTV. The Contractor shall certify a minimum of two complete functional cutters plus key spare components are on the job site before each installation or are in the immediate area of the jobsite and can be quickly obtained at all times during liner installation. Unless otherwise directed by the Owner or his authorized representative, only active laterals shall be reinstated. In the event that a "non-active"

lateral line has been reinstated, it shall be the Contractor's responsibility to install a CIPP point repair liner with no additional cost to the Owner. No additional payment will be made for excavations for the purpose of reopening connections unless approved by the Engineer prior to CIPP installation and the Contractor will be responsible for all costs and liability associated with such excavation and restoration work.

1. The Contractor shall be prepared to utilize CCTV and dye tablets to verify "active" or "non- active" status of sewer service lateral lines. All costs associated with this work shall be the responsibility of the Contractor. Any branch connections serving open lots where the lateral line has been brought to the surface and securely capped shall be reinstated.

3.4 INSPECTION

- A. CIPP samples shall be prepared for each installation designated by the Owner/Engineer or approximately 20% of the project's installations. Pipe physical properties will be tested in accordance with ASTM F1216, Section 8, using either method proposed. The flexural properties must meet or exceed the values listed in Part 2.03 A.4. of this specification, Table 1 of ASTM F1216, or the values submitted to the Owner/Engineer by the Contractor for this project's CIPP wall design, whichever is greater.
- B. Wall thickness of samples shall be determined in a manner consistent with 8.1.2 of ASTM D5813. The minimum wall thickness at any point shall not be less than 87.5% of the specified design thickness calculated in Part 2.03 A.5. of this section.
- C. Post-CIPP CCTV Inspection: Installation shall be inspected visually by closed-circuit television (CCTV). Variations from true line and grade may be inherent because of the conditions of the original piping. No infiltration of groundwater should be observed. All service entrances should be accounted for and be unobstructed. The CCTV inspections shall be provided in a quality acceptable to the Engineer and/or Owner where the camera view is not underwater, blurry, or full of pixels distorting the picture. Video shall not be taken at such a speed so that the reviewer cannot properly identify objects in the camera's path. At each re-instated service connection, the CCTV camera shall come to a complete stop and the service shall be panned in its entirety to show a clear picture of the service lateral cutout and confirm the smoothness of the re-instated service. Each file name shall include the upstream manhole number of the line segment as the first identifier followed by the downstream manhole number of the line segment (e.g. 144 to 145). The Contractor shall utilize the most current manhole numbers as provided by the Owner.
- D. All defects discovered during the post-CIPP CCTV inspection shall be corrected by the Contractor at his expense before the work is considered complete. Defects include any wrinkles in the finished liner that cause backwater greater than one-half (1/2) inch or that result in a reduction of pipeline hydraulic capacity.

3.5 CLEAN-UP

- A. Upon acceptance of the installation work and testing, the Contractor shall restore the project area affected by the operations to a condition at least equal to that existing prior to the work. All work necessary to restore areas damaged by construction activities shall be restored in accordance with the applicable section for such required work contained within these project specifications.

END OF SECTION 330130.72

APPENDIX A

Asbestos Report

December 6, 2024



**LIMITED ASBESTOS-CONTAINING MATERIALS (ACM)
SAMPLING REPORT**



**2418 Merriam Lane
Kansas City, KS 66106**

Report Prepared For:

**Matt Swaback
Henderson Engineers
8345 Lenexa Drive, Suite 300
Lenexa, KS 66214**

Project:

**Limited Asbestos-Containing Materials
(ACM) Sampling
Four Restrooms,
Ragland Education Building, Higginsville Habilitation Center
100 W. 1st Street
Higginsville, MO 64037**

TES Project No.: 24128A

March 21, 2024



Full Service Environmental Consulting, Testing & Contracting
2418 Merriam Lane, KCK 66106 | Phone: 913-432-5500 | www.titankc.com

March 21, 2024

TES Project No.: 24128A

Matt Swaback
Henderson Engineers
8345 Lenexa Drive, Suite 300
Lenexa, KS 66214

RE: Limited Asbestos-Containing Materials Sampling
Four Restrooms,
Ragland Education Building, Higginsville Habilitation Center
100 W. 1st Street
Higginsville, MO 64037

Dear Client:

On March 19, 2024, Titan Environmental Services (TES) conducted a limited asbestos containing materials (ACM) sampling of requested suspect building materials (four restrooms) at the Ragland Education Building, Higginsville Habilitation Center, located at 100 W. 1st Street, Higginsville, MO 64037. Travis Taylor of TES performed the inspection. Mr. Taylor is a licensed Missouri Department of Natural Resources (MDNR) Asbestos Inspector. His certification number is 7001011124MOIR17423, expiration date January 26, 2025. A copy of his certification is attached to this report.

The purpose of this limited sampling was to identify and quantify suspect asbestos-containing materials (ACM) that may be present in the subject property prior to renovation and/or demolition activities that may impact them. The limited sampling of the subject property was performed utilizing the NESHAPS and ASTM assessment, sampling, and analytical protocol.

Sampling Methodology

Suspect materials were grouped together into homogeneous sampling areas. A homogeneous sampling area contains materials that are uniform in texture and color, and appear to be identical in every other respect. Building materials that were installed at different times, or that do not appear to be similar in any other way are considered separate homogeneous materials/areas.

Bulk samples of suspect ACM were collected in order to determine the presence of asbestos. The bulk samples were delivered to Environmental Hazards Services LLC, an independent NVLAP-accredited laboratory located in North Chesterfield, Virginia, for analysis. The samples were analyzed using polarized-light microscopy (PLM), coupled with dispersion staining techniques in accordance with Appendix A to Subpart F of 40 CFR 763.

The asbestos inspection of the subject property was performed using the NESHAPS and ASTM assessment, sampling, and analytical protocol by the EPA/AHERA accredited Asbestos Inspector listed above.

ACM Inspection Findings

Ten (10) bulk samples (with **nineteen [19]** layers analyzed) were collected from requested suspect ACM during the limited sampling of the subject property. The data contained within this report is based upon visible and accessible materials. Without complete accesses to all building systems (i.e. pipe chases, wall cavities, etc.), 100% accuracy in the following data is not possible.

Any material that has greater than 1% asbestos content is defined as an asbestos-containing material (ACM), and is subject to city, state, and/or federal regulations. Mixed results within homogeneous areas are considered positive if any one (1) sample within the homogeneous area is positive. Suspect materials on building systems are listed by material type and location in the table below.

DATE	SAMPLE #	LOCATION	MATERIAL	ASBESTOS CONTENT	CONDITION/ FRIABILITY
3/19/24	HMF1-01 (Layer 1)	East Restrooms Wall Cavity (Small Restrooms)	Hard Mudded Fitting – <u>Cloth Wrap</u> , Hard White Material	Trace <1% Amosite	Damaged/ Friable
3/19/24	HMF1-01 (Layer 2)	East Restrooms Wall Cavity (Small Restrooms)	Hard Mudded Fitting – Cloth Wrap, <u>Hard White Material</u>	2% Amosite	Damaged/ Friable
3/19/24	PI-02	East Restrooms Wall Cavity (Small Restrooms)	Pipe Insulation – Fiberglass & Cloth	None Detected	Damaged/ Non-Friable
3/19/24	WBS1-03	East Men's Restroom Wall (Small Restrooms)	Wallboard System w/Tape & Mud	None Detected	Damaged/ Non-Friable
3/19/24	PWS1-04	East Men's Restroom Wall (Small Restrooms)	Plaster Wall System	None Detected	No Damage/ Non-Friable
3/19/24	HMF1-05 (Layer 1)	Center Mechanical Room (Men's Restroom Plumbing)	Hard Mudded Fitting – <u>Cloth Wrap</u> , Hard White Material	Trace <1% Amosite	No Damage/ Friable
3/19/24	HMF1-05 (Layer 2)	Center Mechanical Room (Men's Restroom Plumbing)	Hard Mudded Fitting – Cloth Wrap, <u>Hard White Material</u>	2% Amosite	No Damage/ Friable
3/19/24	HMF1-06 (Layer 1)	Center Mechanical Room (Women's Restroom Plumbing)	Hard Mudded Fitting – <u>Cloth</u> , Hard White Material	Trace <1% Amosite	No Damage/ Friable
3/19/24	HMF1-06 (Layer 2)	Center Mechanical Room (Women's Restroom Plumbing)	Hard Mudded Fitting – Cloth, <u>Hard White Material</u>	2% Amosite	No Damage/ Friable
3/19/24	FT1-07 (Layer 1)	Center Mechanical Room	9" X 9" Floor Tile w/Black Mastic, <u>Beige Swirl Pattern</u>	2% Chrysotile	No Damage/ Non-Friable
3/19/24	FT1-07 (Layer 2)	Center Mechanical Room	9" X 9" Floor Tile w/ <u>Black Mastic</u> , Beige Swirl Pattern	4% Chrysotile	No Damage/ Non-Friable
3/19/24	IS1-08	Center Women's Restroom Ceiling	Interior Sealant - White	None Detected	No Damage/ Non-Friable

DATE	SAMPLE #	LOCATION	MATERIAL	ASBESTOS CONTENT	CONDITION/FRIABILITY
3/19/24	PWS1-09	Center Women's Restroom Ceiling	Plaster Wall System	None Detected	No Damage/Non-Friable
3/19/24	PWS1-10	Center Men's Restroom Ceiling	Plaster Wall System	None Detected	No Damage/Non-Friable

Summary of Asbestos-Containing Materials

The following table is a listing of the identified ACM within the subject property.

Homogenous Code	Materials Description	Asbestos Type / %	Total Quantity (In Scope of Work)
HMF1	Hard Mudded Fitting – Cloth, Hard White Material	2% Amosite	115 Fittings
2% Amosite was detected in the hard white material as well as 1% trace amosite in the cloth wrap around it. This material was observed in the wall cavity between small/East restrooms and in the mechanical room next to the large/center restrooms. There is approximately 115 pipe fittings present.			
FT1	9" X 9" Floor Tile w/Black Mastic, Beige Swirl Pattern	2-4% Chrysotile	
2% Chrysotile was detected in the floor tile layer and 4% chrysotile was detected in the black mastic floor adhesive layer in sample FT1-07. This material is present throughout common hallways and is likely out of the scope of work. Its possible these materials could be under restrooms ceramic floor and thus was sampled.			

Recommendations

Due to multiple State of Missouri and Federal EPA/OSHA regulations governing the disturbance, employee exposure, and/or disposal of ACM, TES recommends that all ACM listed above be properly addressed by a Missouri Department of Natural Resources (MDNR) licensed abatement contractor prior to the start of any renovation or demolition activities that may impact them. All work practices and engineering controls should be in accordance with EPA, OSHA, and Missouri State regulations.

In the event that additional suspect asbestos containing materials (i.e., thermal system pipe insulation, mudded fittings, duct wrap fire proofing, vinyl flooring, etc.) are discovered where an inspector previously could not access (under sub-floors, in pipe chases, wall or ceiling cavities, etc.) during future renovation and/or demolition activities, bulk samples should be collected to determine the presence of asbestos.

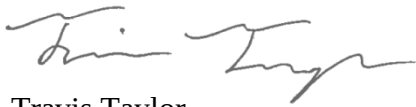
Additionally, a Missouri Department of Natural Resources (MDNR) licensed abatement contractor should remove the ACM that will be impacted as part of the demolition project. All work practices and engineering controls should be implemented in accordance with both state of Missouri Department of Natural Resources (MDNR) and Federal EPA/OSHA abatement regulations.

Closing Comments

The limited asbestos-containing materials (ACM) sampling was performed by TES at the request of the client. Consequently, TES cannot guarantee, and does not warrant, that this limited sampling has revealed all asbestos-containing materials, and other adverse environmental conditions affecting the site. The results reported and opinions reached by TES are for the benefit of the client. The results and opinions set forth by TES in its report will be valid as of the date of the report.

TES appreciates the opportunity to be of assistance to you. If you have any questions, please don't hesitate to contact us.

Respectfully,

A handwritten signature in black ink, appearing to read "Travis Taylor", with a stylized flourish at the end.

Travis Taylor
MDNR ACM Inspector

Attachments Below: Appendix A – Asbestos Bulk Sample Analysis Results
Appendix B – Site Photographs & Drawing
Appendix C – TES Personnel Certifications

APPENDIX A – ASBESTOS BULK SAMPLE ANALYSIS RESULTS



Environmental Hazards Services, L.L.C.
7469 Whitepine Rd
Richmond, VA 23237
Telephone: 800.347.4010

Asbestos Bulk Analysis Report

Report Number: 24-03-02861

Client: Titan Environmental Services inc
P.O. Box 410295
Kansas City, MO 64141

Received Date: 03/20/2024
Analyzed Date: 03/20/2024
Reported Date: 03/21/2024

Project/Test Address: 24128A; 100 W 1st St; Higginsville, MO 64037

Client Number:
201310

Fax Number:
816-589-7803

Laboratory Results

Lab Sample Number	Client Sample Number	Layer Type	Lab Gross Description	Asbestos	Other Materials
24-03-02861-001A	HMF1-01	Covering/ Jacket	Off-White Fibrous; Homogeneous	Trace <1% Amosite	99% Cellulose 1% Non-Fibrous
Total Asbestos: Trace <1%					
Possible contamination from insulation.					
24-03-02861-001B	HMF1-01	Insulation	White Powdery; Fibrous; Homogeneous	2% Amosite	2% Cellulose 25% Fibrous Glass 71% Non-Fibrous
Total Asbestos: 2%					
24-03-02861-002A	PI1-02	Covering/ Jacket	Off-White Fibrous; Homogeneous	NAD	99% Cellulose 1% Non-Fibrous
24-03-02861-002B	PI1-02	Insulation	Orange Fibrous; Homogeneous	NAD	99% Fibrous Glass 1% Non-Fibrous
24-03-02861-003	WBS1-03		White Paint-Like; White Powdery; White Fibrous; Inhomogeneous	NAD	10% Fibrous Glass 90% Non-Fibrous
No drywall present					

Environmental Hazards Services, L.L.C

Client Number: 201310

Report Number: 24-03-02861

Project/Test Address: 24128A; 100 W 1st St; Higginsville, MO
64037

Lab Sample Number	Client Sample Number	Layer Type	Lab Gross Description	Asbestos	Other Materials
24-03-02861-004A	PWS1-04	Skim Coat	White Paint-Like; White Brittle; Inhomogeneous	NAD	100% Non-Fibrous
24-03-02861-004B	PWS1-04	Base Coat	Brown Granular; Homogeneous	NAD	100% Non-Fibrous
24-03-02861-005A	HMF1-05	Covering/Jacket	Off-White Fibrous; Homogeneous	Trace <1% Amosite	99% Cellulose 1% Non-Fibrous
Total Asbestos: Trace <1%					
Possible contamination from insulation.					
24-03-02861-005B	HMF1-05	Insulation	White Powdery; Fibrous; Homogeneous	2% Amosite	2% Cellulose 25% Fibrous Glass 71% Non-Fibrous
Total Asbestos: 2%					
24-03-02861-006A	HMF1-06	Covering/Jacket	Off-White Fibrous; Homogeneous	Trace <1% Amosite	99% Cellulose 1% Non-Fibrous
Total Asbestos: Trace <1%					
Possible contamination from insulation.					
24-03-02861-006B	HMF1-06	Insulation	White Powdery; Fibrous; Homogeneous	2% Amosite	2% Cellulose 25% Fibrous Glass 71% Non-Fibrous
Total Asbestos: 2%					
24-03-02861-007A	FT1-07	Tile	Brown Vinyl; Homogeneous	2% Chrysotile	98% Non-Fibrous
Total Asbestos: 2%					
24-03-02861-007B	FT1-07	Mastic	Black Adhesive; Homogeneous	4% Chrysotile	96% Non-Fibrous
Total Asbestos: 4%					

Environmental Hazards Services, L.L.C

Client Number: 201310

Report Number: 24-03-02861

Project/Test Address: 24128A; 100 W 1st St; Higginsville, MO
64037

Lab Sample Number	Client Sample Number	Layer Type	Lab Gross Description	Asbestos	Other Materials
24-03-02861-008A	IS1-08	Other *	White Pliable; Homogeneous	NAD	100% Non-Fibrous
*Pliable Material					
24-03-02861-008B	IS1-08	Other *	White Pliable Foam-Like; Homogeneous	NAD	100% Non-Fibrous
*Foam-Like Material					
24-03-02861-009A	PWS1-09	Skim Coat	White Paint-Like; White Brittle; Inhomogeneous	NAD	100% Non-Fibrous
24-03-02861-009B	PWS1-09	Base Coat	Gray Granular; Homogeneous	NAD	100% Non-Fibrous
24-03-02861-010A	PWS1-10	Skim Coat	White Paint-Like; White Brittle; Inhomogeneous	NAD	100% Non-Fibrous
24-03-02861-010B	PWS1-10	Base Coat	Gray Granular; Homogeneous	NAD	100% Non-Fibrous

Environmental Hazards Services, L.L.C

Client Number: 201310

Report Number: 24-03-02861

Project/Test Address: 24128A; 100 W 1st St; Higginsville, MO
64037

Lab Sample Number	Client Sample Number	Layer Type	Lab Gross Description	Asbestos	Other Materials

QC Sample: 100-M12014-2

QC Blank: SRM 1866 Fiberglass

Reporting Limit: 1% Asbestos

Method: EPA Method 600/R-93/116, EPA Method 600/M4-82-020

Analyst: Keleigh King

Reviewed By Authorized Signatory:

Melissa Kanode

Melissa Kanode
QA/QC Clerk

These results are based on a comparative visual estimate. The condition of the samples analyzed was acceptable upon receipt per laboratory protocol unless otherwise noted on this report. Each distinct component in an inhomogeneous sample was analyzed separately and reported as a composite. Results represent the analysis of samples submitted by the client. Sample location, description, area, volume, etc., was provided by the client. This report cannot be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government. This report shall not be reproduced except in full, without the written consent of the Environmental Hazards Service, L.L.C. California Certification #2319 NY ELAP #11714 NVLAP #101882-0 VELAP 460172. All information concerning sampling location, date, and time can be found on Chain-of-Custody. Environmental Hazards Services, L.L.C. does not perform any sample collection.

Environmental Hazards Services, L.L.C. recommends reanalysis by point count (for more accurate quantification) or Transmission Electron Microscopy (TEM), (for enhanced detection capabilities) for materials regulated by EPA NESHAP (National Emission Standards for Hazardous Air Pollutants) and found to contain less than ten percent (<10%) asbestos by polarized light microscopy (PLM). Both services are available for an additional fee.

400 Point Count Analysis, where noted, performed per EPA Method 600/R-93/116 with a Reporting Limit of 0.25%.

* All California samples analyzed by Polarized Light Microscopy, EPA Method 600/M4-82-020, Dec. 1982.

LEGEND: NAD = no asbestos detected



A Full Service Environmental Consulting and Testing Firm
Phone: 913-432-5500 Fax: 913-432-0704

ASBESTOS BULK CUSTODY FORM

JOB LOCATION: 100 W. 1st St., Higginsville, MO 64037

PROJECT #:24128A

CONTACT/PHONE: Paul Ehrhardt – (913) 432-5500

DATE	SAMPLE #	LOCATION	MATERIAL DESCRIPTION	CONDITION	FRIABILITY	LAB ID
3/19/24	HMF1-01	East Restrooms Wall Cavity (Small Restrooms)	Hard Mudded Fitting	Damaged	Friable	
3/19/24	* PI-02	East Restrooms Wall Cavity (Small Restrooms)	Pipe Insulation – Fiberglass & Cloth	Damaged	Non-Friable	
3/19/24	WBS1-03	East Men's Restroom Wall (Small Restrooms)	Wallboard System w/Tape & Mud	Damaged	Non-Friable	
3/19/24	PWS1-04	East Men's Restroom Wall (Small Restrooms)	Plaster Wall System	No Damage	Non-Friable	
3/19/24	HMF1-05	Center Mechanical Room (Men's Restroom Plumbing)	Hard Mudded Fitting	No Damage	Friable	
3/19/24	HMF1-06	Center Mechanical Room (Women's Restroom Plumbing)	Hard Mudded Fitting	No Damage	Friable	
3/19/24	FT1-07	Center Mechanical Room	9" X 9" Floor Tile w/Black Mastic, Beige Swirl Pattern	No Damage	Non-Friable	
3/19/24	IS1-08	Center Women's Restroom Ceiling	Interior Sealant - White	No Damage	Non-Friable	
3/19/24	PWS1-09	Center Women's Restroom Ceiling	Plaster Wall System	No Damage	Non-Friable	
3/19/24	PWS1-10	Center Men's Restroom Ceiling	Plaster Wall System	No Damage	Non-Friable	

ADDITIONAL REMARKS: Do NOT Composite any materials with the exception of wallboard systems (if applicable).

Please email results to: paule@titankc.com & kgranger@titankc.com

Sampled by: Travis Taylor
PRINTED NAME

Turnaround Time: **1-Day**

Travis Taylor
SIGNATURE

*Sample ID taken from bag KEK 3/20/24

Relinquished By: Travis Taylor Date/Time: _____

Received By: Melvin L. [Signature] Date/Time: 3/20/24 10:31h

PLEASE RETURN ORIGINAL COPY TO TITAN ENVIRONMENTAL S

24-03-02861

2418 Merriam Lane., Kansas City, Kansas 66106 Phone (913) 432-5500



Due Date:
03/21/2024
(Thursday)
AE

Not
KEK
10pm

United States Department of Commerce
National Institute of Standards and Technology



Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 101882-0

Environmental Hazards Services, L.L.C.
North Chesterfield, VA

*is accredited by the National Voluntary Laboratory Accreditation Program for specific services,
listed on the Scope of Accreditation, for:*

Asbestos Fiber Analysis

*This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017.
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality
management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).*

2024-01-01 through 2024-12-31

Effective Dates



A handwritten signature in blue ink, reading "Dana S. Laman".

For the National Voluntary Laboratory Accreditation Program

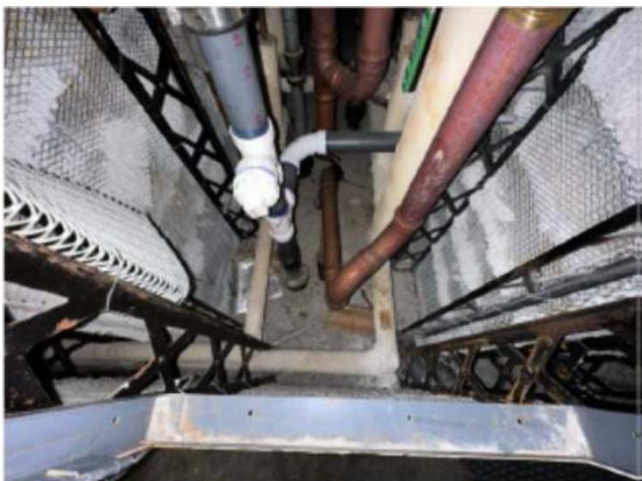
APPENDIX B – SITE PHOTOGRAPHS & DRAWING



Exterior Front & Entry Overviews



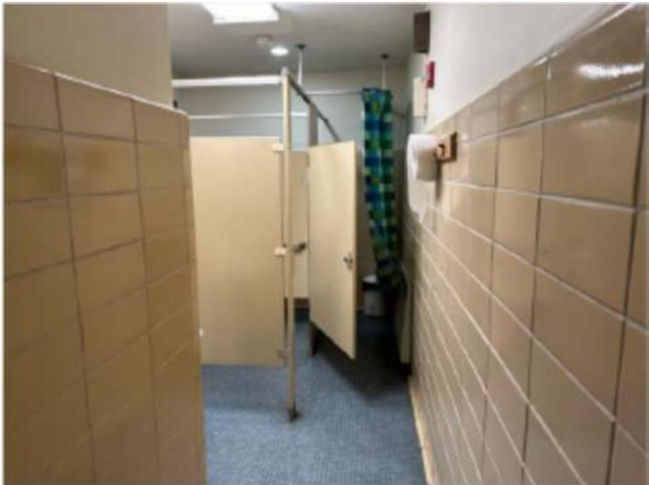
Small Restroom (East) Wall Cavity Access Hatch



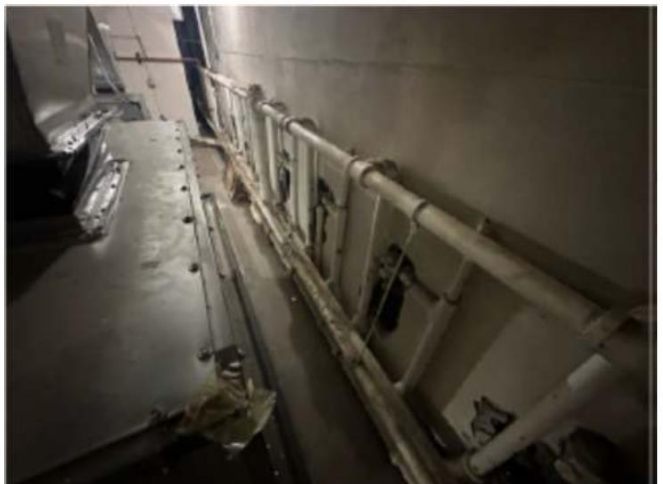
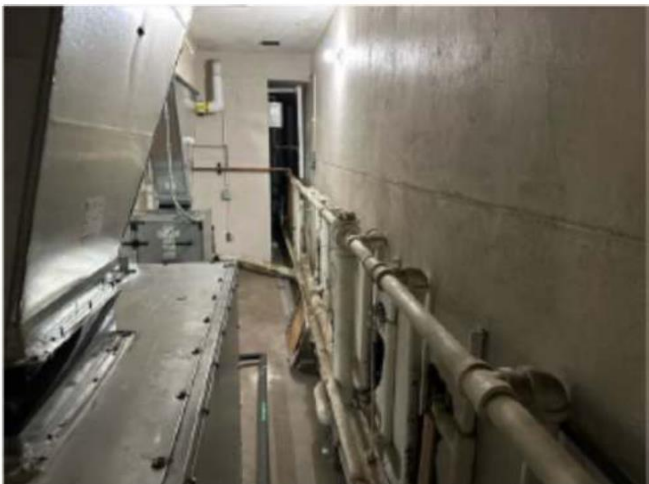
Small Restroom (East) Hard Muddled Fittings 1 & Pipe Insulation 1



Men's Restroom Overview



Women's Restroom Overview



Mechanical Room Pipe Overviews



Mechanical Room Pipe Overviews



Mechanical Room Hard Muddled Fittings & Pipe Overviews



Men's Restroom Overview



Interior Sealant 1

LEGEND - HAZARDOUS MATERIAL SURVEY

REB - RAGLAND EDUCATION BUILDING
 NAT - NATATORIUM
 PT - PAINT SAMPLE
 DW - DRY WALL SAMPLE
 CB - COVE BASE SAMPLE
 FT - FLOOR TILE SAMPLE
 CW - CHILLED WATER INSULATION SAMPLE
 HW - HOT WATER INSULATION SAMPLE
 PL - PLASTER WALL SAMPLE
 CD - CONDENSATE INSULATION SAMPLE
 ST - STEAM INSULATION SAMPLE
 SD - SUPPLY DUCT INSULATION SAMPLE
 RD - RETURN DUCT INSULATION SAMPLE
 FL - FLUE DUCT INSULATION SAMPLE
 LBP - LEAD BASED PAINT X-RAY LOCATION
 HWE - HOT WATER ELBOW INSULATION SAMPLE
 CLG - CEILING SAMPLE
 XRF - XRAY
 CT - CEILING TILE

EXAMPLE

LOCATION - SAMPLE TYPE SAMPLE - NUMBER
 REB FT 2 - RAGLAND EDUCATION BUILDING FLOOR TILE SAMPLE #2

SEE ASBESTOS INSPECTION REPORT
 HABILITATION CENTER 5-7 AUGUST 2019 FOR
 DETAILED RESULTS OF SAMPLES
 ASBESTOS IS PRESENT IN FLOOR TILE SAMPLES
 AND THE INSULATION ELBOWS OF STEAM,
 CONDENSATE, AND DOMESTIC HOT WATER
 PIPING



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

STATE OF MISSOURI
 MICHAEL J. PEARSON
 GOVERNOR



OFFICE OF ADMINISTRATION
 DIVISION OF FACILITIES
 MANAGEMENT DESIGN AND
 CONSTRUCTION

RECORD
 DRAWING
 SET
 11-23-2023



CROSSED SWORDS ENGINEERING
 1619 NE OAK TREE DR.
 LEE'S SUMMIT MO 64066
 (816) 309-6099 Robert7721@gmail.com
 MO STATE CERTIFICATE OF
 AUTHORITY #2016003099
 CONSULTANTS

REPLACE HVAC,
 BAS, AND DOMESTIC
 HOT WATER
 SYSTEM

HIGGINSVILLE HABILITATION
 CENTER
 HIGGINSVILLE, MISSOURI

PROJECT # M16009-01
 SITE # 7357
 ASSET # 6517357027

REVISION
 DATE 11-23-2023
 REVISION
 DATE
 REVISION
 DATE
 ISSUE DATE: 01/10/2022

CAD DWG FILE # H-101.DWG
 DRAWN BY: BJS
 CHECKED BY: BJS
 DESIGNED BY: BJS

SHEET TITLE
 HAZARDOUS
 MATERIALS PLAN
 EDUCATION BUILDING
 FIRST FLOOR

SHEET NUMBER
 H-101

SHEET 3 OF 28
 4/11/2022

APPENDIX C – TES PERSONNEL CERTIFICATIONS

CERTIFICATION NUMBER:

7001011124MOIR17423

THIS CERTIFIES

Travis N. Taylor

HAS COMPLETED THE CERTIFICATION

REQUIREMENTS FOR

Inspector



APPROVED: **01/26/2024**

EXPIRES: **01/26/2025**

TRAINING DATE: **01/11/2024**

A handwritten signature in black ink, appearing to read "Stephen M. Hall". The signature is written in a cursive, flowing style.

Director of Air Pollution Control Program

APPENDIX B

Supplemental Narrative Below Slab Sanitary Piping Repair Scope 6/26/2025



SUPPLEMENTAL NARRATIVE – BELOW SLAB SANITARY PIPING REPAIR SCOPE

This narrative is being supplemented to the design documents (drawings and specifications) to provide additional information pertaining to the below slab sanitary piping scope. A plumbing contractor was engaged to complete the inspection of the lines. Mains and branch lines were inspected. The following summary and scope of work are based on the findings of the inspection. Bidding contractor shall include the following scope of work in their bids.

Summary of Sanitary Line Condition:

After several days of milling and jetting the sanitary line, it has been confirmed that the line is now functioning properly. However, a small belly in the line was located beneath the ball pit. This defect has the potential to cause future issues, particularly as the cast iron pipe continues to deteriorate over time. This natural deterioration can lead to increased scaling and potential backups.

Scope of Work:

To prevent future problems and extend the life of the system, the contractor shall install 400' of 4" CIPP (Cured-In-Place Pipe) liner throughout the sanitary mains within the building. This liner will rehabilitate the main lines only and will not include any branch lines. Refer to the attached 330130.72 specification for requirements for this scope of work.

To complete this work, the contractor shall excavate the slab in select locations to access the pipe and install cleanouts. The contractor shall determine the number and location of these excavation points prior to submitting their bid. These access points will be utilized to properly shoot and cure the liner throughout the pipe and give proper access to the line for future maintenance. Provide new cleanouts at each of these excavation/access points.

It is anticipated that 12–14 lateral line reinstatements of the liner are required to maintain proper connections, however contractor shall confirm exact count prior to bidding.

Contractor shall include all necessary costs to infill and repair slab and flooring at excavation points. Flooring shall match existing. Existing flooring cannot be reinstalled. New flooring material shall be provided.

Attachments:

1. 330130.72 Sanitary Sewer Renovation Using Cured-In-Place Pipe (CIPP)
2. Existing plumbing drawings showing below slab storm and sanitary piping.
3. Sanitary schematic provided by plumbing contractor showing below slab pipe routing.

SECTION 330130.72 – SANITARY SEWER RENOVATION USING CURED-IN-PLACE PIPE (CIPP)

PART 1 - GENERAL

1.1 SUMMARY

- A. The work this section consists of the renovation of pipelines by the installation of a cured-in-place pipe (CIPP) consisting of a thermosetting resin-impregnated flexible felt tube coated on one side with an impermeable plastic which is inverted into the original conduit by the use of a hydrostatic head or pressurized air. Curing is accomplished by circulating hot water or controlled steam throughout the length of the inverted tube to cure the resin into a hard, impermeable pipe with the plastic coating on the internal surface of the CIPP. The final product shall extend the entire length of the original pipe segment providing a continuous, tight-fitting and joint-less CIPP.
 - 1. No pull-in method will be allowed
- B. References: This specification references the following Industry Standards which are made a part hereof by such reference and shall be the latest edition and revision thereof. Where conflicts exist between the referenced standard and this specification, this specification will govern.
 - 1. ASTM International (Formerly American Society of Testing and Materials):
 - a. ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics
 - b. ASTM D5813 – Standard Specification for Cured-in-Place Thermosetting Resin Sewer Piping Systems
 - c. ASTM F1216 – Standard Practice for Renovation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

1.2 SUBMITTALS

- A. Submit under provisions of Section 013300. Include shop drawings, ASTM standards, and manufacturer's data for the following items:
 - 1. Lining materials to be installed.
 - 2. Thermosetting resin to be utilized in producing the CIPP in accordance with these specifications.
 - 3. Bypass plan layout.
 - 4. Safety plan.
 - 5. Design calculations for CIPP thickness of the liner system.
 - 6. Procedures for preparing CIPP samples and testing of physical properties.
 - 7. Pre-installation inspection reports.

8. Facility representative notification plan.

1.3 QUALITY ASSURANCE

- A. Product and Contractor Qualification Requirements: The provided product shall have a 50-year design life, and in order to minimize the Owner's risk, only proven products with substantial long- term track records will be approved. In order for products and contractors to be deemed Commercially Acceptable and approved for this project they must meet the following criteria:
 1. For a Manufacturer's inversion liner product to be considered commercially proven, a minimum of 1,000,000 linear feet or 4,000 manhole-to-manhole line sections of successful wastewater collection system installations in the U.S. must be documented to the satisfaction of the Owner.
 2. The Manufacturer of the inversion liner product must operate under a quality management system that is third party certified to ISO 9001:2000 or other internationally recognized organization standards. Proof of certification shall be required for approval.
 3. Third party test results for the sewer renovation product resin system supporting the long- term performance and structural strength of the product shall be submitted for approval, and such data shall be satisfactory to the Owner. No product will be approved without independent third-party testing verification.
 4. For a Contractor to be approved by the Owner, the Contractor must satisfy all insurance, financial, and bonding requirements of the Owner, and must have successfully installed at least 200,000 linear feet of CIPP in wastewater collection systems.
 5. For a Contractor to be approved by the Owner, the Contractor must submit with their bid correspondence from the Manufacturer stating that the Contractor is certified to install the Manufacturer's inversion liner product.
- B. Bidders must submit proof that they meet the above product and installer requirements with their bid.
- C. Safety: The Contractor shall carry out their operations in strict accordance with OSHA and NIOSH and the manufacturer's safety requirements. Particular attention is drawn to those safety requirements involving working with scaffolding and entering confined spaces.

1.4 BASIS OF PAYMENT

- A. Measurement: Complete product in place lump sum.
- B. Items Included: As indicated and required for a complete installation including, but not limited to, cleaning, flow control, CIPP liner, end seals, trimming, post-CCTV inspections, reinstatement of branch connections, and incidentals.

PART 2 - PRODUCTS

2.1 LINER TUBE

- A. The tube shall consist of one or more layers of absorbent non-woven felt fabric and meet the requirements of ASTM F1216, Section 5. The tube shall be constructed to withstand installation pressures, have sufficient strength to bridge missing pipe, and stretch to fit irregular shaped pipe sections.
- B. The wet-out tube shall have a uniform thickness that when compressed at installation pressures will meet or exceed the calculated minimum design CIPP wall thickness.
- C. The tube shall be manufactured to a size that when installed will tightly fit the internal circumference and length of the original pipe. In the event that under-sized pipe is present, the liner tube shall be manufactured so that overlap folds or wrinkles do not occur. Allowances shall be made for circumferential stretching during inversion.
- D. The outside layer of the tube (before wet-out) shall be coated with a translucent, impermeable polyurethane or polyethylene plastic coating. This coating shall be an impermeable, flexible membrane that will contain the resin and facilitate monitoring of resin saturation during the resin impregnation (wet-out) process. This coating shall form the inner layer of the finished pipe and is required for enhancement of corrosion resistance, flow, and abrasion properties.
- E. The tube shall be homogenous across the entire wall thickness containing no intermediate or encapsulated layers of any material. Additionally, no material shall be included in the tube that may cause delamination in the cured liner, and no dry or unsaturated layers shall be evident.
- F. The wall color of the interior liner surface after installation shall be a light reflective color so that a clear detailed inspection with closed-circuit television equipment may be conducted.
- G. The outside of the tube shall be marked for distance at regular intervals not to exceed 10 feet. Such markings shall include the Manufacturer's name or identifying symbol. The tubes must be manufactured in the USA.
- H. The minimum length shall be that deemed necessary by the Contractor to effectively span the distance between manhole sections of the segment to be lined unless otherwise specified. The Contractor is solely responsible for field verification of all pipe diameters and lengths prior to fabrication, wet-out and installation.

2.2 RESIN

- A. The resin system shall be a corrosion resistant polyester or vinyl ester catalyst system that when properly cured, with the tube composite, meets the requirements of ASTM F1216, the physical properties herein, and those which are to be utilized in the design of the CIPP for this project. The resin shall produce a CIPP that will comply with the structural and chemical resistance requirements of this specification.

- B. The resin shall be shipped directly from the resin manufacturer's facility to the CIPP wet-out facility. The resin shall not be sent to any intermediate mixing facility.
- C. When requested by the Owner, the Contractor shall submit a Certificate of Authenticity from the resin manufacturer for each shipment to the wet-out facility to include the date of manufacture.

2.3 CIPP PRODUCT

A. Structural Requirements:

1. The CIPP shall be designed as per ASTM F1216, Appendix X1. The CIPP design shall assume no bonding to the original pipe wall.
2. Long-term testing must have been performed for flexural creep of the CIPP pipe material to be installed. Such testing results are to be used to determine the long-term, time dependent flexural modulus to be utilized in the product design. This is a performance test of the materials (tube and resin) and general workmanship of the installation and curing as defined within the relevant ASTM standard. A percentage of the instantaneous flexural modulus value (as measured by ASTM D790 testing) will be used in design calculations for external buckling. The percentage, or the long-term creep retention value utilized, will be verified by this testing. Retention values exceeding 50% of the short-term test results shall not be applied unless substantiated by qualified third party test data to the Owner's satisfaction. The materials utilized for the contracted project shall be of a quality equal to or better than the materials used in the long-term test with respect to the initial flexural modulus used in the CIPP design.
3. The layers of the cured CIPP shall be uniformly bonded. It shall not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly, or the probe or knife blade moves freely between the layers. If separation of the layers occurs during field sample testing, new samples will be required to be obtained from the installed pipe. Any reoccurrence may cause rejection of the work.
4. The cured pipe material (CIPP) shall conform to the structural properties, as listed below.

Minimum CIPP Physical Properties		
<u>Property</u>	<u>Test Method</u>	<u>Results</u>
Modulus of Elasticity	ASTM D790	400,000 psi
Flexural Stress	ASTM D790	4,500 psi

5. The minimum acceptable nominal (wet) liner thickness shall be based on the design considerations of ASTM F1216 or 6 mm for pipe 12-inches in diameter and less, 7.5 mm for pipe 15-inches in diameter, and 9.0 mm for pipe 18-inches in diameter, whichever is greater.
 - a. Design Safety Factor (typically used value) = 2.0
 - b. Retention Factor for Long-Term Flexural Modulus to be used in Design = 50%
(As determined by long-term tests described in Part 2.03 A.2. and approved by the Owner)

- c. Ovality (Calculated from X1.1 of ASTM F1216) = Not Less than 2%
 - d. Groundwater Depth (above invert of pipe): Same as Soil Depth
 - e. Soil Depth (above crown of pipe): Field Verify
 - f. Soil Density = 120pcf
 - g. Live Load: H20 Highway
 - h. Design Condition: Fully Deteriorated
6. Any layers of the tube that are not saturated with resin prior to insertion into the existing pipe shall not be included in the structural CIPP wall thickness computation.
- B. Testing Requirements:
- 1. Chemical Resistance: The CIPP shall meet the chemical resistance requirements of ASTM F1216, Appendix X2. CIPP samples for testing shall be of tube and resin system similar to that proposed for actual construction. It is required that CIPP samples with and without plastic coating meet these chemical-testing requirements.
 - 2. Hydraulic Capacity: Overall, the hydraulic cross-section shall be maintained as large as possible. The CIPP shall have a minimum of the full flow capacity of the original pipe before renovation. Calculated capacities may be derived using a commonly accepted roughness coefficient for the existing pipe material taking into consideration its age and condition.
 - 3. CIPP Field Samples: When requested by the Owner, the Contractor shall submit test results from field installations of the same resin system and tube materials as proposed for the actual installation. These test results must verify that the CIPP physical properties specified in Part 2.03 A.4. herein have been achieved in previous field applications. Samples for this project shall be made and tested as described in Part 3.04 A. of this specification.

PART 3 - EXECUTION

3.1 INSTALLATION RESPONSIBILITIES FOR INCIDENTAL ITEMS

- A. Cleaning of Sewer Lines: The Contractor shall remove all internal debris out of the sewer line that will interfere with the installation of CIPP. The Owner shall also provide a dumpsite for all debris removed from the sewers during the cleaning operation. Unless stated otherwise, it is assumed this site will be at or near the sewage treatment facility to which the debris would have arrived in absence of the cleaning operation. Any hazardous waste material encountered during this project will be considered as a changed condition.
- B. Pre-CIPP Installation Inspection of Pipelines: Inspection of pipelines shall be performed by experienced personnel trained in locating breaks, obstacles, and service connections using close circuit television (CCTV) inspection techniques. The pipeline interior shall be carefully inspected to determine the location of any conditions that may prevent proper installation of CIPP. These shall be noted and corrected. A DVD and suitable written log for each line section shall be produced, complete with all “live” service

connections noted, for later reference by the Owner. Contractor shall utilize all techniques, as required, to distinguish between “live”, abandoned, and/or capped service connections. Each file name shall include the upstream manhole number of the line segment as the first identifier followed by the downstream manhole number of the line segment (e.g., 144 to 145). The Contractor shall utilize the most current manhole numbers as provided by the Owner.

- C. **Line Obstructions:** It shall be the responsibility of the Contractor to clear the line of obstructions such as solids and roots that will prevent the insertion of CIPP. If pre-installation inspection reveals an obstruction such as a protruding service connection, dropped joint, or a collapse that will prevent the installation process and cannot be removed by conventional sewer cleaning equipment, then the Contractor shall make a point repair excavation to uncover and remove or repair the obstruction. Such excavation shall be approved in writing by the Owner's representative prior to the commencement of the work. Owner reserves the right to perform necessary point repair excavations with its own work force.
- D. **Sewer Line Sags:** It shall be the responsibility of the Contractor to identify and make a point repair excavation of an existing sewer line when a pipe sag is greater than 25% of the cross-sectional area of the pipe. Such excavation shall be approved in writing by the Owner's representative prior to the commencement of the work. Owner reserves the right to perform necessary point repair excavations with its own work force.
- E. **Bypassing Sewage:** The Contractor, when required, shall provide for the flow of sewage around the section or sections of pipe designated for repair. Plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent system shall make the bypass. The pump(s) and bypass line(s) shall be of adequate capacity to accommodate the sewage flow. The Owner shall require a detail of the bypass plan to be submitted.
- F. **Facility Notification:** The Contractor shall make every effort to maintain sewer service usage throughout the duration of the project. Any sewer service interruptions shall be scheduled and coordinated with facility management and kept to an absolute minimum time frame. A notification program shall be implemented, and shall as a minimum, require the Contractor to be responsible for contacting Facility Representatives and informing them of the work to be conducted, and when the sewer will be off-line. The Contractor shall also provide the following:
 - 1. Written notice to be delivered to Facility Representatives three days prior to the beginning of work being conducted on the section, and a local telephone number of the Contractor they can call to discuss the project or any potential problems.
 - 2. Personal contact with Facility Representatives for any sewer service connection which cannot be reconnected within the time stated in the written notice.

3.2 INSTALLATION

- A. CIPP installation shall be in accordance with ASTM F1216, Section 7, with the following modifications.
 - 1. Resin Impregnation: The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the potential loss of resin during installation through cracks and irregularities in the original pipe wall, as applicable.
 - 2. Tube Insertion: The wet-out tube shall be inverted into the pipeline using as defined within relevant ASTM standards previously stipulated. The tube should be inverted through an existing manhole or approved access point and fully extend to the next designated manhole or termination point.
 - 3. Temperature gauges shall be placed between the tube and the host pipe's invert position to monitor the temperatures during the cure cycle.
 - 4. Curing shall be accomplished by utilizing hot water under hydrostatic pressure or steam pressure in accordance with the manufacturer's recommended cure schedule. A cool-down process shall be conducted that complies with the resin manufacturer's specification. A liner curing and cool down log shall be maintained by the Contractor for each CIPP inversion.
- B. Sealing Liner at Ends: Prior to the installation of the CIPP, the Contractor shall install hydrophilic waterstops to the interior circumference of the existing sewer at the inlet and outlet of each manhole, or as otherwise directed by the City. The waterstop material shall be Insignia by LMK or an engineer approved equal. End seal shall be composed of neoprene rubber with a mechanical fastener composed of spring-loaded retaining rings. Install one end seal at each end of the existing line. Upon completion of CIPP installation the interface between the CIPP pipeline and the adjoining manhole shall be watertight.
- C. Liner Trimming: After the liner has been cured, the liner should be trimmed entering and exiting the manhole, so that 3" extends into the manhole. Also, a V-notch should be cut in the crown of the liner in the downstream manhole, so as to reduce future wear on television cables or cleaning equipment. For each inversion of two (2) or more line segments using a single liner, the liner should be cut flush with the trough at the intermediate manhole(s), so that there is no ponding on the bench of the manhole(s). If additional line segments enter these intermediate manhole(s), the liner should not obstruct the flow from these lines.

3.3 REINSTATEMENT OF BRANCH CONNECTIONS

- A. It is the intent of these specifications that branch connections to buildings be re-opened to 100% of the original diameter without excavation, utilizing a remotely controlled cutting device, monitored by CCTV. The Contractor shall certify a minimum of two complete functional cutters plus key spare components are on the job site before each installation or are in the immediate area of the jobsite and can be quickly obtained at all times during liner installation. Unless otherwise directed by the Owner or his authorized representative, only active laterals shall be reinstated. In the event that a "non-active"

lateral line has been reinstated, it shall be the Contractor's responsibility to install a CIPP point repair liner with no additional cost to the Owner. No additional payment will be made for excavations for the purpose of reopening connections unless approved by the Engineer prior to CIPP installation and the Contractor will be responsible for all costs and liability associated with such excavation and restoration work.

1. The Contractor shall be prepared to utilize CCTV and dye tablets to verify "active" or "non- active" status of sewer service lateral lines. All costs associated with this work shall be the responsibility of the Contractor. Any branch connections serving open lots where the lateral line has been brought to the surface and securely capped shall be reinstated.

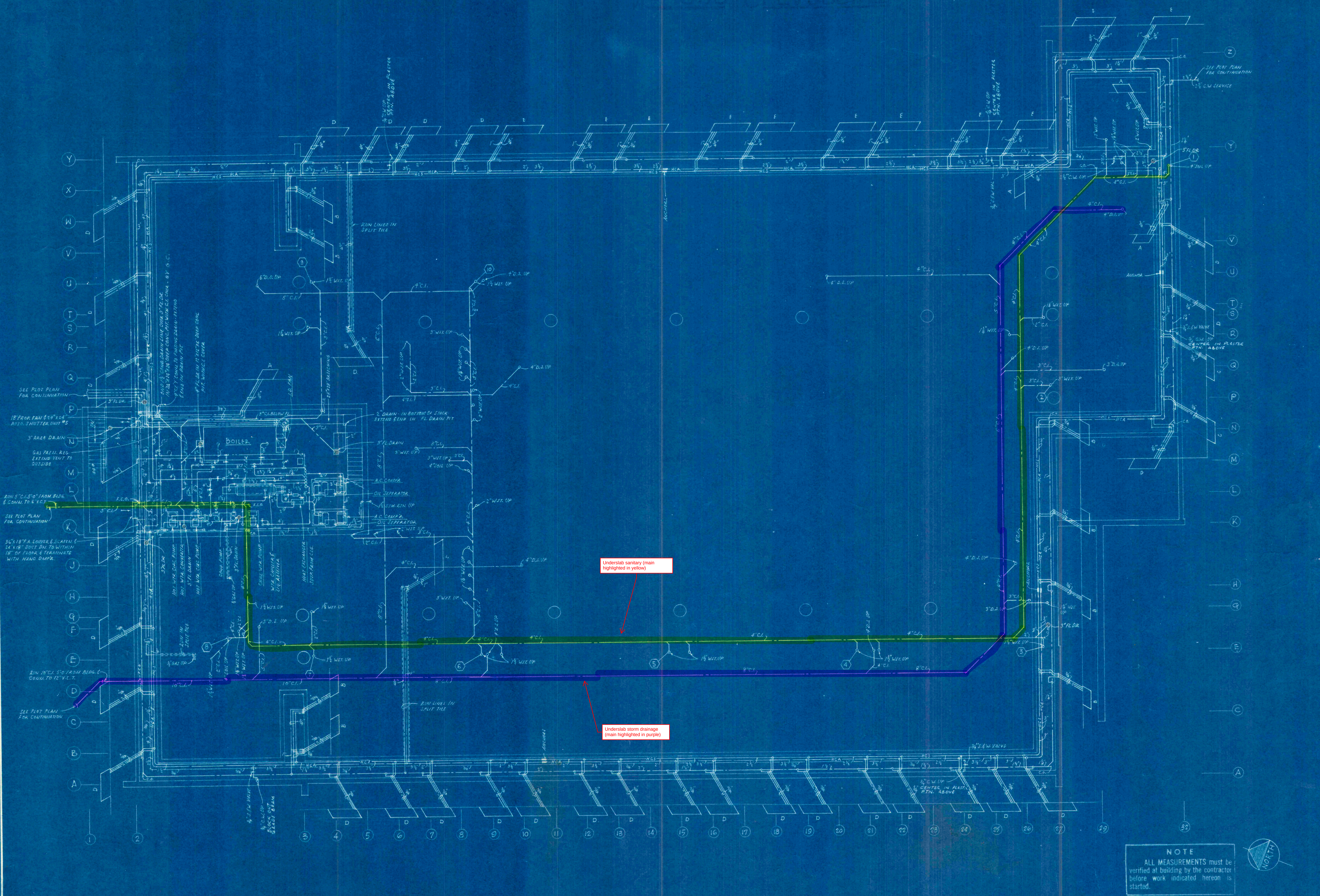
3.4 INSPECTION

- A. CIPP samples shall be prepared for each installation designated by the Owner/Engineer or approximately 20% of the project's installations. Pipe physical properties will be tested in accordance with ASTM F1216, Section 8, using either method proposed. The flexural properties must meet or exceed the values listed in Part 2.03 A.4. of this specification, Table 1 of ASTM F1216, or the values submitted to the Owner/Engineer by the Contractor for this project's CIPP wall design, whichever is greater.
- B. Wall thickness of samples shall be determined in a manner consistent with 8.1.2 of ASTM D5813. The minimum wall thickness at any point shall not be less than 87.5% of the specified design thickness calculated in Part 2.03 A.5. of this section.
- C. Post-CIPP CCTV Inspection: Installation shall be inspected visually by closed-circuit television (CCTV). Variations from true line and grade may be inherent because of the conditions of the original piping. No infiltration of groundwater should be observed. All service entrances should be accounted for and be unobstructed. The CCTV inspections shall be provided in a quality acceptable to the Engineer and/or Owner where the camera view is not underwater, blurry, or full of pixels distorting the picture. Video shall not be taken at such a speed so that the reviewer cannot properly identify objects in the camera's path. At each re-instated service connection, the CCTV camera shall come to a complete stop and the service shall be panned in its entirety to show a clear picture of the service lateral cutout and confirm the smoothness of the re-instated service. Each file name shall include the upstream manhole number of the line segment as the first identifier followed by the downstream manhole number of the line segment (e.g. 144 to 145). The Contractor shall utilize the most current manhole numbers as provided by the Owner.
- D. All defects discovered during the post-CIPP CCTV inspection shall be corrected by the Contractor at his expense before the work is considered complete. Defects include any wrinkles in the finished liner that cause backwater greater than one-half (1/2) inch or that result in a reduction of pipeline hydraulic capacity.

3.5 CLEAN-UP

- A. Upon acceptance of the installation work and testing, the Contractor shall restore the project area affected by the operations to a condition at least equal to that existing prior to the work. All work necessary to restore areas damaged by construction activities shall be restored in accordance with the applicable section for such required work contained within these project specifications.

END OF SECTION 330130.72



Underslab sanitary (main highlighted in yellow)

Underslab storm drainage (main highlighted in purple)

NOTE
ALL MEASUREMENTS must be verified at building by the contractor before work indicated hereon is started.



AUGUST MORE A L U M A I A A R C H I T E C T
1 2 2 1 B A L T I M O R E A V E N U E K A N S A S C I T Y M I S S O U R I

APPROVED FOR THE STATE OF MISSOURI

DIRECTOR: DEPT. OF PUBLIC HEALTH AND WELFARE

CHIEF: PLANNING AND CONSTRUCTION

EXPANSION OF FACILITIES

MISSOURI STATE SCHOOL AND HOSPITAL

HIGGINSVILLE, MISSOURI

MISSOURI STATE DEPARTMENT OF PUBLIC HEALTH AND WELFARE

STATE OF MISSOURI

W. L. CASSELL

NUMBER E-134

REGISTERED PROFESSIONAL ENGINEER

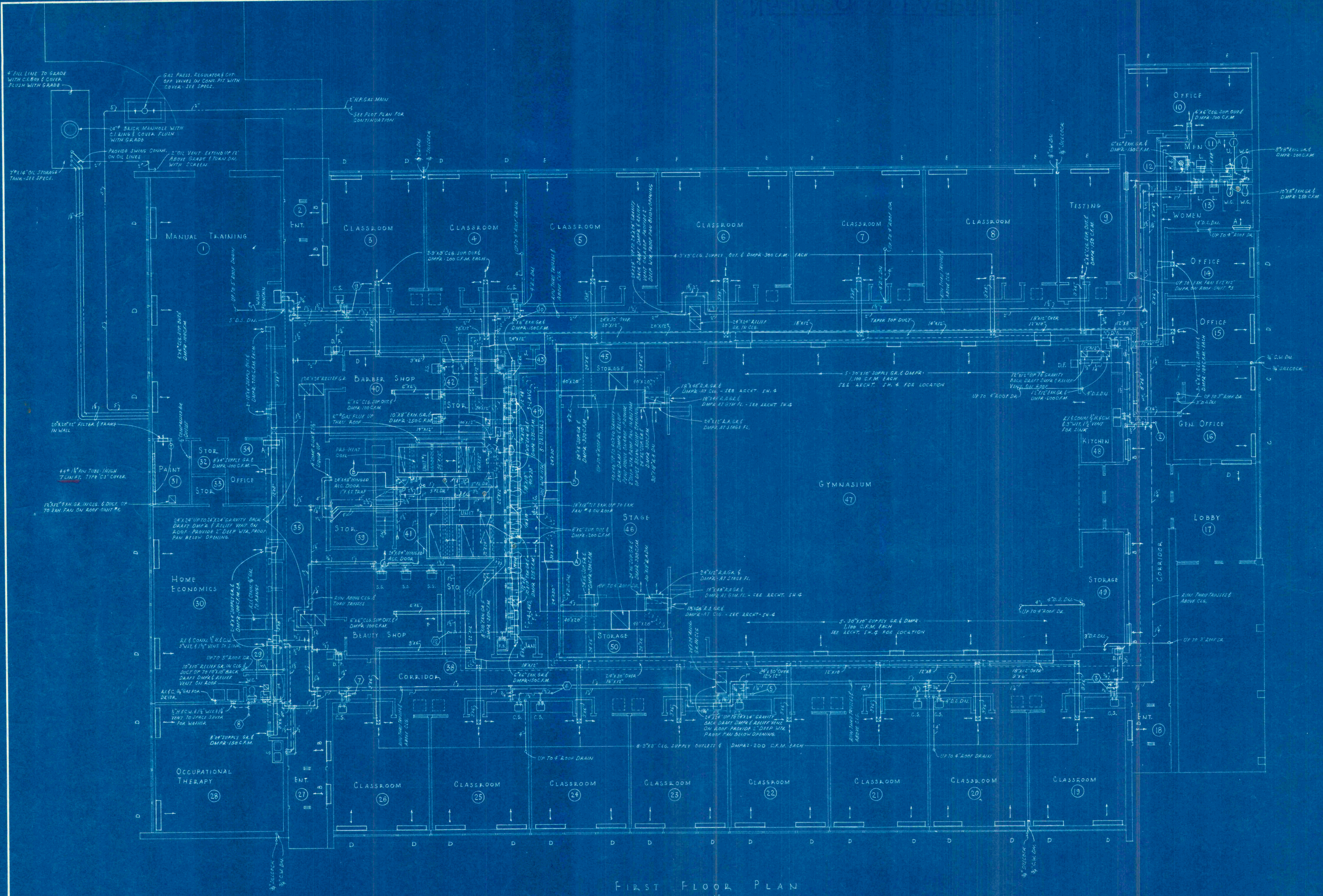
UNIT G

EDUCATION BUILDING

DATE APRIL 5, 1963

JOB 91162

DRAWN J.E.P.



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

NOTE
ALL MEASUREMENTS must be
verified at building by the contractor
before work indicated hereon is
started.

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UNIT G
EDUCATION
BUILDING



