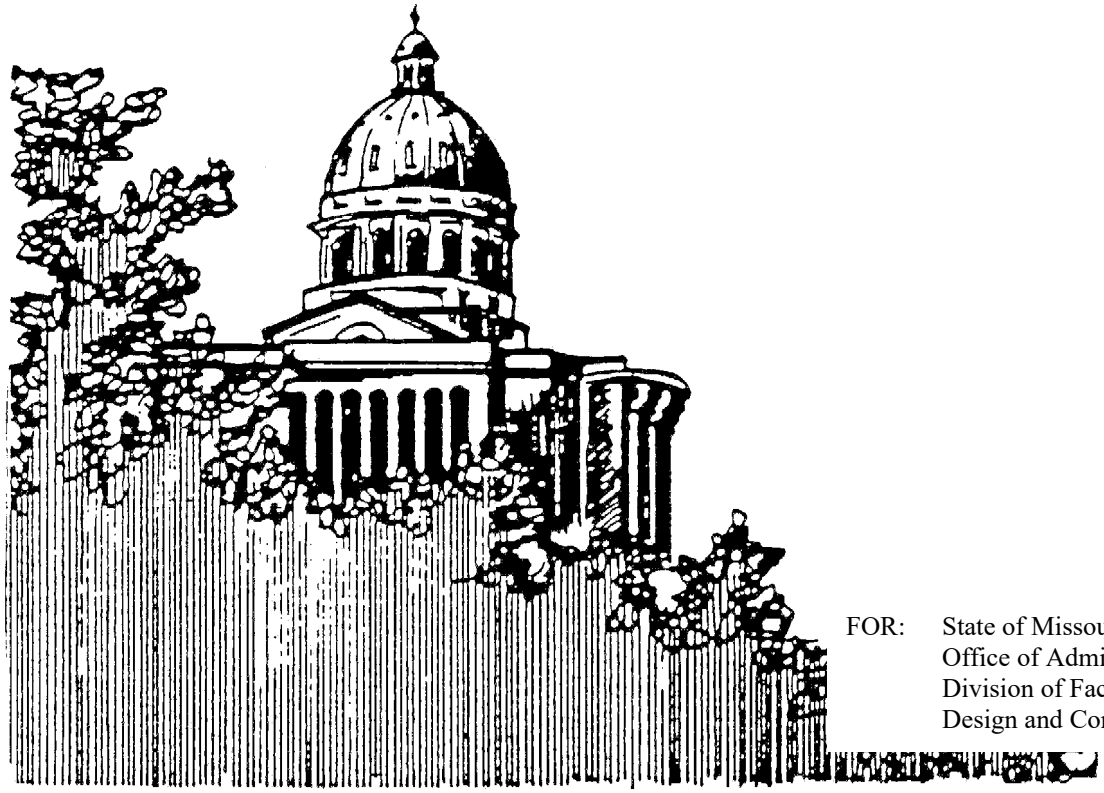
PROJECT MANUAL

RENOVATE INTERIOR
SAINT JOSEPH READINESS CENTER
SAINT JOSEPH, MISSOURI

DESIGNED BY: ELLISON-AUXIER ARCHITECTS INC
924 FRANCIS ST
ST JOSEPH, MO 64501

DATE ISSUED: 12/9/2019

PROJECT NO.: T1905-01



FOR: State of Missouri
Office of Administration
Division of Facilities Management,
Design and Construction

SECTION 000107 - PROFESSIONAL SEALS AND CERTIFICATIONS

PROJECT NUMBER: (T1905-01 "Renovate Interior St. Joseph Readiness 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:
Ellison – Auxier Architects, Inc.
Jeffrey K. Ellison

Mechanical:
Henderson Engineers, Inc.
Bradley Chambon

Dec 5 2019

Plumbing:
Henderson Engineers, Inc.
Bradley Chambon

Dec 5 2019

Electrical:
Henderson Engineers, Inc.
Andria Odrowski

Dec 5 2019

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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:

	TITLE	SHEET #	DATE	CAD #
1	COVER SHEET	G-001	12/9/2019	T1905-01-6255-G-001
2	SHEET INDEX, SYMBOLS & LEGENDS, MOUNTING HEIGHTS & ABBREVIATIONS	G-002	12/9/2019	T1905-01-6255-G-002
3	FIRST FLOOR PLAN	A-101	12/9/2019	T1905-01-6255-A-101
4	INTERIOR ELEVATIONS AND DETAILS	A-201	12/9/2019	T1905-01-6255-A-102
5	SCHEDULES	A-601	12/9/2019	T1905-01-6255-A-601
6	NEW REFLECTED CEILING PLAN	A-701	12/9/2019	T1905-01-6255-A-701
7	FIRST FLOOR DEMOLITION PLAN	D-101	12/9/2019	T1905-01-6255-D-101
8	PLUMBING SYMBOLS, SCHEDULES, LEGENDS & DETAILS	P-001	12/9/2019	T1905-01-6255-P-001
9	PLUMBING FLOOR PLAN	P-111	12/9/2019	T1905-11-6255-P-111
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13	MECHANICAL FLOOR PLAN	M-111	12/9/2019	T1905-11-6255-M-111
14	MECHANICAL DETAILS	M-501	12/9/2019	T1905-01-6255-M-501
15	MECHANICAL SCHEDULES	M-601	12/9/2019	T1905-01-6255-M-601
16	ELECTRICAL SYMBOLS, LEGENDS & NOTES	E-001	12/9/2019	T1905-01-6255-E-001
17	ELECTRICAL POWER DEMO PLAN	E-110	12/9/2019	T1905-10-6255-E-110
18	ELECTRICAL POWER PLAN	E-111	12/9/2019	T1905-11-6255-E-111
19	ELECTRICAL SCHEDULES	E-601	12/9/2019	T1905-01-6255-E-601
20	ELECTRICAL SCHEDULES AND DETAILS	E-602	12/9/2019	T1905-02-6255-E-602
21	ELECTRICAL LIGHTING PLAN	E-701	12/9/2019	T1905-01-6255-E-701

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 INTERIOR
SAINT JOSEPH READINESS CENTER
SAINT JOSEPH, MISSOURI
Project No.: T1905-01

3.0 BIDS WILL BE RECEIVED:

A. Until: 1:30 PM, February 27, 2020

B. **Only electronic bids on MissouriBUYS shall be accepted: https://missouribuys.mo.gov. Bidder must be registered to bid.**

4.0 DESCRIPTION:

A. Scope: The project consists of interior renovations including flooring, paint, ceilings, doors and hardware, minor general construction and limited mechanical, electrical and plumbing work.

B. Estimate: $770,000 to $1,060,000

C. MBE/WBE/SDVE Goals: MBE 10.00%, WBE 10.00%, & SDVE 3.00%. **NOTE: Only MBE/WBE firms certified by a State of Missouri public entity 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.**

D. **NOTE: Bidders are provided new Good Faith Effort (GFE) forms on MissouriBUYS.

5.0 PRE-BID MEETING:

A. Place/Time: Thursday, February 13, 2020 @ 2:00 p.m.; 301 North Woodbine Road, St. Joseph, MO 64501.

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 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: Ellison-Auxier Architects, Inc., Jeffrey Ellison, phone # 816-233-8003, fax # 816-233-7793

B. Project Manager: Craig Bock, phone # 573-751-7831, fax # 573-751-7277

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.

Very Important MissouriBUYS Instructions to Help Submit a Bid Correctly

A. The bidder shall submit his or her bid and all supporting documentation on MissouriBUYS eProcurement System. No hard copy bids shall be accepted. Go to https://missouribuys.mo.gov and register. The bidder must register before access is granted to the solicitation details and bidding is possible, however, the bidder can review a summary of the project by selecting "Bid Board" and then checking off "Open" under "Status" and "OA-FMDC-Contracts Chapter 8" under "Organization" in the boxes shown on the left margin.

B. Once registered, log in.
1. Under "Solicitation" select "View Current Solicitations." A new screen will open.
2. Under "Filter by Agency" select "OA-FMDC-Contracts Chapter 8."
3. Under "Filter by Opp. No." type in the State Project Number. Select "Submit."
4. Above the dark blue bar, select "Other Active Opportunities."
5. To see the Solicitation Summary, single click the Opp. No. (Project Number) and the summary will open. Single quick click each blue bar to open detailed information.

C. Here are simplified instructions for uploading the bid to MissouriBUYS:
1. Find the solicitation by completing Steps 1 through 4 above.
2. Select the three dots under "Actions." Select "Add New Response."
3. When the Quote box opens, give the response a title and select "OK."
4. The detailed solicitation will open. Select "Check All" for the Original Solicitation Documents, open each document, and select "Accept." If this step is not completed, a bid cannot be uploaded. Scroll to the bottom of the page and select "Add Attachments." If you do not see this command, not all documents have been opened and accepted.
5. The Supplier Attachments box will open. Select "Add Attachment" again.
6. The Upload Documents box will open. Read the instructions for uploading. Disregard the "Confidential" check box.
7. Browse and attach up to 5 files at a time. Scroll to bottom of box and select "Upload." The Supplier Attachments box will open. Repeat Steps 5 through 7 if more than 5 files are to be uploaded.
8. When the Supplier Attachments box opens again and uploading is complete, select "Done." A message should appear that the upload is successful. If it does not, go to the Bidder Response tab and select "Submit."
9. The detailed solicitation will open. At the bottom select "Close."

D. Any time a bidder wants to modify the bid, he or she will have to submit a new one. FMDC will open the last response the bidder submits. The bidder may revise and submit the bid up to the close of the solicitation (bid date and time). Be sure to allow for uploading time so that the bid is successfully uploaded prior to the 1:30 PM deadline; we can only accept the bid if it is uploaded before the deadline.

E. If you want to verify that you are uploading documents correctly, we encourage you to submit a fake bid early. Label the fake bid as such to distinguish it from the real bid. The contracts person you contact will let you know if your "bid" was received successfully. Please contact Drew Henrickson: 573-751-8128, drew.henrickson@oa.mo.gov; Kelly Copeland: 573-522-2283, kelly.copeland@oa.mo.gov; or Paul Girouard: 573-751-4797, paul.girouard@oa.mo.gov.

F. If you are experiencing login issues, please contact Web Procure Support (Proactis) at 866-889-8533 anytime from 7:00 AM to 7:00 PM Central Time, Monday through Friday. If you try using a userid or password several times that is incorrect, the system will lock you out. Web Procure Support is the only option to unlock you! If you forget your userid or password, Web Procure Support will provide a temporary userid or password. Also, if it has been a while since your last successful login and you receive an "inactive" message, contact Web Procure (Proactis). If you are having a registration issue, you may contact Cathy Holliday at 573-751-3491 or by email: cathy.holliday@oa.mo.gov.

IMPORTANT INFORMATION REGARDING REQUIREMENT FOR OEO CERTIFICATION

SPECIFICATION CHANGES:

A. SECTION 002113 – INSTRUCTIONS TO BIDDERS: Article 14.0, Section B.1. (bottom of page 6 of 8): Delete: “an MBE or WBE must be certified by the State of Missouri, Office of Equal Opportunity and”.

To allow MBE, WBE, or MBE/WBE contractors, subcontractors, and suppliers to have ample time to register with the Office of Equal Opportunity, this requirement will not take effect until July 1, 2020. Until then, we will continue to accept certifications from the Office of Equal Opportunity and other Missouri certifying agencies.

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, will be required to undergo a fingerprint background check and obtain a State of Missouri identification badge prior to beginning work on site. The Bidder should review the information regarding this requirement in Section 013513 – Site Security and Health Requirements prior to submitting a bid.

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 any one (1) party may be limited in accordance with available supply.

B. For the convenience of contractors, sub-contractors and suppliers, copies of construction documents are on file at the office of the Director, Division of Facilities Management, Design and Construction and on the Division's web site - 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 also 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 contractor to fulfill in every detail all of the requirements of the contract, nor accepted as a basis for any claims for extra compensation.

B. Under no circumstances will contractors give their plans and specifications to another contractor. Any bid received from a contractor whose name does not appear on the list of plan holders may be subject to rejection.

4.0 - INTERPRETATIONS

A. No bidder shall be entitled to rely on oral interpretations as to the meaning of the plans and specifications or the acceptability of alternate products, materials, form or type of construction. Every request for interpretation shall be made in writing and submitted with all supporting documents not less than five (5) working days before opening of bids. Every interpretation made to a bidder will be in the form of an addendum and will be sent as promptly as is practicable to all persons to whom plans and specifications have been issued. All such addenda shall become part of the contract documents.

B. Approval for an "acceptable substitution" issued in the form of an addendum as per Paragraph 4A above, and as per Article 3.1 of the General Conditions; ACCEPTABLE SUBSTITUTIONS shall constitute approval for use in the project of the product.

C. An "acceptable substitution" requested after the award of bid shall be approved if proven to the satisfaction of the Owner and the Designer as per Article 3.1, 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.

D. A request for "Acceptable Substitutions" shall be made on the Section 006325 Substitution Request Form. The request shall be sent directly to the project Designer. A copy of said request should also be mailed to the Owner, Division of Facilities Management, Design and Construction, Post Office Box 809, Jefferson City, Missouri 65102.

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 or their bid will be rejected for being non-responsive.

Depending on the specific project requirements, **the following is a GENERIC list** of all possible bid forms that may be due with bid submittals and times when they may be due. Please check for specific project requirements on the proposal form (Section 004113). ***Not all of the following bid forms may be required to be submitted.***

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

B. All bids shall be submitted without additional terms and conditions, modification or reservation on the bid forms with each space properly filled. Bids not on these forms will be rejected.

C. 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 on the bid form, Section 004113. Failure of the contractor to submit 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 closing, or if on notification of award refuses or is unable to execute tendered contract, provide an acceptable performance and payment bond, provide evidence of required insurance coverage and/or provide required copies of affirmative action plans within ten (10) working days after such tender.

D. The 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. Bid bonds will only be returned upon request.

6.0 - SIGNING OF BIDS

A. A bid from an individual shall be signed as noted on the Bid Form.

B. 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.

C. A bid from a limited liability company (LLC) shall be signed by a manager or a managing member of the LLC.

D. A bid from a corporation shall have the correct corporate name thereon and the signature of an authorized officer of the corporation manually written. Title of office held by the person signing for the corporation shall appear, along with typed name of said individual. Corporate license number shall be provided and, if a corporation organized in a state other than Missouri, a Certificate of Authority to do business in the State of Missouri shall be attached. In addition, for corporate proposals, the President or Vice-President should sign as the bidder. If the signator is other than the corporate president or vice president, the bidder must provide satisfactory evidence that the signator has the legal authority to bind the corporation.

E. 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.

F. The Bidder should include its corporate license number on the Bid Form and, if the corporation is organized in a state other than Missouri, a Certificate of Authority to do business in the State of Missouri shall be attached to the bid form.

7.0 - RECEIVING BID SUBMITTALS

A. It is the bidder's sole responsibility to assure receipt by Owner of bid submittals by the date and time specified in the Invitation for Bid. Bids received after the date and time specified shall not be considered by the Owner.

B. Bids must be submitted through the MissouriBUYS statewide eProcurement system (https://www.missouribuys.mo.gov/) in accordance with the instructions for that system. The Owner shall only accept bids submitted through MissouriBUYS. Bids received by the Owner through any other means, including hard copies, shall not be considered and will be discarded by the Owner unopened.

C. To respond to an Invitation for Bid, the Bidder must first register with MissouriBUYS by going through the MissouriBUYS Home Page (https://www.missouribuys.mo.gov/), clicking the "Register" button at the top of the page, and completing the Vendor Registration. Once registered, the Bidder accesses its account by clicking the "Login" button at the top of the MissouriBUYS Home Page. Enter your USERID and PASSWORD, which the Bidder will select. Under Solicitations, select "View Current Solicitations." A new screen will open. Under "Filter by Agency" select "OA-FMDC-Contracts Chapter 8." Under "Filter by Opp. No." type in the State Project Number. Select "Submit." Above the dark blue bar, select "Other Active Opportunities." To see the Solicitation Summary, single click the Opp. No. (Project Number) and the summary will open. Single quick click each blue bar to open detailed information. The Bidder must read and accept the Original Solicitation Documents and complete all identified requirements. The Bidder should download and save all of the Original Solicitation Documents on its computer so that the Bidder can prepare its response to these documents. The Bidder should upload its completed response to the downloaded documents as an attachment to the electronic solicitation response.

D. Step-by-step instructions for how a registered vendor responds to a solicitation electronically are provided in Section 001116 – Invitation For Bid.

E. The Bidder shall submit its bid on the forms provided by the Owner on MissouriBUYS with each space fully and properly completed, including all amounts required for alternate bids, unit prices, cost accounting data, etc. The Owner may reject bids that are not on the Owner's forms or that do not contain all requested information.

F. No Contractor shall stipulate in his bid any conditions not contained in the specifications or standard bid form contained in the contract documents. To do so may subject the Contractor's bid to rejection.

G. The completed forms shall be without interlineations, alterations or erasures.

8.0 - MODIFICATION AND WITHDRAWAL OF BIDS

A. Bidder may withdraw his bid at any time prior to 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. The Bidder shall modify his or her original bid by submitting a revised bid on MissouriBUYS.

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 by way of limitation, contracts for the furnishing and installation of furniture, equipment, machines, appliances and other apparatus.

C. In awarding the contract the Owner may take into consideration the bidder's skill, facilities, capacity, experience, responsibility, previous work record, financial standing and the necessity of prompt and efficient completion of work herein described. Inability of any bidder to meet the requirements mentioned above may be cause for rejection of his bid. However, no contract will be awarded to any individual,

partnership or corporation, who has had a contract with the State of Missouri declared in default within the preceding twelve months.

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 low bidder.

E. No bid shall be considered binding upon the Owner until the written contract has been properly executed, a satisfactory bond has been furnished, evidence of required insurance coverage, submittal of executed Section 004541, Affidavit of Work Authorization form, documentation evidencing enrollment and participation in a federal work authorization program has been received and an affirmative action plan submitted. Failure to execute and return the contract and associated documents within the prescribed period of time 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.

F. If the successful bidder is doing business in the State of Missouri under a fictitious name, he 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.

G. Any successful bidder which is a corporation organized in a state other than Missouri shall furnish to the Owner, attached to the Bid Form, a properly certified copy of its current Certificate of Authority to do business in the State of Missouri, such certificate to remain on file with the Owner. No contract will be awarded by the Owner unless such certificate is furnished by the bidder.

H. Any successful bidder which is a corporation organized in the State of Missouri shall furnish at its own cost to the Owner, if requested, a Certificate of Good Standing issued by the Secretary of State, such certificate to remain on file with the Owner.

I. 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.

J. 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. Section-004541, Affidavit of Work Authorization is located on the MissouriBUYS solicitation for this project. 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.uscis.gov/e-verify/. The contractor shall be responsible for ensuring that all subcontractors and suppliers associated with this contract enroll in E-Verify.

10.0 - CONTRACT SECURITY

A. The successful bidder shall furnish a performance/payment bond as set forth in General Conditions Article 6.1 on a condition 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, 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. Failure to list the Bidder's firm, or a subcontractor for each category of work identified on the Bid Form or the listing of more than one subcontractor for any category without designating the portion of work to be performed by each shall be cause for rejection of the bid. 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, 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, 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 person'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 - 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 non-responsive, and its bid shall be rejected.

2. The Bidder should submit with its bid all of 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 appropriate

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 Bidder that is a SDVE doing business as Missouri firm, corporation, or individual, or that maintains a Missouri office or place of business, shall receive a three-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 becomes 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. The form is available on the MissouriBUYS solicitation for this project.

A. 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.) In order 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 actually performing, managing and supervising the work or providing supplies or manufactured materials.

B. 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 Administration, Division of Purchasing and Material Management or by the Department of Veterans Affairs.

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/oeo/). The Bidder may determine the eligibility of a SDVE subcontractor or supplier by referring to the Division of Purchasing and Materials Management's online SDVE directory (http://oa.mo.gov/purchasing/vendor-information/missouri-service-disabled-veteran-business-enterprise-sdve-information) or the Department of Veterans Affairs' directory (https://www.vip.vetbiz.gov/).

3. Additional information, clarifications, etc., regarding the listings in the directories may be obtained by calling the Division at (573)751-3339 and asking to speak to the Contract Specialist of record as shown in the Supplementary Conditions (Section 007300).

C. 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 GFE forms are located on the MissouriBUYS solicitation for this project. 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 determined 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;

3. If no bidder has obtained any participation in a particular category (MBE/WBE/SDVE) or made a good faith effort to do so, the Director may waive that goal rather than rebid.

D. 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 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 non-responsive 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 this 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.

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
DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION
MBE/WBE/SDVE DIRECTORY

The MBE/WBE Directory for goods and services is maintained by the Office of Equal Opportunity (OEO). The current Directory can be accessed at the following web address:

https://apps1.mo.gov/MWBCertifiedFirms/

Please note that you may search by MBE, WBE, or both as well as by region, location of the business by city or state, as well as by commodity or service.

The SERVICE DISABLED VETERAN ENTERPRISE (SDVE) Directory (s) may be accessed at the following web addresses:

https://oa.mo.gov/sites/default/files/sdvelisting.pdf

https://www.vip.vetbiz.va.gov

State of Missouri
Construction Contract

THIS AGREEMENT, 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, on behalf of the Department of Guard.

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 INTERIOR** **SAINT JOSEPH READINESS CENTER** **SAINT JOSEPH, MISSOURI**
Project Number:	**T1905-01**

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 **150** 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: $

DELETE THE ALTERNATE INFORMATION IF NOT USED

The Owner accepts the following Alternate Bids:

Alternate One: $

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.

INSERT UNIT PRICE DESCRIPTIONS AND QUANTITY INCLUDED IN THE BASE BID FROM SECTION 01026

OR

IF NO Unit Prices are used, type "NOT APPLICABLE"

ARTICLE 5. PREVAILING WAGE RATE

It is understood and agreed by and between the parties that not less than the prevailing hourly rate of wages shall be paid for work of a similar character 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 in the locality in which the work is performed, both as determined by the Department of Labor and Industrial Relations or as determined by the court on appeal, to all workmen employed by or on behalf of the Contractor or any subcontractor, exclusive of maintenance work. Only such workmen as are directly employed by the Contractor or his subcontractors, in actual construction work on the site shall be deemed to be employed.

When the hauling of materials or equipment includes some phase of the construction other than the mere transportation to the site of the construction, workmen engaged in this dual capacity shall be deemed to be employed directly on the project and entitled to the prevailing wage.

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

Contract documents shall consist of the following component parts:

1. Division 0, with executed forms
2. Division 1
3. Executed Construction Contract Form
4. The Drawings
5. The Technical Specifications
6. Addenda
7. Contractor's Proposal as accepted by the Owner

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

APPROVED:

_____	_____
Mark Hill, P.E., Director Division of Facilities Management, Design and Construction	Contractor's Authorized Signature

DELETE IF PRIVATE OR PARTNERSHIP

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

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

AFFIDAVIT FOR AFFIRMATIVE ACTION

PROJECT NUMBER

NAME

First being duly sworn on oath states: that

he/she is the ☐ sole proprietor ☐ partner ☐ officer or ☐ manager or managing member of

NAME

a ☐ sole proprietorship ☐ partnership

☐ limited liability company (LLC)

or ☐ corporation, and as such, said proprietor, partner, or officer is duly authorized to make this

affidavit on behalf of said sole proprietorship, partnership, or corporation; that under the contract known as

PROJECT TITLE

Less than 50 persons in the aggregate will be employed and therefore, the applicable Affirmative Action

requirements as set forth in Article 1.4 of the General Conditions of the State of Missouri have been met.

PRINT NAME & SIGNATURE	DATE

NOTARY INFORMATION

NOTARY PUBLIC EMBOSSER SEAL	STATE OF	COUNTY (OR CITY OF ST. LOUIS)	USE RUBBER STAMP IN CLEAR AREA BELOW
	SUBSCRIBED AND SWORN BEFORE ME, THIS DAY OF YEAR		
	NOTARY PUBLIC SIGNATURE	MY COMMISSION EXPIRES	
	NOTARY PUBLIC NAME (TYPED OR PRINTED)		

MO 300-1401 (05/18) FILE/Construction Contract

Bond No._____

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

SUBMIT WITH **ALL** INVOICES: (PLEASE CHECK APPROPRIATE BOX BELOW)

☐CONSULTANT ☐CONSTRUCTION

INVOICE NO.	PROJECT NUMBER
CHECK IF FINAL ☐**FINAL**	DATE

PROJECT TITLE

PROJECT LOCATION

FIRM

TOTAL CONTRACT AMOUNT

$

THE PERCENTAGE AND DOLLAR AMOUNT OF THIS PROJECT THAT ARE TO BE MBE/WBE/SDVE AS INDICATED IN THE ORIGINAL CONTRACT: **%** and **$** **.**

CHECK MBE WBE SDVE	ITEM OF WORK	TOTAL AMOUNT OF SUBCONTRACT	$ AMOUNT & % COMPLETE (PAID-TO-DATE)	CONSULTANT/SUBCONSULTANT OR CONTRACTOR/SUBCONTRACTOR/SUPPLIER NAME, ADDRESS, CONTACT, AND PHONE NUMBER
MBE ☐ WBE ☐ SDVE☐		$	$ %	- -
MBE ☐ WBE ☐ SDVE☐		$	$ %	- -
MBE ☐ WBE ☐ SDVE☐		$	$ %	- -
MBE ☐ WBE ☐ SDVE☐		$	$ %	- -
MBE ☐ WBE ☐ SDVE☐		$	$ %	- -

ORIGINAL: Attach to ALL Progress and Final Payments

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 EMBOSSER 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

A. 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.
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"**: Labor, material, supplies, plant and equipment required to perform and complete the service agreed to by the Contractor 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, 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 take affirmative action to insure 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.

B. The Contractor and his Subcontractors shall develop, implement, maintain and submit in writing to the Owner an affirmative action program if at least fifty (50) persons in the aggregate are employed under this contract. If less than fifty (50) persons in the aggregate are to be employed under this contract, the Contractor shall submit, in lieu of the written affirmative action program, a properly executed Affidavit for Affirmative Action in the form included in the contract specifications. For the purpose of this section, an "affirmative action program" means positive action to influence all employment practices (including, but not limited to, recruiting, hiring, promoting and training) in providing equal employment opportunity regardless of race, color, sex, national origin, religion, age (where the person affected is between age 40 and 70), disabled and Vietnam-era veteran status, and disability. Such "affirmative action program" shall include:

1. A written policy statement committing the total organization to affirmative action and assigning management responsibilities and procedures for evaluation and dissemination;
2. The identification of a person designated to handle affirmative action;
3. The establishment of non-discriminatory selection standards, objective measures to analyze recruitment, an upward mobility system, a wage and salary structure, and standards applicable to lay-off, recall, discharge, demotion and discipline;
4. The exclusion of discrimination from all collective bargaining agreements; and
5. Performance of an internal audit of the reporting system to monitor execution and to provide for future planning.

In the enforcement of this non-discrimination clause, the Owner may use any reasonable procedures available, including, but not limited to: requests, reports, site visits and inspection of relevant documents of contractors and subcontractors.

C. 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

A. 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

A. 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

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 place 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 insure 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 negotiated, and may vary according to the nature, extent, and complexity of the work

involved. However, the overhead and profit for the Contractor or subcontractor actually performing the work shall not exceed 14%. When one or more tiers of subcontractors are used, in no event shall any Contractor or subcontractor receive as overhead and profit more than 3% of the cost of the work performed by any of his subcontractors. In no case shall the total overhead and profit paid by the Owner on any Contract Changes exceed twenty percent (20%) 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 bonding and insurance to their cost of work. This bonding and insurance cost shall not exceed 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 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 negotiated, and may vary according to the nature, extent and complexity of the work involved, but in no case shall be less than ten percent (10%). If the percentage for overhead and profit charged for work added by Contract Changes for this contract has been negotiated to less than 10%, the negotiated rate shall then apply to credits as well.

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 <u>without</u> 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.
4. Written Affirmative Action Plans as required in Article 1.4.

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 contact 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

A. 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:	Jeffrey Ellison Ellison-Auxier Architects, Inc. 924 Francis St. St. Joseph, MO 64501 Telephone: 816-233-8003; Fax: 816-233-7793 Email: Jeff@ellison-auxier.com
Construction Representative:	Rick Howard Division of Facilities Management, Design and Construction 836 North Scott, Belton, MO 64012 Telephone: 816-322-1166 x 236; Fax: 573-522-1763 Email: ricky.howard@oa.mo.gov
Project Manager:	Craig Bock Division of Facilities Management, Design and Construction 301 West High Street, Room 730 Jefferson City, Missouri 65101 Telephone: 573-751-7831; Fax: 573-751-7277 Email: craig.bock@oa.mo.gov
Contract Specialist:	Drew Henrickson Division of Facilities Management, Design and Construction 301 West High Street, Room 730 Jefferson City, Missouri 65101 Telephone: 573-751-8128; Fax: 573-751-7277 Email: drew.henrickson@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 10 complete sets of drawings and specifications at no charge.
B. The Owner will furnish the Contractor with approximately 10 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 ILLEGAL IMMIGRATION REFORM AND IMMIGRANT RESPONSIBILITY ACT

The Contractor understands and agrees that by signing a contract for this project, they certify the following:

A. The Contractor shall only utilize personnel authorized to work in the United States in accordance with applicable federal and state laws. This includes but is not limited to the Illegal Immigration Reform and Immigrant Responsibility Act (IIRIRA) and INA Section 274A.
B. If the Contractor is found to be in violation of this requirement or the applicable laws of the state, federal and local laws and regulations, and if the State of Missouri has reasonable cause to believe that the Contractor has knowingly employed individuals who are not eligible to work in the United States, the state shall have the right to cancel the contract immediately without penalty or recourse and suspend or debar the contractor from doing business with the state.
C. The Contractor agrees to fully cooperate with any audit or investigation from federal, state or local law enforcement agencies.

6.0 SAFETY REQUIREMENTS

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

7.0 ENVIRONMENTAL MANAGEMENT SYSTEM (eMS):

The Missouri Army National Guard (MOARNG) has implemented an Environmental Management System (eMS). One of the key components of the eMS is the establishment of an Environmental Policy that must be communicated to all persons working for or on behalf of the organization including all suppliers and contractors. This policy stresses commitment to compliance with accepted environmental practices, and meeting or exceeding applicable environmental requirements, legal and otherwise. This policy also stresses commitment to waste minimization, pollution prevention, and management of personnel, processes, real property, and materials in a manner to reduce environmental impacts. The policy is available upon request to all parties by contacting the Environmental Management Office at (573) 638-9514.

Missouri
Division of Labor Standards
WAGE AND HOUR SECTION

MICHAEL L. PARSON, Governor

Annual Wage Order No. 26

Section 011
BUCHANAN 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
Taylor Burks, Director
Division of Labor Standards

Filed With Secretary of State: **March 8, 2019**

Last Date Objections May Be Filed: **April 8, 2019**

Prepared by Missouri Department of Labor and Industrial Relations

OCCUPATIONAL TITLE	** Date of Increase	Basic Hourly Rates
Asbestos Worker		$62.56
Boilermaker		$25.64*
Bricklayer		$52.19
Carpenter		$50.42
Lather		
Linoleum Layer		
Millwright		
Pile Driver		
Cement Mason		$51.16
Plasterer		
Communications Technician		$25.64*
Electrician (Inside Wireman)		$48.08
Electrician Outside Lineman		$25.64*
Lineman Operator		
Lineman - Tree Trimmer		
Groundman		
Groundman - Tree Trimmer		
Elevator Constructor		$25.64*
Glazier		$25.64*
Ironworker		$62.95
Laborer		$39.06
General Laborer		
First Semi-Skilled		
Second Semi-Skilled		
Mason		$48.74
Marble Mason		
Marble Finisher		
Terrazzo Worker		
Terrazzo Finisher		
Tile Setter		
Tile Finisher		
Operating Engineer		$55.14
Group I		
Group II		
Group III		
Group III-A		
Group IV		
Group V		
Painter		$38.30
Plumber		$59.99
Pipe Fitter		
Roofer		$45.45
Sheet Metal Worker		$61.69
Sprinkler Fitter		$25.64*
Truck Driver		$25.64*
Truck Control Service Driver		
Group I		
Group II		
Group III		
Group IV		

*The Division of Labor Standards received less than 1,000 reportable hours as required by RSMo 290.257.4(b). Public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center, in accordance with RSMo 290.257.2.

Heavy Construction Rates for
BUCHANAN County

OCCUPATIONAL TITLE	** Date of Increase	Basic Hourly Rates
Carpenter		$25.64*
Millwright		
Pile Driver		
Electrician (Outside Lineman)		$25.64*
Lineman Operator		
Lineman - Tree Trimmer		
Groundman		
Groundman - Tree Trimmer		
Laborer		$40.19
General Laborer		
Skilled Laborer		
Operating Engineer		$51.83
Group I		
Group II		
Group III		
Group IV		
Truck Driver		$25.64*
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 less than 1,000 reportable hours as required by RSMo 290.257.4(b). Public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center, in accordance with RSMo 290.257.2.

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 interior renovations including minor general construction, mechanical and electrical replacements.

1. Project Location: 301 N. Woodbine, St. Joseph, MO, 64501
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 9, 2019**, Plans and specifications were prepared for the Project by Ellison – Auxier Architects, Inc., 924 Francis Street, St. Joseph, MO. 64501 Contact: Jeff Ellison 816-233-8003.

C. The Work consists of interior finishes, doors and hardware and limited new interior wall construction, and mechanical and electrical upgrades.

1. The Work includes new doors and hardware, flooring, ceilings, paint, partial mechanical and plumbing replacements, and lighting replacements.

D. The Work will be constructed under a single prime contract.

1.3 DESIGNER'S ESTIMATE OF CONSTRUCTION COSTS

A. The project designer has estimated project costs to be in the range of $770,000 - $990,000.

1.4 WORK SEQUENCE

A. The Work will be conducted in one phase.

1.5 CONTRACTOR USE OF PREMISES

A. General: During the construction period the Contractor shall have full use of the premises for construction operations, including use of the site. The Contractor's use of the premises is limited only by the Owner's right to perform work or to retain other contractors on portions of the Project.

B. 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.

C. Use of the Existing Building: Maintain the existing building in a weathertight condition throughout the construction period. Repair damage caused by construction operations. Take all precautions necessary to protect the building and its occupants during the construction period..

1.6 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

3.1 SCHEDULE OF PRODUCTS ORDERED IN ADVANCE (Not Applicable)

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 Contract Change.

B. Types of allowances include the following:

1. Weather allowances.

C. Related Sections include the following:

1. Division 1 Section "Contract Modification Procedures" for procedures for submitting and handling Contract Changes for allowances.

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 Contract Change time extension will be executed for “bad weather” days, as defined above, encountered during the remainder of the Project.

PART 2 - EXECUTION

2.1 SCHEDULE OF ALLOWANCES

A. Weather Allowance: Included within the completion period for this Project are 10 “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 0, Section 007213, Article 3.1 "Acceptable Substitutions" for administrative procedures for handling Requests for Substitutions made after Contract award.
4. Division 0, Section 007213, Article 4.0 "Changes in the Work" for Contract Change 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 Contactor 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 Contract Change 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 Contract Change Detailed Breakdown form. Subcontractors may use the appropriate Contract Change 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 CONTRACT CHANGE PROCEDURES

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REFERENCED FORMS

A. The following forms can be found on our website at https://oa.mo.gov/facilities/vendor-links/architectengineering-forms or https://oa.mo.gov/facilities/vendor-links/contractor-forms:

1. Request for Information
2. Designer’s Supplemental Instructions
3. Request for Proposal
4. Contract Change
5. Contract Change Detailed Breakdown – SAMPLES

6. Contract Change Detailed Breakdown – General Contractor (GC)
7. Contract Change Detailed Breakdown – Subcontractor (SUB)

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 – Bar Chart" 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

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.

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 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. 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. Fabrication

4. Deliveries

5. Installation

6. Testing

7. Adjusting

8. Startup and placement into final use and operation

C. 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 if applicable.
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 within (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 or inspection
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.

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.

		TYPE OF SUBMITTAL														
SECTION	**DESCRIPTION**	**Shop Drawings**	**Product Data**	**Sample**	**Certifications/Qualifications**	**Manufacturer' s Instruc-**	**Test report**	**Inspection Report**	**Wiring Diagrams**	**Record Photographs**	**Maintenance Data**	**Operating Instruction**	**Schedules**	**Warranty**		
07 4213	**Metal Wall Panels**	**X**		**X**	**X**									**X**		
08 0671	**Door Hardware Schedule**		**X**										**X**			
08 1113	**Hollow metal Doors and Frames**	**X**	**X**		**X**								**X**			
08 4313	**Aluminum Framed Store-fronts**	**X**	**X**		**X**								**X**	**X**		
08 7100	**Door Hardware**	**X**	**X**		**X**								**X**	**X**		
08 8300	**Mirrors**	**X**	**X**		**X**	**X**							**X**	**X**		
09 2116	**Gypsum Board Assemblies**		**X**		**X**	**X**								**X**		
09 5100	**Acoustical Ceilings**	**X**	**X**	**X**	**X**								**X**	**X**		
09 6500	**Resilient Flooring**	**X**	**X**	**X**							**X**			**X**		
09 6700	**Fluid-Applied Flooring**		**X**	**X**		**X**					**X**			**X**		
09 9123	**Interior Painting**		**X**	**X**	**X**	**X**					**X**		**X**			
10 2113	**Horizontal Louver Blinds**	**X**	**X**	**X**	**X**	**X**						**X**	**X**	**X**		
10 2113.19	**Plastic Toilet Compart-ments**	**X**	**X**	**X**		**X**					**X**		**X**	**X**		
22 0500	**Access Panels and Doors**	**X**	**X**			**X**										
22 0500		**X**	**X**			**X**										

	Fire Sealant															
22 0515	**Piping Accessories**	**X**	**X**			**X**							**X**			
22 0519	**Thermometers, Thermometer Well**	**X**	**X**			**X**								**X**		
22 0523	**Valves**	**X**	**X**			**X**							**X**			
22 0529	**Hanger and Supports**	**X**	**X**			**X**										
22 0553	**Plastic Equipment Markers and Valve Tags**	**X**	**X**			**X**							**X**			
22 0700	**Piping Insulation**	**X**	**X**			**X**							**X**			
22 1100	**Piping Specialties**	**X**	**X**			**X**										
22 1100	**Water Piping materials and Fittings**	**X**	**X**			**X**										
22 1123	**Pumps, Circulators, Assc.**	**X**	**X**			**X**			**X**			**X**	**X**	**X**		

		TYPE OF SUBMITTAL														
SECTION	**DESCRIPTION**	**Shop Drawings**	**Product Data**	**Sample**	**Certifications/Qualifications**	**Manufacturer's Instruc-**	**Test report**	**Inspection Report**	**Wiring Diagrams**	**Record Photographs**	**Maintenance Data**	**Operating Instruction**	**Schedules**	**Warranty**		
22 1300	**Sanitary Drainage Piping and Fittings**	**X**	**X**													
22 1300	**Sanitary Drainage Piping Specialties**	**X**	**X**													
22 3400	**Gas Fired Storage Water Heaters and Accessories**	**X**	**X**			**X**			**X**			**X**	**X**			
22 3400	**Gas fired instantaneous Water Heaters and Accessories**	**X**	**X**			**X**			**X**			**X**	**X**			
22 4000	**Plumbing Fixtures (Water Closets, Urinals, Lavatories, Sinks, Faucets, Shower Heads)**	**X**	**X**			**X**			**X**			**X**	**X**			
22 4000	**Plumbing Fixture Trim, Insulation Kits, Supplies, and Accessories**	**X**	**X**			**X**										
22 7000	**Natural Gas Valves, pressure Regulators, and Meters**	**X**	**X**			**X**										
22 7000	**Natural Gas piping and Fittings**	**X**	**X**			**X**										

23 0500	**Access Panels and Doors**	X	X			X										
23 0500	**Fire Sealant**	X	X			X						X				
23 0529	**Hangers and Supports**	X	X			X										
23 0529	**Roof Equipment Supports**	X	X			X										
23 0550	**Vibration Isolators**	X	X			X										
23 0553	**Plastic Equipment Markers**	X	X	X		X						X				
23 0593	**Test and Balance Agency Data**				X											
23 0700	**Piping Insulation**	X	X			X						X				
23 0700	**Ductwork Insulation**	X	X			X						X				
23 2300	**Refrigeration Valves and Accessories**	X	X			X										
23 2300	**Refrigeration Piping**	X	X			X										

SECTION	DESCRIPTION	Shop Drawings	Product Data	Sample	Certifications/Qualifications	Manufacturer' s Instruc-	Test report	Inspection Report	Wiring Diagrams	Record Photographs	Maintenance Data	Operating Instruction	Schedules	Warranty		
23 3113	**Sealing Materials**	X	X			X										
23 3113	**Ductwork Layout**	X	X													
23 3113	**Duct Construction and Fit-tings**	X	X			X										
23 3300	**Flexible Duct**	X	X			X										
23 3300	**Dampers**	X	X			X										
23 3713	**Air Inlet and Outlet Product Data**	X	X			X							X			
23 3713	**Air Inlet and Outlet Per-formance Data**	X	X													
23 5100	**Double Wall Gas Vent**	X	X			X										
23 5100	**Condensing Appliance Vent**	X	X			X										
23 8126	**Split System Air Condition-ing and Heat Pump Units**	X	X			X			X			X	X			
23 8500	**Cabinet Unit Heaters**	X	X			X			X			X	X			
26 0500	**Access Panels and Doors**	X	X			X										

26 0500	**Fire Sealnt**	**X**	**X**			**X**						**X**				
26 0510	**Back Boxes for Telecom-munication**	**X**	**X**													
26 0519	**Conductors, Cables, Con-nectors and Fittings**	**X**	**X**													
26 0529	**Hangers and Supports**	**X**	**X**			**X**							**X**			
26 0533	**Metal Conduit, Tubing, Raceways, Outlet Boxes and Junction Boxes**	**X**	**X**													
26 0553	**Equipment markers and Labels**	**X**	**X**	**X**		**X**							**X**			
26 0923	**Switches, Occupancy Sen-sors, Power Packs, Contac-tors and Cover Plates**	**X**	**X**			**X**			**X**							
26 2726	**Receptacles, Switches, Dimmers and Cover Plates**	**X**	**X**			**X**			**X**							

		TYPE OF SUBMITTAL														
SECTION	**DESCRIPTION**	**Shop Drawings**	**Product Data**	**Sample**	**Certifications/Qualifications**	**Manufacturer' s Instruc-**	**Test report**	**Inspection Report**	**Wiring Diagrams**	**Record Photographs**	**Maintenance Data**	**Operating Instruction**	**Schedules**	**Warranty**		
26 2816	**Switches, Circuit breakers and Enclosures**	**X**	**X**			**X**			**X**							
26 5100	**Interior Light Fixtures, Exit Signs, Emergency Lights and Lamps**	**X**	**X**			**X**			**X**							
26 5100	**Light fixture Supports, Transformers and Light-ing Accessories**	**X**	**X**			**X**			**X**							

END OF SECTION 013300

SECTION 013513.28 – SITE SECURITY AND HEALTH REQUIREMENTS

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 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.
   3. Required fingerprinting for criminal background and warrants check. A list of the names of all employees who will submit fingerprints for a background check and the signed privacy documents identified below for each employee.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 ACCESS TO THE SITE

A. The Contractor shall arrange with the Construction Representative and appropriate Facility Representatives for the controlled entry of construction personnel, materials, and equipment into the work areas.

B. The Contractor shall establish regular working hours with the Construction Representative and the Facility. Working hour changes or overtime are to be reported and approved (48) hours ahead of time. Emergency overtime is to be reported as soon as it is evident that overtime is needed.

C. The Contractor shall provide the name and phone number of the individual(s) who is in charge onsite and who can be contacted in case of an emergency. This individual(s) must be able to furnish names and addresses of all construction personnel upon request.

D. 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.

3.2 FIRE PROTECTION, SAFETY, AND HEALTH CONTROLS

A. The Contractor shall be responsible and take all necessary precautions to guard against and eliminate possible fire hazards. Onsite burning is prohibited.

B. Store all flammable or hazardous materials in proper container located outside the buildings or offsite, if possible.

C. Provide and maintain in good order, during construction, all fire extinguishers as required by the National Fire Protection Association. In areas of flammable liquids, asphalt, or electrical hazards, extinguishers of the 15-pound carbon dioxide type or 20-pound dry chemical type shall be provided.

D. 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.

E. Conduct operations and removal of debris to ensure minimum interference with roads, streets, walks, and other adjacent facilities. Do not obstruct streets or walks or use facilities without permission from the Facility.

F. Construction personnel shall not exceed the Facility speed limit of 15mph unless posted otherwise.

G. Take all necessary reasonable measures to reduce air and water pollution by any material or equipment use during construction. Keep volatile wastes in covered containers. Do not dispose of volatile wastes or oils in storm or sanitary drains.

H. Keep project neat, orderly, and in a safe condition at all times. Immediately remove all hazardous waste. Do not allow rubbish to accumulate. Provide onsite containers for collection of rubbish and dispose of it at frequent intervals during progress of Work.

I. For all hazardous materials brought onsite, Material Safety Data Sheets shall be on site and readily available upon request at least a day before delivery.

J. 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.

3.3 DISRUPTION OF UTILITIES

A. The Contractor shall give minimum (72) hours written notice to the Construction Representative and Facility Representative before disconnecting electric, gas, water, fire protection, or sewer service to any building.

B. The contractor shall give minimum (72) hours written notice to the Construction Representative and Facility Representative before closing any access drives and shall make temporary access available if possible. Do not obstruct streets, walks, or parking.

3.4 REQUIRED FINGERPRINTING FOR CRIMINAL BACKGROUND AND WARRANTS CHECK

A. All employees of the Contractor are required to submit fingerprints to the Missouri State Highway Patrol to enable the Office of Administration, Division of Facilities Management, Design and Construction (FMDC) to receive state and national criminal background checks on such employees. FMDC reserves the right to prohibit any employee of the Contractor from perform-ing work in or on the premises of any facility owned, operated, or utilized by the State of Missouri for any reason.

B. 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 finger-printed and a signed Missouri Applicant Fingerprint Privacy Notice, Applicant Privacy Rights and Privacy Act Statement 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 em-ployees must comply with the process for background checks and contractor ID badges found on FMDC's website at: https://oa.mo.gov/fmdc-contractor-id-badges

C. Pursuant to section 43.540, RSMo, FMDC participates in the Missouri Rap Back and Na-

tional Rap Back programs as of August 28, 2018. This means that the Missouri State Highway Patrol, Central Records Repository, and the Federal Bureau of Investigation will retain the fingerprints submitted by each of the Contractor's employees, and those fingerprints will be searched against other fingerprints on file, including latent fingerprints. While retained, an employee's fingerprints may continue to be compared against other fingerprints submitted or retained by the Federal Bureau of Investigation, including latent fingerprints.

D. As part of the Missouri and National Rap Back programs, FMDC will receive notification if a new arrest is reported for an employee whose fingerprints have been submitted for FMDC after August 28, 2018. If the employee is performing work on a State contract at the time of the arrest notification, FMDC will request and receive the employee's updated criminal history records. If the employee is no longer performing work on a State contract, FMDC will not obtain updated criminal records.

E. Pursuant to section 43.540, RSMo, the Missouri State Highway Patrol will provide the results of the employee's background check directly to FMDC. FMDC may NOT release the results of a background check to the Contractor or provide the Contractor any information obtained from a background check, either verbally or in writing. FMDC will notify the Contractor only whether an employee is approved to work on State property.

F. Each employee who submits fingerprints to the Missouri State Highway Patrol has a right to obtain a copy of the results of his or her background check. The employee may challenge the accuracy and completeness of the information contained in a background check report and obtain a determination from the Missouri State Highway Patrol and/or the FBI regarding the validity of such challenge prior to FMDC making a final decision about his or her eligibility to perform work under a State contract.

G. The Contractor shall notify FMDC via email to FMDCSecurity@oa.mo.gov if an employee is terminated or resigns from employment with the Contractor. If the Contractor does not anticipate performing work on a State contract in the future, the Contractor may request that FMDC remove its em-ployees from the Rap Back programs. However, if removed from the Rap Back pro-grams, employees will be required to submit new fingerprints should the contractor be awarded another State contract.

H. Upon award of a Contract, the Contractor should contact FMDC at FMDCSecurity@oa.mo.gov to determine if its employees need to provide a new background check. If a Contractor's employee has previously submitted a fingerprint background check to FMDC as part of the Missouri and National Rap Back programs, the employee may not need to submit another finger-print search for a period of three to six years, depending upon the circumstances. The Contractor understands and agrees that FMDC may require more frequent background checks without providing any explanation to the Contractor. The fact that an additional background check is requested by FMDC does not indicate that the employee has a crim-inal record.

END OF SECTION 013513.28

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. Sanitary facilities, including drinking water

C. Support facilities include, but are not limited to, the following:

1. Field offices and storage sheds
2. Dewatering facilities and drains
3. Temporary enclosures
4. Temporary project identification signs and bulletin boards
5. Waste disposal services
6. Rodent and pest control
7. 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. 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:

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. Tarpaulins: Provide waterproof, fire-resistant, UL-labeled tarpaulins with flame-spread rating of (15) or less. For temporary enclosures, provide translucent, nylon-reinforced laminated polyethylene or polyvinyl chloride, fire-retardant tarpaulins.

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 barbed-wire top strand and 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 temporary power distribution box 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 or LED 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 Offices: Provide prefabricated or mobile units with lockable entrances, operable windows, and serviceable finishes. Provide heated and air-conditioned units on foundations adequate for normal loading.

H. 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.

I. 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. 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.

B. 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.

C. 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.

D. 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.

E. Temporary Telephones: The Contractor will be responsible for maintaining cell phones on site for their use.

F. Temporary Toilets: Use of the Owner's existing toilet facilities will be permitted, so long as facilities are cleaned and maintained in a condition acceptable to the Owner. All construction personnel will be allowed access only to those specific facilities designed by the Construction Representative. At substantial completion, restore these facilities to the condition prevalent at the time of initial use.

G. Wash Facilities: The Owner will provide wash facilities within the building. All construction personnel will be allowed access only to those specific facilities designated by the Construction Representative.

H. Drinking-Water Facilities: The Owner will provide drinking water facilities within the building. All construction personnel will be allowed access only to those specific facilities designated by the Construction Representative.

I. 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. 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.

C. Construction Parking: Parking at the site will be provided in the areas designated at the Pre-Construction Meeting.

D. Dewatering Facilities and Drains: For temporary drainage and dewatering facilities and operations not directly associated with construction activities included under individual Sections, comply with dewatering requirements of applicable Specification Sections. Where feasible, utilize the same facilities. Maintain the site, excavations, and construction free of water.

E. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.

1. Where heat is needed and the permanent building enclosure is not complete, provide temporary enclosures where there is no other provision for containment of heat. Coordinate enclosure with ventilating and materials drying or curing requirements to avoid dangerous conditions and effects.

2. Install tarpaulins securely with incombustible wood framing and other materials. Close openings of 25 SqFt (2.3 SqM) or less with plywood or similar materials.

3. Close openings through floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.

4. Where temporary wood or plywood enclosure exceeds 100 SqFt (9.2 SqM) in area, use UL-labeled, fire-retardant-treated material for framing and main sheathing.

F. 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.

G. 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.

H. Rodent Pest Control: Before work has been started, retain a local exterminator or pest control company to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests. Employ this service to perform extermination and control procedures are regular intervals so the Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

I. Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate. Cover finished, permanent stairs with a protective covering of plywood or similar material so finishes will be undamaged at the time of acceptance.

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.
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. 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.

F. 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 impending 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 food-service equipment to a sanitary condition, ready and acceptable for its intended use.

18. 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.

19. Leave the Project clean and ready for occupancy.

C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid the Project of rodents, insects, and other pests. Comply with regulations of local authorities.

D. Removal of Protection: Remove temporary protection and facilities installed during construction to protect previously completed installations during the remainder of the construction period.

E. 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 02 4100 - DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Selective demolition of building elements for alteration purposes.

1.2 RELATED REQUIREMENTS

1.2.1 Section 01 1000 - Summary of Work: Limitations on Contractor's use of site and premises.

1.2.2 Section 01 1000 - Summary of Work: Description of items to be salvaged or removed for re-use by Contractor.

1.2.3 Section 01 5000 - Construction Facilities and Temporary Controls: Site fences, security, protective barriers, and waste removal.

1.3 REFERENCE STANDARDS

1.3.1 NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.1 SCOPE

3.1.1 Remove other items indicated, for salvage and relocation.

3.1.2 Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as required so that required rough grade elevations do not subside within one year after completion.

3.2 GENERAL PROCEDURES AND PROJECT CONDITIONS

3.2.1 Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.

a. Obtain required permits.
b. Comply with applicable requirements of NFPA 241.
c. Use of explosives is not permitted.
d. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
e. Provide, erect, and maintain temporary barriers and security devices.
f. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
g. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
h. Do not close or obstruct roadways or sidewalks without permit.
i. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
j. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.

3.2.2 Do not begin removal until receipt of notification to proceed from Owner.

3.2.3 Protect existing structures and other elements that are not to be removed.

a. Provide bracing and shoring.
b. Prevent movement or settlement of adjacent structures.
c. Stop work immediately if adjacent structures appear to be in danger.

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

3.2.5 If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

3.3 EXISTING UTILITIES

3.3.1 Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

3.3.2 Protect existing utilities to remain from damage.

3.3.3 Do not disrupt public utilities without permit from authority having jurisdiction.

3.3.4 Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

3.3.5 Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

3.3.6 Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

3.4 SELECTIVE DEMOLITION FOR ALTERATIONS

3.4.1 Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.

a. Verify that construction and utility arrangements are as indicated.
b. Report discrepancies to Architect before disturbing existing installation.
c. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

3.4.2 Separate areas in which demolition is being conducted from other areas that are still occupied.

a. Provide, erect, and maintain temporary dustproof partitions of construction indicated on drawings .

3.4.3 Remove existing work as indicated and as required to accomplish new work.

a. Remove items indicated on drawings.

3.4.4 Services (Including but not limited to HVAC, Plumbing, and Electrical): Remove existing systems and equipment as indicated.

a. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
b. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
c. Verify that abandoned services serve only abandoned facilities before removal.
d. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.

3.4.5 Protect existing work to remain.

a. Prevent movement of structure; provide shoring and bracing if necessary.
b. Perform cutting to accomplish removals neatly and as specified for cutting new work.
c. Repair adjacent construction and finishes damaged during removal work.
d. Patch as specified for patching new work.

3.5 DEBRIS AND WASTE REMOVAL

3.5.1 Remove debris, junk, and trash from site.

3.5.2 Leave site in clean condition, ready for subsequent work.

3.5.3 Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 07 4213 - METAL WALL PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Manufactured metal panels for soffit panels, with related flashings and accessory components.

1.2 REFERENCE STANDARDS

1.2.1 AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2017a.

1.2.2 ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2018.

1.3 SUBMITTALS

1.3.1 Shop Drawings: Indicate dimensions, layout, joints, construction details, and methods of anchorage.

1.3.2 Samples: Submit two samples of soffit panel, 12 inch by 12 inch in size illustrating color, sheen amd profile.

1.3.3 Manufacturer's Qualification Statement.

1.3.4 Installer's Qualification Statement.

1.4 QUALITY ASSURANCE

1.4.1 Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.4.2 Installer Qualifications: Company specializing in installing products of the type specified in this section with minimum three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.

1.5.2 Store prefinished material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.

1.5.3 Prevent contact with materials that may cause discoloration or staining of products.

1.6 WARRANTY

1.6.1 Correct defective work within a five year period after Date of Substantial Completion for degradation of panel finish, including color fading caused by exposure to weather.

PART 2 PRODUCTS

2.1 MANUFACTURERS

2.1.1 Metal Soffit Panels:

a. Berridge Manufacturing Company; FW-1025 Panel: www.berridge.com/#sle.
b. Fabral; Posi-Lock Soffit: www.fabral.com/#sle.
c. Metal Roofing Systems, Inc; Flush Seam Soffit Panels: www.metalroofingsystems.biz/#sle.

2.2 MANUFACTURED METAL PANELS

2.2.1 Soffit Panels:

a. Profile: Style as indicated.
b. Material: Precoated steel sheet, 22 gage, 0.0299 inch minimum thickness.
c. Color: As selected by Architect from manufacturer's standard line.

2.2.2 Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.

2.2.3 Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

2.2.4 Anchors: Galvanized steel.

2.3 MATERIALS

2.3.1 Precoated Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, Structural Steel (SS) or Forming Steel (FS), with G90/Z275 coating; continuous coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.

2.4 FINISHES

2.4.1 Exposed Surface Finish: Panel manufacturer's standard polyvinylidene fluoride (PVDF) coating, top coat over epoxy primer.

2.4.2 Panel Backside Finish: Panel manufacturer's standard siliconized polyester wash coat.

2.4.3 Fluoropolymer Coil Coating System: Manufacturer's standard multi-coat aluminum coil coating system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of coil coated aluminum surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch; color and gloss to match sample.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Install panels on walls and soffits in accordance with manufacturer's instructions.

3.1.2 Fasten panels to structural supports; aligned, level, and plumb.

3.1.3 Use concealed fasteners unless otherwise approved by Architect.

3.2 TOLERANCES

3.2.1 Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16 inch.

3.3 CLEANING

3.3.1 Remove site cuttings from finish surfaces.

3.3.2 Remove protective material from wall panel surfaces.

3.3.3 Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

END OF SECTION

SECTION 08 0671 - DOOR HARDWARE SCHEDULE

PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Preliminary schedule of door hardware sets for swinging as indicated on drawings.

1.2 RELATED REQUIREMENTS

1.2.1 Section 08 7100 - Door Hardware: Requirements to comply with in coordination with this section.

1.3 REFERENCE STANDARDS

1.3.1 BHMA A156.13 - American National Standard for Mortise Locks & Latches Series 1000; 2017.

1.3.2 BHMA A156.18 - American National Standard for Materials and Finishes; 2016.

PART 2 PRODUCTS

2.1 MANUFACTURERS

2.1.1 Only manufacturers listed in Door Hardware Schedule or Section 08 7100 are considered acceptable, unless noted otherwise.

2.1.2 Obtain each type of door hardware as indicated from a single manufacturer and single supplier.

2.1.3 Manufacturer's Abbreviations: Coordinate with manufacturers listed in Section 08 7100.

a. BAS - Best Access Systems.
b. BOM - Bommer Industries.
c. CRL - C. R. Laurence.
d. DMA - Dorma.
e. HGR - Hager.
f. HIA - Hiawatha.
g. IVE - Ives.
h. LCN - LCN.
i. McK - McKinney.
j. NGP - National Guard Products.
k. NOR - Norton.
l. PEM - Pemko.
m. ROC - Rockwood.
n. SCH - Schlage.
o. SDC - Stanley Door Closers.
p. SH - Stanley Hinges.
q. STH - Stanley Commercial Hardware.
r. TR - Trimco.
s. VD - Von Duprin.

2.2 DESCRIPTION

2.2.1 Door hardware sets provided represent the design intent, they are only a guideline and should not be considered a detailed or complete hardware schedule.

a. Provide door hardware item(s) as required for similar purposes, even when item is not listed for a door in Door Hardware Schedule.
b. Door hardware supplier is responsible for providing proper size and hand of door for products required in accordance with Door Hardware Schedule and as indicated on drawings.
c. Quantities listed are for each Pair (PR) of doors, or for each Single (SGL) door, as indicated in hardware sets.

2.3 LOCK FUNCTION CODES

2.3.1 Function Codes for Mortise Locks: Complying with BHMA A156.13.

a. Office Lock: Deadlocking latch bolt by knobs except when outside knob is locked by buttons in face (edge), then by key outside.
b. Classroom Lock: Deadlocking latch bolt by knobs. Outside knob locked by key outside. Inside knob always free.

(1) Schoolhouse Safety Deadlock: Deadbolt retracted by key outside or turn inside. Deadbolt projected by key outside.

c. Exit Device: Entrance by pull/trim when actuating bar is locked down (Dogged-Down). Note-Fire Exit devices cannot be locked down.

d. Storeroom Lock: Deadlocking latch bolt by inside knob or key outside. Outside knob rigid.

(1) Storeroom with Hold Back: Latch bolt operated by key outside or by operating inside knob. Outside knob is always inoperative. Latch bolt may be held in retracted position by key from outside. Deadlocking latch.

e. Privacy Lock: Latch bolt operated by knob from either side except when outside knob is locked by inside T-turn. Operating inside knob, closing door, or operating outside emergency release unlocks outside knob. Emergency tool finished with lock.

f. Latrines: Operates by push / pull hardware, does not latch.

g. Passage: Latch retracted by lever at all times.

2.4 FINISHES

2.4.1 Finishes: Complying with BHMA A156.18.

a. Code 626: Satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D).

PART 3 EXECUTION

3.1 DOOR HARDWARE SCHEDULE

3.1.1 See the door schedule on the drawings for the set descriptions.

END OF SECTION

SECTION 08 1113 - HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Non-fire-rated hollow metal doors and frames.

1.1.2 Fire-rated hollow metal doors and frames.

1.1.3 Thermally insulated hollow metal doors with frames.

1.2 RELATED REQUIREMENTS

1.2.1 Section 08 7100 - Door Hardware.

1.3 ABBREVIATIONS AND ACRONYMS

1.3.1 ANSI: American National Standards Institute.

1.3.2 ASCE: American Society of Civil Engineers.

1.3.3 HMMA: Hollow Metal Manufacturers Association.

1.3.4 NAAMM: National Association of Architectural Metal Manufacturers.

1.3.5 NFPA: National Fire Protection Association.

1.3.6 SDI: Steel Door Institute.

1.3.7 UL: Underwriters Laboratories.

1.4 REFERENCE STANDARDS

1.4.1 ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

1.4.2 ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.

1.4.3 ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2017.

1.4.4 ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.

1.4.5 ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2018.

1.4.6 ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2018.

1.4.7 ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.

1.4.8 BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2016.

1.4.9 ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.4.10 ITS (DIR) - Directory of Listed Products; current edition.

1.4.11 NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.

1.4.12 NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.

1.4.13 NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.

1.4.14 NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2019.

1.4.15 NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2017.

1.4.16 UL (DIR) - Online Certifications Directory; Current Edition.

1.4.17 UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.5 SUBMITTALS

1.5.1 Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.

1.5.2 Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

1.5.3 Manufacturer's Qualification Statement.

1.5.4 Installer's Qualification Statement.

1.6 QUALITY ASSURANCE

1.6.1 Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.

1.6.2 Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

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

1.7 DELIVERY, STORAGE, AND HANDLING

1.7.1 Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

1.7.2 Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

2.1.1 Hollow Metal Doors and Frames:

a. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com/#sle.
b. Mesker, dormakaba Group: www.meskeropeningsgroup.com/#sle.
c. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
d. Steelcraft, an Allegion brand: www.allegion.com/#sle.

2.2 PERFORMANCE REQUIREMENTS

2.2.1 Requirements for Hollow Metal Doors and Frames:

a. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
b. Accessibility: Comply with ICC A117.1 and ADA Standards.
c. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
d. Door Edge Profile: Manufacturers standard for application indicated.
e. Typical Door Face Sheets: Flush.
f. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
g. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
    (1) Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.

2.2.2 Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements

specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.3 HOLLOW METAL DOORS

2.3.1 Exterior Doors: Thermally insulated.
- a. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
  - (1) Level 2 - Heavy-duty.
  - (2) Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
  - (3) Model 1 - Full Flush.
  - (4) Door Face Metal Thickness: 18 gage, 0.042 inch, minimum.
- b. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
- c. Door Thickness: 1-3/4 inch, nominal.
- d. Weatherstripping: Integral, recessed into door edge or frame.
- e. Door Finish: Factory primed and field finished.

2.3.2 Interior Doors, Non-Fire-Rated:
- a. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
  - (1) Level 2 - Heavy-duty.
  - (2) Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
  - (3) Model 1 - Full Flush.
  - (4) Door Face Metal Thickness: 18 gage, 0.042 inch, minimum.
- b. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
- c. Door Thickness: 1-3/4 inch, nominal.

2.3.3 Fire-Rated Doors:
- a. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
  - (1) Level 1 - Standard-duty.
  - (2) Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
  - (3) Model 1 - Full Flush.
  - (4) Door Face Metal Thickness: 18 gage, 0.042 inch, minimum.
- b. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
- c. Provide units listed and labeled by UL (DIR) or ITS (DIR).
  - (1) Attach fire rating label to each fire rated unit.
- d. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
- e. Door Thickness: 1-3/4 inch, nominal.
- f. Door Finish: Factory primed and field finished.

2.4 HOLLOW METAL FRAMES

2.4.1 Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

2.4.2 Exterior Door Frames: Face welded type.
- a. Frame Metal Thickness: 18 gage, 0.042 inch, minimum.
- b. Frame Finish: Factory primed and field finished.
- c. Weatherstripping: Separate, see Section 08 7100.

2.4.3 Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
- a. Frame Metal Thickness: 18 gage, 0.042 inch, minimum.
- b. Frame Finish: Factory primed and field finished.

2.4.4 Door Frames, Fire-Rated: Face welded type.
- a. Fire Rating: Same as door, labeled.
- b. Frame Metal Thickness: 18 gage, 0.042 inch, minimum.
- c. Frame Finish: Factory primed and field finished.

2.5 FINISHES

2.5.1 Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.6 ACCESSORIES

2.6.1 Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

2.6.2 Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify existing conditions before starting work.

3.1.2 Verify that opening sizes and tolerances are acceptable.

3.1.3 Verify that finished walls are in plane to ensure proper door alignment.

3.2 PREPARATION

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

3.3 INSTALLATION

3.3.1 Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

3.3.2 Install fire rated units in accordance with NFPA 80.

3.3.3 Coordinate frame anchor placement with wall construction.

3.3.4 Install door hardware as specified in Section 08 7100.

3.4 TOLERANCES

3.4.1 Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.5 ADJUSTING

3.5.1 Adjust for smooth and balanced door movement.

END OF SECTION

SECTION 08 4313 - ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Aluminum-framed storefront, with vision glass.

1.1.2 Aluminum doors and frames.

1.2 REFERENCE STANDARDS

1.2.1 AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.

1.2.2 AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).

1.2.3 ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

1.2.4 ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

1.3 SUBMITTALS

1.3.1 Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.

1.3.2 Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.

1.3.3 Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in the drawings and specifications.

1.4 QUALITY ASSURANCE

1.4.1 Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.4.2 Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Handle products of this section in accordance with AAMA CW-10.

1.5.2 Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.6 FIELD CONDITIONS

1.6.1 Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during, and 48 hours after, installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

2.1.1 Aluminum-Framed Storefront and Doors:

a. Kawneer North America; 451T/451: www.kawneer.com/#sle. Basis of Design.
b. Manko Window Systems, Inc: www.mankowindows.com/#sle.
c. Tubelite, Inc: www.tubeliteinc.com/#sle.

2.2 STOREFRONT

2.2.1 Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.

a. Glazing Rabbet: For 1 inch insulating glazing.
b. Glazing Position: Centered (front to back).
c. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.
d. Finish: Class I color anodized.
   (1) Factory finish all surfaces that will be exposed in completed assemblies.

e. Finish Color: Medium bronze.
f. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
g. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
h. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
i. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
j. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
k. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

2.3 COMPONENTS

2.3.1 Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
a. Framing members for interior applications need not be thermally broken.
b. Glazing Stops: Flush.
c. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.

2.3.2 Swing Doors: Glazed aluminum.
a. Thickness: 1-3/4 inches.
b. Top Rail: 4 inches wide.
c. Vertical Stiles: 4-1/2 inches wide.
d. Bottom Rail: 6 inches wide.
e. Finish: Same as storefront.

2.4 MATERIALS

2.4.1 Extruded Aluminum: ASTM B221 (ASTM B221M).

2.4.2 Fasteners: Stainless steel.

2.4.3 Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

2.5 FINISHES

2.5.1 Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

2.5.2 Color: Medium bronze.

2.6 HARDWARE

2.6.1 For each door, include weatherstripping, sill sweep strip, and threshold.

2.6.2 Other Door Hardware: Storefront manufacturer's standard type to suit application.
a. Finish on Hand-Contacted Items: Polished chrome.
b. For each door, include butt hinges, pivots, push handle, pull handle, exit device, narrow stile handle latch, and closer.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify dimensions, tolerances, and method of attachment with other work.

3.1.2 Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.2 INSTALLATION

3.2.1 Install wall system in accordance with manufacturer's instructions.

3.2.2 Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

3.2.3 Provide alignment attachments and shims to permanently fasten system to building structure.

3.2.4 Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

3.2.5 Provide thermal isolation where components penetrate or disrupt building insulation.

3.2.6 Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

3.2.7 Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

3.2.8 Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

3.2.9 Set thresholds in bed of sealant and secure.

3.2.10 Install hardware using templates provided.

3.2.11 Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.3 TOLERANCES

3.3.1 Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.

3.3.2 Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.4 ADJUSTING

3.4.1 Adjust operating hardware and sash for smooth operation.

3.5 CLEANING

3.5.1 Remove protective material from pre-finished aluminum surfaces.

3.5.2 Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

3.6 PROTECTION

3.6.1 Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 7100 - DOOR HARDWARE

PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Hardware for hollow metal doors. Contractor is required to coordinate the reuse of existing electrically operated and controlled hardware.

1.1.2 Hardware for fire-rated doors.

1.1.3 Electrically operated and controlled hardware. Where existing doors have electronic access hardware and equipment currently installed, contractor shall prepare new doors and or frames to receive and reuse such hardware.

1.1.4 Thresholds.

1.1.5 Weatherstripping and gasketing.

1.2 REFERENCE STANDARDS

1.2.1 BHMA A156.1 - American National Standard for Butts and Hinges; 2016.

1.2.2 BHMA A156.3 - American National Standard for Exit Devices; 2014.

1.2.3 BHMA A156.4 - American National Standard for Door Controls - Closers; 2013.

1.2.4 BHMA A156.5 - American National Standard for Cylinders and Input Devices for Locks; 2014.

1.2.5 BHMA A156.6 - American National Standard for Architectural Door Trim; 2015.

1.2.6 BHMA A156.13 - American National Standard for Mortise Locks & Latches Series 1000; 2017.

1.2.7 BHMA A156.16 - American National Standard for Auxiliary Hardware; 2013.

1.2.8 BHMA A156.18 - American National Standard for Materials and Finishes; 2016.

1.2.9 BHMA A156.21 - American National Standard for Thresholds; 2014.

1.2.10 BHMA A156.22 - American National Standard for Door Gasketing and Edge Seal Systems, Builders Hardware Manufacturers Association; 2017.

1.2.11 BHMA A156.30 - American National Standard for High Security Cylinders; 2014.

1.2.12 ITS (DIR) - Directory of Listed Products; current edition.

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

1.2.14 NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2019.

1.2.15 NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2017.

1.2.16 UL (DIR) - Online Certifications Directory; Current Edition.

1.2.17 UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.2.18 UL 437 - Standard for Key Locks; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

1.3.1 Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

1.4 SUBMITTALS

1.4.1 Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.

1.4.2 Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in the plans and specifications.

a. Provide complete description for each door listed.

1.4.3 Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.4.4 Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

1.5 QUALITY ASSURANCE

1.5.1 Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years of documented experience.

1.5.2 Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least five years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

PART 2 PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

2.1.1 Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

2.1.2 Provide individual items of single type, of same model, and by same manufacturer.

2.1.3 Provide door hardware products that comply with the following requirements:
- a. Applicable provisions of federal, state, and local codes.
- b. Fire-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
- c. Hardware on Fire-Rated Doors: Listed and classified by UL (DIR), ITS (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for application indicated.
- d. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.

2.1.4 Electrically Operated and/or Controlled Hardware: Coordinate the reuse of and if needed, provide new necessary power supplies, power transfer hinges, relays, and interfaces as required for proper operation; provide wiring between hardware and control components and to building power connection in compliance with NFPA 70.

2.2 HINGES

2.2.1 Manufacturers:
- a. Bommer Industries, Inc: www.bommer.com/#sle.
- b. Hager Companies: www.hagerco.com/#sle.
- c. Stanley, dormakaba Group: www.stanleyhardwarefordoors.com/#sle.

2.2.2 Hinges: Comply with BHMA A156.1, Grade 1.
- a. Provide hinges on every swinging door.
- b. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
- c. Provide following quantity of butt hinges for each door:
  - (1) Doors up to 60 inches High: Two hinges.
  - (2) Doors From 60 inches High up to 90 inches High: Three hinges.

2.3 FLUSH BOLTS

2.3.1 Manufacturers:
- a. McKinney, an Assa Abloy Group company: www.assaabloydss.com/#sle.
- b. Hager Companies: www.hagerco.com/#sle.
- c. Ives, an Allegion brand: www.allegion.com/us/#sle.

2.3.2 Flush Bolts: Comply with BHMA A156.16, Grade 1.
- a. Flush Bolt Throw: 3/4 inch, minimum.
- b. Provides extension bolts in leading edge of door, one bolt into floor, one bolt into top of frame.

(1) Pairs of Swing Doors: At inactive leaves, provide flush bolts of type as required to comply with code.

c. Provide dustproof floor strike for bolt into floor, except at metal thresholds.

d. Manual Flush Bolts: Provide lever extensions for top bolt at over-sized doors.

2.4 EXIT DEVICES

2.4.1 Manufacturers:

a. DORMA USA, Inc: www.dorma.com/#sle.

b. Stanley, dormakaba Group: www.stanleyhardwarefordoors.com/#sle.

c. Von Duprin, an Allegion brand: www.allegion.com/us/#sle.

2.4.2 Exit Devices: Comply with BHMA A156.3, Grade 1.

a. Lever design to match lockset trim.

b. Provide cylinder with cylinder dogging or locking trim.

c. Provide exit devices properly sized for door width and height.

d. Provide strike as recommended by manufacturer for application indicated.

e. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.

2.5 LOCK CYLINDERS

2.5.1 Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.

a. Provide full size interchangeable core (FSIC) type cylinders, Grade 1, with seven-pin core in compliance with BHMA A156.5 at locations indicated.

b. Provide high security mechanical type cylinders, Grade 1, with six-pin core in compliance with BHMA A156.30 or UL 437 at locations indicated.

c. Provide cylinders from same manufacturer as locking device.

d. Provide cams and/or tailpieces as required for locking devices.

2.6 MORTISE LOCKS

2.6.1 Manufacturers:

a. Corbin Russwin; an Assa Abloy Group company: www.assaabloydss.com/#sle.

b. Best, dormakaba Group: www.bestaccess.com/#sle.

c. Schlage, an Allegion brand: www.allegion.com/us/#sle.

2.6.2 Mortise Locks: Comply with BHMA A156.13, Grade 1, Security.

a. Latchbolt Throw: 3/4 inch, minimum.

b. Deadbolt Throw: 1 inch, minimum.

c. Backset: 2-3/4 inch unless otherwise indicated.

d. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.

(1) Finish: To match lock or latch.

2.7 DOOR PULLS AND PUSH PLATES

2.7.1 Manufacturers:

a. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.

b. Hager Companies: www.hagerco.com/#sle.

c. Pamex, Inc: www.pamexinc.com/#sle.

d. Substitutions: See Section 01 6000 - Product Requirements.

2.7.2 Door Pulls and Push Plates: Comply with BHMA A156.6.

a. Pull Type: Straight, unless otherwise indicated.

b. Push Plate Type: Flat, with square corners, unless otherwise indicated.

(1) Edges: Beveled, unless otherwise indicated.

c. Material: Aluminum, unless otherwise indicated.

2.8 CLOSERS

2.8.1 Manufacturers; Surface Mounted:

a. C. R. Laurence Company, Inc: www.crl-arch.com/#sle.

b. LCN, an Allegion brand: www.allegion.com/us/#sle.
c. Stanley, dormakaba Group: www.stanleyhardwarefordoors.com/#sle.

2.8.2 Closers: Comply with BHMA A156.4, Grade 1.
a. Type: Surface mounted to door.
b. Provide door closer on each exterior door.
c. Provide door closer on each fire-rated and smoke-rated door.
d. At corridor entry doors, mount closer on room side of door.
e. At outswinging exterior doors, mount closer on interior side of door.

2.9 PROTECTION PLATES

2.9.1 Manufacturers:
a. C. R. Laurence Company, Inc: www.crl-arch.com/#sle.
b. Hager Companies: www.hagerco.com/#sle.
c. Ives, an Allegion brand: www.allegion.com/us/#sle.

2.9.2 Protection Plates: Comply with BHMA A156.6.

2.9.3 Metal Properties: Aluminum.
a. Metal, Heavy Duty: Thickness 0.062 inch, minimum.

2.9.4 Edges: Beveled, on four sides unless otherwise indicated.

2.9.5 Fasteners: Countersunk screw fasteners.

2.10 KICK PLATES

2.10.1 Manufacturers:
a. Hiawatha, Inc, an Activar Construction Products Group company: www.activarcpg.com/hiawatha/#sle.
b. Ives, an Allegion brand: www.allegion.com/us/#sle.
c. Trimco: www.trimcohardware.com/#sle.

2.10.2 Kick Plates: Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
a. Size: 12 inch high by 2 inch less door width (LDW) on push side of door.

2.11 FLOOR STOPS

2.11.1 Manufacturers:
a. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
b. Hager Companies: www.hagerco.com/#sle.
c. Hiawatha, Inc, division of Activar Construction Products Group, Inc: www.activarcpg.com/hiawatha/#sle.

2.11.2 Floor Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
a. Type: Manual hold-open, with dome floor stop.
b. Material: Aluminum housing with rubber insert.

2.12 WALL STOPS

2.12.1 Manufacturers:
a. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
b. Hager Companies: www.hagerco.com/#sle.
c. Hiawatha, Inc, division of Activar Construction Products Group, Inc: www.activarcpg.com/hiawatha/#sle.

2.12.2 Wall Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
a. Provide wall stops to prevent damage to wall surface upon opening door.
b. Type: Bumper, concave, wall stop.
c. Material: Aluminum housing with rubber insert.

2.13 ASTRAGALS

2.13.1 Manufacturers:
- a. Pemko; an Assa Abloy Group company: www.assaabloydss.com/#sle.
- b. Hager Companies: www.hagerco.com/#sle.
- c. National Guard Products, Inc: www.ngpinc.com/#sle.

2.13.2 Astragals: Comply with BHMA A156.22.
- a. Provide surface mounted astragal to cover or fill space for full door height between pair of doors or door and adjacent jamb.
- b. Type: Split, two parts, and with sealing gasket.
- c. Material: Steel, with neoprene weatherstripping.
- d. Provide non-corroding fasteners at exterior locations.

2.14 THRESHOLDS

2.14.1 Manufacturers:
- a. Pemko; an Assa Abloy Group company: www.assaabloydss.com/#sle.
- b. Hager Companies: www.hagerco.com/#sle.
- c. National Guard Products, Inc: www.ngpinc.com/#sle.

2.14.2 Thresholds: Comply with BHMA A156.21.
- a. Provide threshold at interior doors for transition between two different floor types, and over building expansion joints, unless otherwise indicated.
- b. Provide threshold at each exterior door, unless otherwise indicated.
- c. Type: Flat surface.
- d. Material: Aluminum, with rubber weatherstripping.
- e. Threshold Surface: Fluted horizontal grooves across full width.
- f. Field cut threshold to profile of frame and width of door sill for tight fit.
- g. Provide non-corroding fasteners at exterior locations.

2.15 WEATHERSTRIPPING AND GASKETING

2.15.1 Manufacturers:
- a. Pemko; an Assa Abloy Group company: www.assaabloydss.com/#sle.
- b. Hager Companies: www.hagerco.com/#sle.
- c. National Guard Products, Inc: www.ngpinc.com/#sle.

2.15.2 Weatherstripping and Gasketing: Comply with BHMA A156.22.
- a. Head and Jamb Type: Adjustable.
- b. Door Sweep Type: Encased in retainer.
- c. Material: Aluminum, with rubber weatherstripping.

2.16 SILENCERS

2.16.1 Manufacturers:
- a. Ives, an Allegion brand: www.allegion.com/us/#sle.
- b. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
- c. C. R. Laurence; www.crlaurence.com.

2.16.2 Silencers: Provide at equal locations on door frame to mute sound of door's impact upon closing.
- a. Single Door: Provide three on strike jamb of frame.
- b. Pair of Doors: Provide two on head of frame, one for each door at latch side.
- c. Material: Rubber, gray color.

2.17 FINISHES

2.17.1 Finishes: Provide door hardware of same finish, unless otherwise indicated.
- a. Primary Finish: 626; satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D); BHMA A156.18.
- b. Secondary Finish: 626; satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D); BHMA A156.18.

(1) Use secondary finish in kitchens, bathrooms, and other spaces containing chrome or stainless steel finished appliances, fittings, and equipment; provide primary finish on one side of door and secondary finish on other side if necessary.

c. Exceptions:

(1) Where base material metal is specified to be different, provide finish that is an equivalent appearance in accordance with BHMA A156.18.

(2) Hinges for Fire-Rated Doors: Steel base material with painted finish, in compliance with NFPA 80.

(3) Aluminum Surface Trim and Gasket Housings: Anodized to match door panel finish, not other hardware, unless otherwise indicated.

(4) Hardware for Aluminum Storefront Doors: Finished to match door panel finish, except at hand contact surfaces provide stainless steel with satin finish, unless otherwise indicated.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

3.2 INSTALLATION

3.2.1 Install hardware in accordance with manufacturer's instructions and applicable codes.

3.2.2 Coordinate and reinstall electronically operated or controlled hardware to match existing assemblies, to deliver a fully funtional system.

3.2.3 Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.

3.2.4 Use templates provided by hardware item manufacturer.

3.2.5 Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item.

3.2.6 Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.3 ADJUSTING

3.3.1 Adjust hardware for smooth operation.

3.3.2 Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.4 CLEANING

3.4.1 Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.

3.4.2 Clean adjacent surfaces soiled by hardware installation.

3.4.3 Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.5 PROTECTION

3.5.1 Do not permit adjacent work to damage hardware or finish.

END OF SECTION

SECTION 08 8300 - MIRRORS

PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Glass mirrors.
   a. Tempered safety glass.

1.2 REFERENCE STANDARDS

1.2.1 ASTM C1036 - Standard Specification for Flat Glass; 2016.

1.2.2 ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2018.

1.3 WARRANTY

1.3.1 Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

PART 2 PRODUCTS

2.1 MANUFACTURERS

2.1.1 Mirrors:
   a. Bobrick: bobrick.com
   b. Bradley: bradleycorp.com
   c. Global: globalindustrial.com.

2.2 MATERIALS

2.2.1 Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.

2.2.2 Mirror Glass: ASTM C1036, Type 1 - Transparent Flat, Class 1 - Clear, Quality - Q1 (high-quality mirrors); silvering, protective coating, and quality requirements in compliance with ASTM C1503.
   a. Thickness: 3/16 inch.
   b. Size: 24 inch wide by 30 inch high nominal.
   c. Stainless steel frame with 5" shelf.

2.3 ACCESSORIES

2.3.1 Channel Frame: One piece, channel frame, stainless steel, Type 430, satin finish, 1/2 inch by 1/2 inch by 3/8 inch deep with 90 degree mitered corners.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.2 PREPARATION

3.2.1 Clean contact surfaces with solvent and wipe dry.

3.3 INSTALLATION

3.3.1 Install mirrors in accordance with manufacturer's recommendations.

3.3.2 Set mirrors plumb and level, and free of optical distortion.

3.3.3 Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.

3.4 CLEANING

3.4.1 Remove labels after work is complete.

3.4.2 Clean mirrors and adjacent surfaces.

END OF SECTION

SECTION 09 2116 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Metal stud wall framing.

1.1.2 Metal channel ceiling framing.

1.1.3 Gypsum sheathing.

1.1.4 Cementitious backing board.

1.1.5 Gypsum wallboard.

1.1.6 Joint treatment and accessories.

1.2 REFERENCE STANDARDS

1.2.1 ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2010 (Reaffirmed 2016).

1.2.2 ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (Reaffirmed 2016).

1.2.3 ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.

1.2.4 ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014, with Editorial Revision (2015).

1.2.5 ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2017.

1.2.6 ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2018b.

1.2.7 ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.

1.2.8 ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2016.

1.2.9 ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.

1.2.10 ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing; 2018.

1.2.11 ASTM C1325 - Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units; 2017a.

1.2.12 ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.

1.2.13 ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2016.

1.2.14 GA-216 - Application and Finishing of Gypsum Panel Products; 2016.

1.3 SUBMITTALS

1.3.1 Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

2.1.1 Provide completed assemblies complying with ASTM C840 and GA-216.

2.2 METAL FRAMING MATERIALS

2.2.1 Manufacturers - Metal Framing, Connectors, and Accessories:
a. ClarkDietrich: www.clarkdietrich.com/#sle.

b. Marino: www.marinoware.com/#sle.
c. Phillips Manufacturing Co: www.phillipsmfg.com/#sle.

2.2.2 Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
a. Studs: "C" shaped with flat or formed webs with knurled faces.
b. Runners: U shaped, sized to match studs.
c. Ceiling Channels: C-shaped.
d. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
e. Resilient Furring Channels: Single or double leg configuration; 1/2 inch channel depth.

2.2.3 Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.

2.3 BOARD MATERIALS

2.3.1 Manufacturers - Gypsum-Based Board:
a. American Gypsum Company: www.americangypsum.com/#sle.
b. National Gypsum Company: www.nationalgypsum.com/#sle.
c. USG Corporation: www.usg.com/#sle.

2.3.2 Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
a. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
b. Thickness:
(1) Vertical Surfaces: 5/8 inch.
(2) Ceilings: 5/8 inch.
(3) Areas called out for overlay: 1/4 inch.

2.3.3 Backing Board For Wet Areas: One of the following products:
a. Application: Surfaces behind tile in wet areas including tub and shower surrounds, shower ceilings, and for shower epoxy walls.
b. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
c. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
(1) Thickness: 5/8 inch.

2.4 Gypsum Wallboard ACCESSORIES

2.4.1 Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, galvanized steel, or rolled zinc, unless noted otherwise.
a. Corner Beads: Low profile, for 90 degree outside corners.
b. Expansion Joints:
(1) Type: V-shaped PVC with tear away fins.

2.4.2 Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
a. Paper Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
b. Joint Compound: Drying type, vinyl-based, ready-mixed.

2.4.3 Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.

2.4.4 Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify that project conditions are appropriate for work of this section to commence.

3.2 FRAMING INSTALLATION

3.2.1 Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.

3.2.2 Suspended Ceilings and Soffits: Space framing and furring members at 16 inches on center.

3.2.3 Studs: Space studs at 16 inches on center.

a. Extend partition framing to structure where indicated and to ceiling in other locations.
b. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
c. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.

3.2.4 Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

3.3 BOARD INSTALLATION

3.3.1 Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

3.3.2 Single-Layer Non-Rated: Install gypsum board perpendicular to framing, with ends and edges occurring over firm bearing.

3.3.3 Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

3.3.4 Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.

3.3.5 Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

3.3.6 Installation on Metal Framing: Use screws for attachment of gypsum board.

3.4 INSTALLATION OF TRIM AND ACCESSORIES

3.4.1 Control Joints: Place control joints consistent with lines of building spaces and as follows:

a. Not more than 30 feet apart on walls and ceilings over 50 feet long.
b. At exterior soffits, not more than 30 feet apart in both directions.

3.4.2 Corner Beads: Install at external corners, using longest practical lengths.

3.4.3 Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.5 JOINT TREATMENT

3.5.1 Finish gypsum board in accordance with levels defined in ASTM C840, as follows:

a. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
b. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.

3.5.2 Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.

a. Feather coats of joint compound so that camber is maximum 1/32 inch.

3.6 TOLERANCES

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

END OF SECTION

SECTION 09 5100 - ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Suspended metal grid ceiling system.

1.1.2 Acoustical units.

1.2 REFERENCE STANDARDS

1.2.1 ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2017.

1.2.2 ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.

1.3 SUBMITTALS

1.3.1 Shop Drawings: Indicate grid layout and related dimensioning.

1.3.2 Product Data: Provide data on suspension system components.

1.3.3 Samples: Submit two samples 12 by 12 inch in size illustrating material and finish of acoustical units.

1.3.4 Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
- a. See Section 01 6000 - Product Requirements, for additional provisions.
- b. Extra Acoustical Units: Quantity equal to or greater than 5 percent of total installed.

1.4 QUALITY ASSURANCE

1.4.1 Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.4.2 Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

2.1.1 Acoustic Tiles/Panels:
- a. Armstrong World Industries, Inc: www.armstrong.com/#sle.
- b. CertainTeed Corporation: www.certainteed.com/#sle.
- c. USG: www.usg.com/#sle.

2.1.2 Suspension Systems:
- a. Armstrong World Industries, Inc: www.armstrong.com/#sle.
- b. CertainTeed Corporation: www.certainteed.com/#sle.
- c. USG: www.usg.com/#sle.

2.2 ACOUSTICAL UNITS

2.2.1 Acoustical Panels: Painted mineral fiber, ASTM E1264 Type III, with the following characteristics:
- a. Size: 24 by 24 inches.
- b. Thickness: 5/8 inches.
- c. Composition: Wet felted.
- d. Edge: Square.
- e. Surface Color: White.
- f. Surface Pattern: Perforated, randomly spaced large holes.
- g. Suspension System: Exposed grid.

2.3 SUSPENSION SYSTEM(S)

2.3.1 Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.

2.3.2 Exposed Suspension System: Formed steel, commercial quality cold rolled; heavy-duty.
- a. Profile: Tee; 15/16 inch wide face.

b. Construction: Double web.
c. Finish: White painted.

2.4 ACCESSORIES

2.4.1 Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

2.4.2 Perimeter Moldings: Same material and finish as grid.
a. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify existing conditions before starting work.

3.1.2 Verify that layout of hangers will not interfere with other work.

3.2 INSTALLATION - SUSPENSION SYSTEM

3.2.1 Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

3.2.2 Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size unless existing dimensions will not allow.

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

3.2.4 Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

3.2.5 Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

3.2.6 Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

3.2.7 Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

3.2.8 Do not eccentrically load system or induce rotation of runners.

3.2.9 Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
a. Use longest practical lengths.
b. Overlap and rivet corners.

3.3 INSTALLATION - ACOUSTICAL UNITS

3.3.1 Install acoustical units in accordance with manufacturer's instructions.

3.3.2 Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

3.3.3 Fit border trim neatly against abutting surfaces.

3.3.4 Install units after above-ceiling work is complete.

3.3.5 Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

3.3.6 Cutting Acoustical Units:
a. Make field cut edges of same profile as factory edges.

3.4 TOLERANCES

3.4.1 Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

3.4.2 Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

SECTION 09 6500 - RESILIENT FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Resilient tile flooring.

1.1.2 Resilient base.

1.1.3 Installation accessories.

1.2 REFERENCE STANDARDS

1.2.1 ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2004 (Reapproved 2018).

1.2.2 ASTM F1861 - Standard Specification for Resilient Wall Base; 2016.

1.2.3 RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; 2011.

1.3 SUBMITTALS

1.3.1 Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

1.3.2 Verification Samples: Submit two samples, 12 by 12 inch in size illustrating color and pattern for each resilient flooring product specified.

1.3.3 Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
- a. Extra Stair Materials: Quantity equivalent to or greater than 5 percent of each type and color.

1.4 QUALITY ASSURANCE

1.4.1 Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.

1.4.2 Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.

1.5.2 Store all materials off of the floor in an acclimatized, weather-tight space.

1.5.3 Maintain temperature in storage area between 55 degrees F and 90 degrees F.

1.5.4 Do not double stack pallets.

1.6 FIELD CONDITIONS

1.6.1 Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.1 TILE FLOORING

2.1.1 Vinyl Composition Tile: Homogeneous, with color extending throughout thickness.
- a. Manufacturers:
  - (1) Armstrong World Industries, Inc: www.armstrong.com/#sle.
  - (2) Johnsonite, a Tarkett Company: www.johnsonite.com/#sle.
  - (3) Mannington Mills, Inc: www.mannington.com/#sle.
- b. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
- c. Size: 12 by 12 inch.
- d. Thickness: 0.125 inch.
- e. Color: As indicated on drawings.

2.2 RESILIENT BASE

2.2.1 Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
- a. Manufacturers:

(1) Burke Flooring: www.burkeflooring.com/#sle.
(2) Johnsonite, a Tarkett Company: www.johnsonite.com/#sle.
(3) Roppe Corp: www.roppe.com/#sle.

b. Height: 4 inch.
c. Thickness: 0.125 inch.
d. Finish: Satin.
e. Length: Roll.
f. Color: To be selected by Architect from manufacturer's full range.
g. Accessories: Premolded external corners and internal corners.

2.3 ACCESSORIES

2.3.1 Adhesive for Vinyl Flooring:

a. Manufacturers:
(1) Stauf USA, LLC; D737 High-Tack: www.staufusa.com/#sle.
(2) TEC, an H.B. Fuller Construction Products Brand; TEC Roll Fast Vinyl Flooring Adhesive: www.tecspecialty.com/#sle.
(3) Armstrong, S-750; armstrongflooring.com.
(4) Substitutions: Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

3.1.2 Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

3.2 PREPARATION

3.2.1 Remove existing resilient flooring and flooring adhesives; follow the recommendations of RFCI (RWP).

3.2.2 Prepare floor substrates as recommended by flooring and adhesive manufacturers.

3.2.3 Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.

3.2.4 Prohibit traffic until filler is fully cured.

3.3 Installation - General

3.3.1 Starting installation constitutes acceptance of sub-floor conditions.

3.3.2 Install in accordance with manufacturer's written instructions.

3.3.3 Adhesive-Applied Installation:

a. Spread only enough adhesive to permit installation of materials before initial set.
b. Fit joints and butt seams tightly.
c. Set flooring in place, press with heavy roller to attain full adhesion.

3.3.4 Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.4 Installation - Tile Flooring

3.4.1 Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

3.5 Installation - Resilient Base

3.5.1 Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

3.5.2 Install base on solid backing. Bond tightly to wall and floor surfaces.

3.6 CLEANING

3.6.1 Remove excess adhesive from floor, base, and wall surfaces without damage.

3.6.2 Clean in accordance with manufacturer's written instructions.

3.7 PROTECTION

3.7.1 Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

SECTION 09 6700 - FLUID-APPLIED FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Fluid-applied flooring, walls, and base.

1.2 REFERENCE STANDARDS

1.2.1 ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair; 2013.

1.3 SUBMITTALS

1.3.1 Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available.

1.3.2 Samples: Submit two samples, 12 by 12 inch in size illustrating color and pattern for each floor material for each color specified.

1.3.3 Manufacturer's Installation Instructions: Indicate special procedures.

1.3.4 Maintenance Data: Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.

1.4 QUALITY ASSURANCE

1.4.1 Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.4.2 Applicator Qualifications: Company specializing in performing the work of this section.
a. Minimum 3 years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Store resin materials in a dry, secure area.

1.5.2 Store materials for three days prior to installation in area of installation to achieve temperature stability.

1.6 FIELD CONDITIONS

1.6.1 Maintain minimum temperature in storage area of 55 degrees F.

1.6.2 Store materials in area of installation for minimum period of 72 hours prior to installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

2.1.1 Fluid-Applied Flooring:
a. Elite Crete Systems: www.elitecrete.com/#sle.
b. Sherwin-Williams Company: General Polymers Brand: www.generalpolymers.com/#sle.
c. Desco Coatings, Inc.; Product: Granite Series.

2.2 FLUID-APPLIED FLOORING SYSTEMS

2.2.1 Fluid-Applied Flooring and walls: Epoxy base coat(s), with broadcast aggregate.
a. Aggregate: Quartz granules.
b. Top Coat: Polyurethane.
c. System Thickness: 1/8 inch, nominal, when dry.
d. Texture: Slip resistant.
e. Sheen: High gloss.
f. Color: As selected by Architect.

2.3 ACCESSORIES

2.3.1 Base Caps: Zinc with projecting base of 1/8 inch; color as selected.

2.3.2 Fillet Strips: Molded of flooring resin material.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive flooring.

3.1.2 Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive flooring.

3.1.3 Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of materials to sub-floor surfaces.

3.1.4 Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

3.2.1 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with sub-floor filler.

3.2.2 Prepare concrete surfaces according to ICRI 310.2R.

3.2.3 Apply, trowel, and float filler to achieve smooth, flat, hard surface. Grind irregularities above the surface level. Prohibit traffic until filler is cured.

3.2.4 Vacuum clean substrate.

3.2.5 Apply primer to surfaces required by flooring manufacturer.

3.3 INSTALLATION - Accessories

3.3.1 Install fillet strips at base of walls where flooring is to be extended up wall as base.

3.3.2 Install terminating cap strip at top of base; attach securely to wall substrate.

3.4 INSTALLATION - FLOORING, WALLS

3.4.1 Apply in accordance with manufacturer's instructions.

3.4.2 Apply each coat to minimum thickness indicated.

3.4.3 Finish to smooth level surface.

3.4.4 Fillet and cove at vertical surfaces and continue vertically up walls where indicated.

3.5 PROTECTION

3.5.1 Prohibit traffic on floor finish for 48 hours after installation.

3.5.2 Barricade area to protect flooring until fully cured.

END OF SECTION

SECTION 09 9123 - INTERIOR PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Surface preparation.

1.1.2 Field application of paints.

1.1.3 Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.

1.1.4 Do Not Paint or Finish the Following Items:
- a. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
- b. Items indicated to receive other finishes.
- c. Items indicated to remain unfinished.
- d. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
- e. Floors, unless specifically indicated.
- f. Glass.
- g. Acoustical materials, unless specifically indicated.
- h. Concealed pipes, ducts, and conduits.

1.2 REFERENCE STANDARDS

1.2.1 MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

1.2.2 SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

1.2.3 SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.3 SUBMITTALS

1.3.1 Product Data: Provide complete list of products to be used, with the following information for each:
- a. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
- b. MPI product number (e.g. MPI #47).
- c. Cross-reference to specified paint system(s) product is to be used on; include description of each system.

1.3.2 Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
- a. Where sheen is specified, submit samples in only that sheen.

1.3.3 Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
- a. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
- b. Label each container with color in addition to the manufacturer's label.

1.4 QUALITY ASSURANCE

1.4.1 Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

1.4.2 Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

1.5.2 Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

1.5.3 Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.6 FIELD CONDITIONS

1.6.1 Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

1.6.2 Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

1.6.3 Do not apply materials when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.

1.6.4 Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.

1.6.5 Provide a minimum lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.1 MANUFACTURERS

2.1.1 Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

2.1.2 Paints:
- a. PPG Paints: www.ppgpaints.com/#sle.
- b. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
- c. Benjamin Moore Paints.

2.1.3 Primer Sealers: Same manufacturer as top coats.

2.2 PAINTS AND FINISHES - GENERAL

2.2.1 Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
- a. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
- b. Supply each paint material in quantity required to complete entire project's work from a single production run.
- c. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

2.3 PAINT SYSTEMS - INTERIOR

2.3.1 Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete masonry units, and hollow metal doors and frames.
- a. Two top coats and one coat primer.
- b. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, or 141.
  - (1) Products:
    - (a) PPG Paints Pitt-Glaze WB1 Pre-Catalyzed Water-Borne Acrylic Epoxy, 16-310 Series, Eggshell.
    - (b) PPG Paints Pitt-Glaze WB1 Pre-Catalyzed Water-Borne Acrylic Epoxy, 16-510 Series, Semi-Gloss.
    - (c) PPG Paints Pitt-Tech Plus WB DTM Industrial Enamel, 90-1210 Series, Semi-Gloss.
    - (d) Sherwin-Williams Pre-Catalyzed Waterbased Epoxy, Eg-Shel. (MPI #139)
    - (e) Sherwin-Williams Pre-Catalyzed Waterbased Epoxy, Semi-Gloss. (MPI #141)
    - (f) Equal Benjamin: Corotech, pre-catalyzed water borne epoxy. V-342, V-341..

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify that surfaces are ready to receive work as instructed by the product manufacturer.

3.1.2 Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

3.1.3 Test shop-applied primer for compatibility with subsequent cover materials.

3.1.4 Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   a. Gypsum Wallboard: 12 percent.
   b. Masonry, Concrete, and Concrete Masonry Units: 12 percent.

3.2 PREPARATION

3.2.1 Clean surfaces thoroughly and correct defects prior to application.

3.2.2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.2.3 Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

3.2.4 Seal surfaces that might cause bleed through or staining of topcoat.

3.2.5 Masonry:
   a. Prepare surface as recommended by top coat manufacturer.

3.2.6 Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

3.2.7 Ferrous Metal:
   a. Solvent clean according to SSPC-SP 1.
   b. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

3.2.8 Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

3.3.1 Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

3.3.2 Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

3.3.3 Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

3.3.4 Apply each coat to achieve a uniform appearance in thicknesses specified by manufacturer.

3.3.5 Sand wood and metal surfaces lightly between coats to achieve required finish.

3.3.6 Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

3.3.7 Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing, after paint has dried.

3.4 CLEANING

3.4.1 Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 PROTECTION

3.5.1 Protect finishes until completion of project.

3.5.2 Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 10 2113.19 - PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Solid plastic toilet compartments.

1.1.2 Urinal screens.

1.2 REFERENCE STANDARDS

1.2.1 NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2015.

1.3 SUBMITTALS

1.3.1 Product Data: Provide data on panel construction, hardware, and accessories.

1.3.2 Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.

1.3.3 Samples: Submit two samples of partition panels, 12 by 12 inch in size illustrating panel finish, color, and sheen.

PART 2 PRODUCTS

2.1 MANUFACTURERS

2.1.1 Solid Plastic Toilet Compartments:
- a. All American Metal Corp - AAMCO: www.allamericanmetal.com/#sle.
- b. Metpar Corp: www.metpar.com/#sle.
- c. Scranton Products (Santana/Comtec/Capital): www.scrantonproducts.com/#sle.

2.2 PLASTIC TOILET COMPARTMENTS

2.2.1 Solid Plastic Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE), tested in accordance with NFPA 286; floor-mounted unbraced.
- a. Doors:
  - (1) Thickness: 1 inch.
  - (2) Width: 24 inch.
  - (3) Width for Handicapped Use: 36 inch, out-swinging.
  - (4) Height: 55 inch.
- b. Panels:
  - (1) Thickness: 1 inch.
  - (2) Height: 55 inch.
- c. Pilasters:
  - (1) Thickness: 1 inch.
  - (2) Width: As required to fit space; minimum 3 inch.

2.3 ACCESSORIES

2.3.1 Pilaster Shoes: Stainless steel, satin finish, 3 inches high; concealing floor fastenings.
- a. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.

2.3.2 Head Rails: Extruded aluminum, anti-grip profile.
- a. Size: Manufacturer's standard size.

2.3.3 Wall and Pilaster Brackets: Stainless steel; continuous type.

2.3.4 Attachments, Screws, and Bolts: Stainless steel, tamper proof type.

2.3.5 Hinges: Stainless steel, manufacturer's standard finish.
- a. Pivot hinges, gravity type, adjustable for door close positioning; two per door.

2.3.6 Door Hardware: Stainless steel, manufacturer's standard finish.
- a. Door Latch: Slide type with exterior emergency access feature.

b. Door Strike and Keeper with Rubber Bumper: Mount on pilaster in alignment with door latch.
c. Provide door pull for outswinging doors.

2.3.7 Coat Hook: One per compartment, mounted on door.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify that field measurements are as indicated on shop drawings.

3.1.2 Verify correct spacing of and between plumbing fixtures.

3.1.3 Verify correct location of built-in framing, anchorage, and bracing.

3.2 INSTALLATION

3.2.1 Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

3.2.2 Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.

3.2.3 Attach panel brackets securely to walls using anchor devices.

3.2.4 Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

3.2.5 Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.3 TOLERANCES

3.3.1 Maximum Variation From True Position: 1/4 inch.

3.3.2 Maximum Variation From Plumb: 1/8 inch.

3.4 ADJUSTING

3.4.1 Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.

3.4.2 Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.

3.4.3 Adjust adjacent components for consistency of line or plane.

END OF SECTION

SECTION 12 2113 - HORIZONTAL LOUVER BLINDS

PART 1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Horizontal slat louver blinds.

1.1.2 Operating hardware.

1.2 REFERENCE STANDARDS

1.2.1 WCMA A100.1 - Safety of Window Covering Products; 2018.

1.3 SUBMITTALS

1.3.1 Product Data: Provide data indicating physical and dimensional characteristics.

1.3.2 Shop Drawings: Indicate opening sizes, tolerances required, method of attachment, clearances, and operation.

1.3.3 Samples: Submit two samples, 12 inch long illustrating slat materials and finish, cord and wand type and color.

1.3.4 Manufacturer's Installation Instructions: Indicate special procedures.

1.3.5 Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
- a. See Section 01 6000 - Product Requirements, for additional provisions.
- b. Extra Blind Assemblies: One of each size.
- c. Extra Slats: 20 of each type and size.
- d. Extra Lift Cords, Control Cords, and Wands: One of each type.

1.4 QUALITY ASSURANCE

1.4.1 Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

2.1.1 Horizontal Louver Blinds:
- a. Hunter Douglas Architectural: www.hunterdouglasarchitectural.com/#sle.
- b. Levolor; Metal Blinds: www.levolor.com/commercial/#sle.
- c. SWFcontract, a division of Spring Window Fashions, LLC: www.swfcontract.com/#sle.

2.2 BLINDS

2.2.1 Description: Horizontal slat louvers hung from full-width headrail with full-width bottom rail.

2.2.2 Manual Operation: Control of raising and lowering by cord with full range locking; blade angle adjustable by control wand.

2.2.3 Metal Slats: Spring tempered pre-finished aluminum; square slat corners, with manufacturing burrs removed.
- a. Width: 1 inch.
- b. Thickness: 0.008 inch.
- c. Color: As selected by Architect.

2.2.4 Slat Support: Woven polypropylene cord, ladder configuration.

2.2.5 Head Rail: Pre-finished, formed aluminum box, with end caps; internally fitted with hardware, pulleys, and bearings for operation; same depth as width of slats.

2.2.6 Bottom Rail: Pre-finished, formed steel; with end caps.
- a. Color: Same as headrail.

2.2.7 Lift Cord: Braided nylon; continuous loop; complying with WCMA A100.1.
- a. Free end weighted.

2.2.8 Control Wand: Extruded hollow plastic; hexagonal shape.
- a. Non-removable type.

b. Length of window opening height less 3 inch.
c. Color: Clear.

2.2.9 Headrail Attachment: Wall brackets.

2.2.10 Accessory Hardware: Type recommended by blind manufacturer.

2.3 FABRICATION

2.3.1 Determine sizes by field measurement.

2.3.2 Fabricate blinds to fit within openings with uniform edge clearance of 1/4 inch.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify that openings are ready to receive the work.

3.2 INSTALLATION

3.2.1 Install blinds in accordance with manufacturer's instructions.

3.2.2 Secure in place with flush countersunk fasteners.

3.3 TOLERANCES

3.3.1 Maximum Variation of Gap at Window Opening Perimeter: 1/4 inch.

3.3.2 Maximum Offset From Level: 1/8 inch.

3.4 ADJUSTING

3.4.1 Adjust blinds for smooth operation.

3.5 CLEANING

3.5.1 Clean blind surfaces just prior to occupancy.

END OF SECTION

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 generally describe these systems, but the scope of the Plumbing work includes all such work indicated in the Contract Documents.

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 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. 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:

ADA	American Disabilities Act
AIA	Guidelines for Design and Construction of Hospital and Healthcare Facilities

AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards 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
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 Manufactures' 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: 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. 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.

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 provide materials with trim which will fit properly the types of ceiling, wall, or floor finishes actually installed.

D. 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.

E. 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 SUBMITTALS

A. Refer to Section 013300, Division 1 and General Conditions for submittal requirements in addition to requirements specified herein.

B. Submittals and shop drawings shall not contain the firm name, logo, seal, or signature of the Engineer. They shall not be copies of the work product of the Engineer. If the Contractor desires to use elements of such product, the license agreement for transfer of information obtained from the Engineer must be used.

C. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples and other submittals required by this Division.

D. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.

E. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.

F. Submittals shall contain the following information:

1. The project name.
2. The applicable specification section and paragraph.
3. Equipment identification acronym as used on the drawings.
4. The submittal date.
5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.

G. Refer to Division 1 for acceptance of electronic submittals for this project.

H. The checking and subsequent acceptance by the Engineer and/or Architect of submittals shall not relieve responsibility from the Contractor for (1) deviations from the Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Architect prior to implementing any deviation.

I. Provide welders' qualification certificates.

1.8 ELECTRONIC DRAWING FILES

A. Refer to Division 01 and General Conditions for use of electronic files. 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 Section 007213, 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 Section 013300, Division 1 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.

B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.

C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.

D. Prior to Substantial Completion of the project, furnish to the Architect, for Engineer's review, and for the Owner's use, Operation and Maintenance Manuals in labeled, hard-back three-ring

binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.

E. Refer to Division 1 for acceptance of electronic manuals for this project.

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 Section 013300, Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.

B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension, from column lines.

C. Contractor shall provide As-builts to the designer as part of their closeout documents. Consultant will be then responsible for providing OA with Record Drawings.

1.13 TRAINING

A. Provide training as indicated in each specific section. Schedule training with the Owner at least 7 days in advance. Video tape the training sessions in format as agreed to with the Owner. Provide three copies of each session to the Owner and obtain written receipt from the Owner.

1.14 PAINTING

A. Exposed ferrous surfaces, including pipe, pipe hangers, equipment stands and supports [and exposed insulated piping] shall be painted by the Plumbing Contractor. 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.

1.15 DELIVERY, STORAGE AND HANDLING

A. Refer to Division 1 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.

B. Equipment and material shall be delivered to the job site in their original containers with labels intact, fully identified with manufacturer's name, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.

C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, to include the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which become rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Architect.

D. The Contractor shall be responsible for the safe storage of his own tools, material and equipment.

1.16 GUARANTEES AND WARRANTIES

A. Refer to Division 1 and General Conditions for Guarantees and Warranties in addition to requirements specified herein.

B. Each system and element thereof shall be warranted against defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in the Construction Documents or manufacturer's

standard warranty. The Contractor shall remedy defects occurring within a period of one year from the date of Substantial Completion or as stated in the General Conditions.

C. The following additional items shall be guaranteed:

1. Piping shall be free from obstructions, holes or breaks of any nature.
2. Insulation shall be effective.
3. Proper circulation of fluid in each piping system.

D. The above guarantees shall include both labor and material; and repairs or replacements shall be made without additional cost to the Owner.

E. The remedial work shall be performed promptly, upon written notice from the Architect or Owner.

F. At the time of Substantial Completion, deliver to the Owner warranties with terms extending beyond the one year guarantee period, each warranty instrument being addressed to the Owner and stating the commencement date and term. Refer to Table 3 at the end of this section for a list of specification sections in Division 22 that contain special warranties.

1.17 TEMPORARY FACILITIES

A. Refer to Division 1 and General Conditions for Temporary Facilities requirements in addition to requirements specified herein.

B. Temporary Utilities: The types of services required include, but are not limited to, water, sewerage, surface drainage and gas. When connecting to existing franchised utilities for required services, comply with service companies' recommendations on materials and methods, or engage service companies to install services. Locate and relocate services (as necessary) to minimize interference with construction operations.

1. Water: Premises are supplied with water services which may be used in this work.
2. Provide the necessary backflow prevention devices where connecting to the potable water system. Protect water service from freezing by draining system or by providing adequate heat. Where non-potable water is used, mark each outlet with health hazard warning signs.
3. Sewer Sediment: Maintain sewers and temporary connecting sewers in a clean, non-clogged condition during construction period.

C. Construction Facilities: Provide facilities reasonably required to perform construction operations properly and adequately.

1. Enclosures: When temporary enclosures are required to ensure adequate workmanship, weather protection and ambient conditions required for the work, provide fire-retardant treated lumber and plywood; provide tarpaulins with UL label and flame spread of 15 or less; provide translucent type (nylon reinforced polyethylene) where daylighting of enclosed space would be beneficial for workmanship, and reduce use of temporary lighting.
2. Heating: Provide heat, as necessary, to protect work, materials and equipment from damage due to dampness and cold. In areas where building is occupied, maintain a temperature not less than 65 degrees Fahrenheit. Use steam, hot water, or gas from piped distribution system where available. Where steam, hot water or piped gas are not available, heat with self-contained LP gas or fuel oil heaters, bearing UL, FM or other approval labels appropriate for application. Vent fuel-burning heaters, and equip units with individual-space thermostatic controls. Use electric-resistance space heaters only where no other, more energy-efficient, type of heater is available and allowable.

1.18 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. 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 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 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.

[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.

3.4 EXCAVATION AND BACKFILLING

A. Refer to Division 01 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. 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.

L. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.

M. 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.

N. 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.

O. 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.

P. 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.

Q. 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.

R. 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.

S. 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.

T. 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 ½" 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.

U. 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.

V. 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. The Contractor shall do necessary cutting of walls, floors, ceilings and roofs.

B. No structural member shall be cut without permission from Architect.

C. Patch around openings to match adjacent construction.

D. After the final waterproofing membrane has been installed, roofs may be cut only with written permission by the Architect.

3.6 CLEANING

A. Dirt and refuse resulting from the performance of the work shall be removed from the premises as required to prevent accumulation. The Plumbing Contractor shall cooperate in maintaining reasonably clean premises at all times.

B. Immediately prior to the final inspection, the Plumbing Contractor shall clean material and equipment installed under the Plumbing Contract. Dirt, dust, plaster, stains, and foreign matter shall be removed from surfaces including components internal to equipment. Damaged finishes shall be touched-up and restored to their original condition.

3.7 SUBSTANTIAL COMPLETION REVIEW

A. Prior to requesting inspection for "CERTIFICATE OF SUBSTANTIAL COMPLETION", the Contractor shall complete the following items:

1. Submit complete Operation and Maintenance Manuals.
2. Submit complete Record Drawings.
3. Start-up testing of systems.
4. Removal of temporary facilities from the site.
5. Comply with requirements for Substantial Completion in the "General Conditions".

B. The Contractor's written request shall state that the Contractor has complied with the requirements for Substantial Completion.

C. Upon receipt of a request for review, the Architect/Engineer will either proceed with the review or advise the Contractor of unfulfilled requirements.

D. If the Contractor requests a site visit for Substantial Completion review prior to completing the above mentioned items, He shall reimburse the Architect/Engineer for time and expenses incurred for the visit.

E. Upon completion of the review, the Architect/Engineer will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.

F. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.

G. Prior to requesting a final review, the Contractor shall submit a copy of the final list of items to be completed or corrected. He shall state in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

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

C. Refer to Division 26, "Enclosed Switches and Circuit Breakers" for specification of disconnect switches.

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 PLUMBING EQUIPMENT

ITEM	FURN BY	SET BY	POWER WIRING	CONTROL WIRING
Equipment motors	DIV 22	DIV 22	DIV 26	---
Factory furnished motor starters, contactors and disconnects	DIV 22	DIV 26	DIV 26	DIV 23
Loose motor starters, disconnect switches, thermal overloads and heaters.	DIV 26	DIV 26	DIV 26	DIV 23
Factory assembled control panels	DIV 22	DIV 26	DIV 26	DIV 23
Manual operating multi-speed switches	DIV 22	DIV 26	DIV 26	DIV 23
Control relays and transformers	DIV 22	DIV 22	DIV 26	DIV 23
Thermostats (low voltage)	DIV 22	DIV 22	---	DIV 23
Thermostats (line voltage)	DIV 22	DIV 22	DIV 26	---
Time switches DIV 22	DIV 22	DIV 26	DIV 23	
Remote pressure switches (booster pumps)	DIV 22	DIV 22	---	DIV 23
Variable speed drives	DIV 22	DIV 22	DIV 26	DIV 23
Motor and solenoid operated valves	DIV 22	DIV 22	DIV 23	DIV 23

DIV 22 = Plumbing Contractor
DIV 23 = Mechanical Contractor
DIV 26 = Electrical Contractor

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. Plumbing equipment nameplate data.
3. Concrete for bases and housekeeping pads.
4. Non-shrink grout for equipment installations.
5. Sleeves for Plumbing penetrations.
6. Miscellaneous metals for support of Plumbing materials and equipment.
7. Wood grounds, nailers, blocking, fasteners, and anchorage for support of Plumbing materials and equipment.
8. Joint sealers for sealing around Plumbing materials and equipment.
9. 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 22 Section "Basic piping Materials and Methods" for materials and methods for mechanical sleeve seals.
2. Division 22 Section “Sanitary Drainage and Vent Piping and Specialties” for indirect drain piping and installation requirements.
3. Division 26 Section “Common Work Results for Electrical” required electrical devices.
4. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.2 SUBMITTALS

A. General: Submit the following in accordance with Division 1 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.
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 1.
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.
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 PLUMBING EQUIPMENT NAMEPLATE DATA

A. For each piece of power operated Plumbing 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.

2.3 CONCRETE EQUIPMENT BASES/HOUSEKEEPING PADS

A. Provide concrete equipment bases and housekeeping pads for various pieces of floor mounted Plumbing equipment. Concrete equipment bases/housekeeping pads shall generally conform to the shape of the piece of equipment it serves with a minimum 4" margin around the equipment and supports.

B. Form concrete equipment bases and housekeeping pads using framing lumber or steel channel with form release agent. Chamfer top edges and corners. Trowel tops and sides of each base/pad to a smooth finish, equal to that of the floors.

C. Concrete equipment bases and housekeeping pads shall be made of a minimum 28 day, 4000 psi concrete conforming to American Concrete Institute Standard Building Code for Reinforced Concrete (ACI 318-99) and the latest applicable recommendations of the ACI standard practice manual. Concrete shall be composed of cement conforming to ASTM C 150 Type I, aggregate conforming to ASTM C33, and potable water. All exposed exterior concrete shall contain 5 to 7 percent air entrainment.

D. Unless otherwise specified or shown on the structural drawings, reinforce equipment bases and housekeeping pads with No. 4 reinforcing bars conforming to ASTM A 615 or 6x6 – W2.9 x W2.9 welded wire mesh conforming to ASTM A185. Reinforcing bars shall be placed 24” on center with a minimum of two bars each direction.

E. Provide galvanized anchor bolts for all equipment placed on concrete equipment bases and housekeeping pads or on concrete slabs. Anchor bolts size, number and placement shall be as recommended by the Manufacturer of the equipment.

F. Concrete equipment bases and housekeeping pads shall have minimum heights in accordance with the following table:

Equipment	Minimum Height
Water Heaters, Water Softeners and Equipment Less than or equal to 20 tons and Other Equipment Not Listed – Note 1	3-1/2”

NOTES:

1. Height of equipment bases applies to equipment installed on slab-on-grade. For equipment installed on floors above grade and/or roof, reference the drawings.

2.4 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.

2.5 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.

2.6 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.

2.7 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 AWPA 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 that 15/32 inches.

2.8 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. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.

2. Sealant Primers for Nonporous Substrates: 250 g/L.

3. [Sealant Primers for Porous Substrates: 775 g/L.

C. Low-Emitting Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Colors: As selected by the Architect from manufacturer's standard colors.

E. 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.

F. 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.

G. Latex Joint Sealant: One-part, nonsag, mildew-resistant, paintable acrylic latex or siliconized acrylic latex, complying with ASTM C 834, Type OP, Grade NF. Provide one of the following:
1. BASF Building Systems; Sonolac.
2. Bostik, Inc.; Chem-Calk 600.
3. May National Associates, Inc.; Bondaflex 600.
4. Pecora Corporation; AC-20+.
5. Schnee-Morehead, Inc.; SM 8200.
6. Tremco Incorporated; Tremflex 834.

2.9 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).

2.10 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: FyreWrap 0.5 Plenum Insulation, ETS Schaefer Plenumshield Blanket, or equivalent utilizing light weight, high temperature blanket enhanced for biosolubility. The encapsulating material shall be aluminum foil with fiberglass reinforcing scrim covering.

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.

2.11 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. Hilti
2. RectorSeal
3. Specified Technologies Inc.,
4. United States Gypsum Company
5. 3M Corp.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install 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. New Construction:

1. Coordinate with Divisions 03 and 04 for installation of sleeves and sleeve seals integrally in cast-in-place, precast, and masonry walls and horizontal slabs where indicated on the Drawings or as required to support piping or ductwork penetrations.

B. 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.

C. 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.

D. 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.

E. The cutting of new or existing construction shall not be permitted except by written approval of the Architect.

F. 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.

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 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.

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 ≤0.25% per Safe Drinking Water Act as amended January 4th 2011 Section 1417.

1.3 SUBMITTALS

A. Refer to Section 013300, 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
8. Flexible Connectors

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. Elster Perfection Corporation.
   b. Grinnell Mechanical Products; Tyco Fire Products LP
   c. 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. Calpico, Inc.
   b. FMC Technologies
   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:
   a. Armstrong Machine Works.
   b. Hoffman Specialty ITT; Fluid Handling Div.
   c. MEPCO
   d. Metraflex Co.
   e. Mueller Steam Specialties.
   f. Nicholson Steam
   g. RP&C Valve, Division of Conbraco Ind.
   h. Spirax Sarco.
   i. Watts Regulator Co.
6. Mechanical Sleeve Seals:
   a. Thunderline/Link Seal
   b. Calpico, Inc.
   c. Metraflex Co.
7. Metal Flexible Connectors:
   a. U.S. Hose, Corp.
   b. Hyspan

c. Mason Industries, Inc.
d. Mercer Rubber Co.
e. Metraflex Co.
f. Proco Products, Inc.
g. Resistoflex
h. Tyler Pipe; Gustin-Bacon Div.

8. Rubber Flexible Connectors:
   a. General Rubber Corp.
   b. Mason Industries, Inc.
   c. Mercer Rubber Co.
   d. Metraflex Co.
   e. Proco Products, Inc.
   f. Uniflex, Inc.
9. 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. 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.

F. Y-Type Strainers: Provide strainers full line size of connecting piping, with ends matching piping system materials. Screens for 4” and smaller shall be Type 304 stainless steel mesh with 0.062” perforations and screens for 5” and larger shall be Type 304 stainless steel, with 0.125" perforations.

1. 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.
2. Solder Ends, 2” and Smaller: Lead free cast bronze body meeting ASTM B584, screwed screen retainer with centered blowdown fitted with pipe plug.
3. [Threaded Ends, 2” and Smaller: Cast bronze body, screwed screen retainer with centered blowdown fitted with pipe plug.]
4. [Threaded Ends, 2" and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.]
5. [Threaded Ends, 2-1/2" and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.]
6. Flanged Ends, 2-1/2" and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.

G. Sleeves:

1. Sleeve: Refer to Division 22 Section “Common Work Results for Plumbing” for sleeve materials.

H. 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.

I. Flexible Connectors: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections.

1. Stainless-Steel-Hose, Flexible Connectors: For 2” and smaller, corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include ANSI 150# 304 stainless-steel nipples with screwed connections, welded to hose.
2. Bronze Hose, Flexible Connectors: For 2” and smaller, corrugated bronze inner tubing covered with bronze wire braid. Include ANSI 150# brass nipples with screwed connections, braised to hose.
3. Stainless-Steel-Hose, Flexible Connectors: For 2-1/2” and larger, corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include ANSI 150# 304 stainless-steel nipples or flanges, welded to hose.

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.

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. 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.

C. Underground, Exterior-Wall Penetrations: Install cast-iron wall pipes for sleeves. Size sleeves to allow for 1-inch or larger, if required by the mechanical sleeve 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. Inspect installed sleeve and sleeve-seal installations for damage and faulty work. Verify watertight integrity of sleeves and seals installed below grade to seal against hydrostatic pressure.

D. 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.

E. 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.

F. 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.

G. Interior Penetrations of Non-Fire-Rated Walls: Seal annular space between sleeve and pipe or duct, 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.

H. Exterior Wall Penetrations: Seal annular space between sleeve and pipe or duct, 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. 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. 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.

J. 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 flanges at the final connection to each piece of equipment, adjacent to each isolation valve or valve assembly in piping 2-1/2" and larger. Install flanges at each valve 2-1/2” and larger.

G. Install dielectric unions for piping 2” and smaller or dielectric flanges for piping 2-1/2” and larger 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.

H. Install dielectric unions for piping 2” and smaller or dielectric flanges for piping 2-1/2” and larger 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.

I. Install dielectric waterway fittings for piping 2” and smaller for copper or brass pipe connections to carbon steel equipment connections.

J. Install dielectric flanges for piping 2-1/2” and larger for copper or brass pipe connections to carbon steel equipment connections, steel, ductile iron or cast iron valves and fittings.

K. 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.
2. Pipe Larger Than 2":
a. Weld pipe joints (except for exterior water service pipe) in accordance with ASME Code for Pressure Piping, B31.
b. Weld pipe joints of exterior water service pipe in accordance with AWWA C206.
c. Install flanges on all valves, apparatus, and equipment. Weld pipe flanges to pipe ends in accordance with ASME B31.9 Code for Building Services Piping. Clean flange faces and install gaskets. Tighten bolts to torque specified by manufacturer of flange and flange bolts, to provide uniform compression of gaskets.

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 FLEXIBLE CONNECTORS

A. Install flexible connectors for piping system connections on equipment side of shutoff valves for all Plumbing equipment, pumps, and where indicated on Drawings.
1. Install stainless steel connectors for domestic water copper equipment connections 2” and smaller.
2. Install bronze connectors for non-domestic water copper equipment connections 2” and smaller.
3. Install flanged stainless steel connectors for flanged equipment connections 2-1/2” and larger.

B. Install connectors according to manufacturer’s recommendations.

3.9 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

SECTION 220519 - METERS AND GAUGES FOR PLUMBING PIPING

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes the following types of meters and gauges:

1. Temperature gauges and fittings.

1.2 SUBMITTALS

A. General: Submit the following in accordance with Section 013300 and Division 1 Specification Sections.

1. Product data for each type of meter and gauge. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit meter and gauge schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gauge.
2. Product certificates signed by manufacturers of meters and gauges certifying accuracy under specified operating conditions and products' compliance with specified requirements.
3. Maintenance data for each type of meter and gauge for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 22 Section "General Plumbing Requirements."

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Glass Tube Industrial Thermometers:
   a. H. O. Trerice Co.
   b. Marshalltown Instruments, Inc.
   c. Miljoco Corporation
   d. Weiss Instruments, Inc.
   e. Weksler Instruments Corp.
   f. Winters Instruments
2. Bimetal Dial Thermometers:
   a. Ashcroft Dresser Industries Instrument Div.
   b. Ernst Gage Co.
   c. H. O. Trerice Co.
   d. Marshalltown Instruments, Inc.
   e. Miljoco Corporation
   f. Tel-Tru Manufacturing Co., Inc.
   g. Weiss Instruments, Inc.
   h. Weksler Instruments Corp.
   i. Winters Instruments
3. Thermometer Wells: Same as for thermometers.

2.2 THERMOMETERS, GENERAL

A. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

B. Scale range: Temperature ranges for services listed as follows:

1. Domestic Hot Water: 30 to 240 deg with 2-degree scale divisions (0 to 115 deg C with 1-degree scale divisions).

2.3 GLASS TUBE INDUSTRIAL THERMOMETERS

A. Case: Die cast, aluminum finished, in baked epoxy enamel, glass front, spring secured, 9 inches long.

B. Adjustable Joint: Finished to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.

C. Tube: Non-red color reading, non-toxic organic spirit-filled glass tube, magnifying lens.

D. Scale: Satin-faced, nonreflective aluminum, with permanently etched markings.

E. Stem: Copper-plated steel, aluminum or brass, for separable socket, length to suit installation.

2.4 BIMETAL DIAL THERMOMETERS

A. Type: Direct mounted, bimetal, universal angle.

B. Case: Stainless steel, glass lens, 5-inch diameter.

C. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.

D. Element: Bimetal coil.

E. Scale: Satin faced, nonreflective aluminum, permanently etched marking.

F. Stem: Stainless steel for separable socket, length to suit installation.

2.5 THERMOMETER WELLS

A. Thermometer Wells: Brass or stainless steel, pressure rated to match piping system design pressure; with 2-inch extension for insulated piping and threaded cap nut with chain permanently fastened to well and cap.

PART 3 - EXECUTION

3.1 THERMOMETERS INSTALLATION

A. Install in the following locations and elsewhere as indicated:

1. At outlet of each domestic water heater.

B. Thermometer Wells: Install in piping tee where thermometers are indicated, in vertical position. Fill well with oil or graphite and secure cap.

END OF SECTION 220519

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 mechanical 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 ≤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 Section 013300 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 evidence third party 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 various MSS Standard Practices referenced.

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. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.

G. 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, 2-1/2-Inch and Larger: MSS SP-70; Class 125, 200-psi CWP, iron body, bronze mounted, with body and bonnet conforming to ASTM A 126 Class B; with flanged ends, " non-asbestos composition packing, and two-piece packing gland assembly.

B. Lead Free 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. Lead Free 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 chrome-plated lead free brass ball, with replaceable "Teflon" or "TFE" seats and seals, solder ends and vinyl-covered steel handle.

B. Cast Iron Body Ball Valves, 2-1/2” and larger: 200 CWP, maximum operating temperature of 140F; two piece cast iron body meeting ASTM A126 Class B with flanged ends, 304 stainless steel full port ball and shaft, ductile iron handle, PTFE gasket, stem seal and seat.

2.5 GLOBE VALVES

A. Globe Valves, 2-1/2-Inch and Larger: MSS SP-85; Class 125, 200-psi CWP; iron body and bolted bonnet conforming to ASTM A 126, Class B; with outside screw and yoke, bronze mounted, flanged ends, and non-asbestos composition packing, and two-piece backing gland assembly.

B. Lead Free Globe Valves, 2-Inch and Smaller: Meeting MSS SP-80; Class 125, 300-psi CWP; body, disc and screwed bonnet of ASTM B 584 lead free cast bronze; brass replaceable composition disc and stem of ASTM B 283 alloy C46400 naval brass, brass packing gland, with solder ends, non-asbestos composition packing, and malleable iron handwheel.

2.6 CHECK VALVES

A. Lead Free 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. Swing Check Valves, 2-1/2-Inch and Larger: MSS SP-71; Class 125 200-psi CWP, cast iron body and bolted cap conforming to ASTM A 126, Class B; with horizontal swing, bronze disc with bronze disc face ring, and bronze seat ring; and flanged ends. Provide valves capable of being refitted 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 valves in horizontal piping with stem at or above the center of the pipe.

E. Install valves in a position to allow full stem movement.

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.
2. Copper Tube Sizes 2-1/2 Inch and Larger: flanged end.

3.3 VALVE PRESSURE/TEMPERATURE CLASSIFICATION SCHEDULES

A. VALVES, 2-INCH AND SMALLER

SERVICE	GATE	GLOBE	BALL	CHECK
Domestic Hot and Cold Water	125	125	150	125

B. VALVES, 2-1/2-INCH AND LARGER

SERVICE	GATE	GLOBE	BUTTERFLY	CHECK	BALL
Dom. Hot & Cold Water	125	125	200	125	200

3.4 VALVE SCHEDULE

A. Gate Valves - 2-1/2 Inch and Larger:

MANUFACTURER	OS&Y RS	NRS
Apollo	611F	610F
Hammond	IR1140	IR1138
Milwaukee	F2885	F-2882
Nibco	F617-O	F-619

B. Lead Free Gate Valves - 2 Inch and Smaller, Class 125:

MANUFACTURER	SOLDER NRS
Apollo	102S-LF
Hammond	UP-668
Milwaukee	UP668
NIBCO	S-113-LF

C. Iron Body Ball Valves – 2-1/2” and larger, Class 125: Full Port:

MANUFACTURER	FLANGED ENDS
Apollo (Conbraco)	6P
Watts	G4000-FDA

D. Lead Free Ball Valves – 2 inch and smaller

MANUFACTURER	SOLDER ENDS
Apollo-(Conbraco)	70-LF-200
Hammond	UP8511
Milwaukee	UPBA-150
NIBCO	N/A

E. Lead Free Ball Valves (full port) – 2 inch and smaller

MANUFACTURER	SOLDER ENDS	THREADED ENDS
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

F. Lead Free Ball Valves (full port – SS Ball) – 2 inch and smaller

MANUFACTURER	SOLDER ENDS	THREADED ENDS
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

G. Globe Valves - 2-1/2 Inch and Larger:

MANUFACTURER	STRAIGHT BODY	ANGLE BODY
Apollo	711F	x
Bray	CG-J	x
Hammond	IR116	IR118
Milwaukee	F2981	F2986
Nibco	F-718-B	F-818-B

1. x means not available.

H. Lead Free Globe Valves – 2 inch and smaller, Class 125:

MANUFACTURER	SOLDER ENDS
Apollo	121S-LF
Hammond	UP-418
Milwaukee	UP1502

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: Class 125, NSF 61 Annex G lead free cast bronze or cast-iron body to suit piping system.
2. Ball Valves, 2” And Smaller: Class 150, 600-psi CWP, with stem extension, NSF 61 Annex G lead free cast bronze.
3. Ball Valves, 2-1/2” and larger: 200-psi CWP cast iron body.
4. Globe Valves: Class 125, NSF 61 Annex G lead free cast bronze or cast-iron body to suit piping system, and bronze or teflon disc.
5. Bronze Swing Check: Class 125, NSF 61 Annex Glead free cast bronze, with rubber seat.
6. Check Valves: Class 125, swing or wafer type as indicated.

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 REQUIREMENTS

1.1 SUMMARY

A. This Section includes the following:

1. Horizontal-piping hangers and supports.
2. Vertical-piping clamps.
3. Saddles and Shields.
4. Hanger-rod attachments.
5. Building attachments.
6. Spring hangers and supports.
7. Equipment supports.
1. Pre-engineered roof supports
2. Miscellaneous materials.

B. 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.
4. Division 22 “Storm Drainage & Piping and Specialties”, for pipe hanger types and spacing for horizontal and vertical storm drainage piping of sizes and materials indicated.

1.2 DEFINITIONS

A. Terminology used in this Section is defined in MSS SP-90.

1.3 SUBMITTALS

A. General: Submit the following in accordance with conditions of Section 013300 and Division 01 specification Sections.

1. Product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support.
2. Product certificates signed by the manufacturer of hangers and supports certifying that their products meet the specified requirements.
3. Welder certificates signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" Article.
4. Assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.
5. Maintenance data for supports and anchors for inclusion in Operating and Maintenance Manual specified in Division 01 and Division 22 Section "General Plumbing Requirements."
6. Submit style and type of anchors to Architect or Structural Engineer for approval prior to installation.

1.4 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. Qualify welding processes and welding operators in accordance with ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

C. Regulatory Requirements: Comply with applicable plumbing codes pertaining to product materials and installation of supports and anchors.

D. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Hangers, supports, and components shall be listed and labeled by a NRTL where used for fire protection piping systems. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. Hangers and Supports

1. Armacell.
2. Anvil International.
3. B-Line.
4. Elite Components
5. Halfen-DEHA.
6. Hilti.
7. ERICO\Michigan Hanger Co..
8. FNW
9. Midwest.
10. National Pipe Hanger Corporation.
11. Power-Strut.
12. Truscon.
13. Unistrut.

B. Pre-Insulated Supports:

1. Calcium Silicate Shield Supports:
   a. Cooper B-Line, Inc.
   b. Buckaroos, Inc.
2. Pre-Engineered Thermal Hanger Inserts:
   a. Armacell “Armafix”.
   b. Cooper B-Line, Inc.

C. Pre-Engineered Roof Pipe Supports:

1. Airtec.
2. B-Line.
3. ERICO.
4. FNW
5. MIRO.
6. Roof Top Blox.

2.2 SUPPORT MATERIALS

A. Hangers and support 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 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 indicated.

2.3 SADDLES AND SHIELDS

A. Pipe Covering Protection Saddles:

1. Sheet metal construction, meeting MSS SP-58 Type 39A or B, 100-psi average compressive strength, with center rib for pipes 12” and larger. Saddles shall cover approximately one sixth of the circumference of the pipe and shall be 12” long.

B. Pre-Insulated Supports:

1. Calcium Silicate Shield Supports:

a. Waterproofed calcium silicate conforming to ASTM C795 encased with an insulation protection shield.

2. Pre-Engineered Thermal Hanger Inserts:

a. Flexible elastomeric insulation conforming to ASTM C534, Type I with integral high density pipe support.

C. Insulation Protection Shield:

1. Sheet metal construction, meeting MSS SP-69 & 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. 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.

a. Length: Minimum 8 inch long section at each support joint.

b. 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) 5	6	7	8	9	10
	0.5	5	6	8	-	-	-
	1	3	5	5	-	-	-
≤ 1	1.5	3	5	5	-	-	-
	2	3	3	3	-	-	-
	3	3	3	3	-	-	-
	0.5	8	8	11	11	12	14
	1	5	6	8	9	11	11
≤ 2	1.5	5	6	8	8	9	9
	2	5	5	6	6	8	8
	3	5	5	6	6	6	8

2. 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.

D. Hangers with pre-manufactured polymer inserts:

1. Strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts designed to receive butted insulation internally may be used in lieu of other insulated pipe support systems. 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. Note: Metal shields are not required with clevis hangers of this type. Approved manufacturers include:

a. Klo-Shure.

b. Anvil.

c. Holdrite.

2.4 PRE-ENGINEERED SUPPORT STRUT SYSTEMS

A. Support strut systems shall comply with MSS SP-69, Type 59. Shop- or field-fabricated pipe-support assembly shall be made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts. Minimum 14 gauge galvanized steel with factory-

punched attachment holes. Two piece straps shall be captivated at the shoulder when attachment nut is tightened and designed for use with strut system. Long or short pipe rollers designed for use with strut system, where indicated, shall attach to the channel with brackets and nuts. Provide plastic galvanic isolators for connecting bare copper pipe for use with pre-engineered support strut system where indicated. All nuts, brackets and clamps shall have the same finish as the channels.

2.5 PRE-ENGINEERED ROOF PIPE SUPPORTS

A. Nominal 4” X 4” X 12” long closed cell polyethylene blocks with embedded pre-engineered support strut or pre-engineered support struts with factory plastic bases. Two piece straps shall be captivated at the shoulder when attachment nut is tightened and designed for use with strut system. All nuts, brackets and clamps shall have the same finish as the channels.

2.6 MISCELLANEOUS MATERIALS

A. Steel Plates, Shapes, and Bars: Conforming to ASTM A 36.

B. 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 INSTALLATION, GENERAL

A. Install hangers and supports in accordance with manufacturer’s installation instructions.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

A. Install hangers, supports, clamps and attachments to support piping properly from building structure.

B. Do not attach to ceilings, equipment, ductwork, conduit and other non-structural elements such as floor and roof decking.

C. 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 Section 220700 for definition of hot and cold piping and required insulation thickness.

D. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible. Install supports with maximum spacing complying with MSS SP-69. Where piping of various sizes is supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.

E. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through openings at top of inserts.

F. 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.

G. Field-Fabricated, Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS D-1.1.

H. Support fire protection systems piping independently from other piping systems.

I. Install 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.

J. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

K. 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.

L. Insulated Piping: Comply with the following installation requirements.

1. Riser Clamps: Attach riser clamps, including spacers (if any), to piping with riser clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9. 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”.

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.

3. Insulation Protection Shield: Install insulation protection shield and high density insulation where vapor barrier is indicated, sized for the insulation thickness used as specified in Division 22 Section “Plumbing Insulation”.

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 as specified in Division 22 Section “Hangers and Supports for Plumbing Piping and Equipment.”

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 inch and larger.

5. Contractor’s Option: Provide strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts.

M. Pre-Engineered Roof Pipe Supports: Set supports on an 18” X 18” x 3/16” thick roof walkway material compatible with the roof material.

3.3 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.

B. Anchor to building substrate.

3.4 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. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions to control movement to compensators.

D. Anchor 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.

3.5 EQUIPMENT SUPPORTS

A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.

B. Grouting: Place grout under supports for piping and equipment.

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 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. 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.

1. [Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

C. Touch-Up Painting: Cleaning and touch-up painting of field welds, bolted connections, and abraded areas of the shop paint on miscellaneous metal is specified in Division 9 Section "Painting".

D. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

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. Valve Tags
5. Valve Schedule Frames
6. Engraved Plastic-Laminate Signs
7. Plastic Equipment Markers
8. 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.

B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

C. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 1.

D. Maintenance Data: Include product data and schedules in Maintenance Manuals as specified in Division 1 and Section “General Plumbing Requirements.”

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. Allen Systems, Inc.
2. Brady (W.H.) Co.; Signmark Div.
3. Industrial Safety Supply Co., Inc.
4. Seton Name Plate Corp.

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. 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.

F. 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.

G. 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 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.

2.7 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.

2.8 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.

2.9 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.

2.10 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.

2.11 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).

2.12 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. Insulated and non-insulated storm water piping.
5. Natural gas 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 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.

3.4 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. Water heaters, tanks and pressure vessels.

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 SUMMARY

A. Extent of Plumbing insulation required by this Section is indicated on drawings and schedules, and by requirements of this Section.

B. Types of Plumbing insulation specified in this Section include the following:

1. Piping Systems Insulation:

a. Fiberglass

b. Flexible Elastomeric

1.2 QUALITY ASSURANCE

A. 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 E 84 (NFPA 255) method.

1. Exception: Outdoor Plumbing insulation may have flame spread index of 75 and smoke developed index of 150.

2. Exception: Industrial Plumbing insulation that will not affect life safety egress of building may have flame spread index of 75 and smoke developed index of 150.

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 22 Section "Hangers and Supports for Plumbing Piping," for insulation shields for protecting insulation vapor barrier and materials and methods for piping installations.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of Plumbing insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each Plumbing system requiring insulation.

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.

PART 2 - PRODUCTS AND MATERIALS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. Aeroflex USA, Inc.

2. Armacell LLC.

3. CertainTeed Corp.

4. Knauf Insulation

5. Johns Manville

6. K-Flex USA

7. Owens Corning

2.2 PIPING INSULATION MATERIALS

A. Fiberglass Piping Insulation: ASTM C 547, Class 1 unless otherwise indicated.

B. Flexible Elastomeric Piping Insulation: ASTM C534, Type I.

C. Jackets for Piping Insulation: ASTM C1136, Type I for piping with temperatures below ambient, Type II for piping with temperatures above ambient. Type I may be used for all piping at Installers option.

1. PVC: One-piece, pre-molded PVC cover conforming to ASTM D1784, Johns Manville Zeston 2000 PVC or approved equivalent. Factory supplied, pre-cut insulation blanket inserts for use with PVC fitting covers are acceptable.

D. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.

E. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

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.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

3.2 PLUMBING PIPING SYSTEM INSULATION

A. Insulation Omitted: Omit insulation on the following:

1. Chrome-plated exposed piping
2. Water Hammer Arrestors
3. Balancing and flow valves
4. Drain lines from water coolers
5. Drainage piping located in crawl spaces or tunnels
6. Exterior condensate drain piping
7. Buried piping
8. Pre-insulated equipment.
9. Cold water piping
10. Condensate piping

B. Cold Piping:

1. Application Requirements: Insulate the following cold plumbing piping systems:
   a. Potable cold water piping.
   b. Non-potable cold water piping
   c. Plumbing vents within 6 lineal feet of roof outlet.
   d. Condensate piping inside the building.
   e. Auxiliary Condensate Piping.
   f. Trap arms, waste branches and stacks serving condensate drains.
2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
   a. Fiberglass: 1" thickness.
   b. Flexible Elastomeric: 1" thickness

C. Hot Piping:

1. Application Requirements: Insulate the following hot plumbing piping systems:
   a. Potable hot water piping.
   b. Potable hot water recirculation piping.
2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:

a. Fiberglass: 1-1/2" thick for pipe sizes up to and including 1-1/4", 2" thick for pipe sizes 1-1/2" and larger.]

3. Insulate hot water piping systems up to 140F specified above with one of the following types and thicknesses of insulation:

a. Fiberglass: 1" thick for pipe sizes up to and including 3/4", 1-1/2" thick for pipe sizes 1" and larger.

4. [Insulate hot water piping systems greater than 140F specified above with one of the following types and thicknesses of insulation:

D. P-traps:

1. Insulate P-traps receiving chilled water waste and P-traps of water coolers as described below:

a. Flexible Elastomeric: 1/2" thick for pipe sizes up to and including 2", 1” 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.

E. 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” to 6” (largest size permitted).

3.3 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. Provide high density insulation material under supports or pre-insulated supports for cold piping. Protect insulation with shields to prevent puncture or other damage. Refer to Division 22 Section “Hangers and Supports for Plumbing Piping” for pre-insulated supports and insulation shields.

1. Insulation material shall extend a minimum 2 inches past the pipe shield on each side.

G. Provide pipe hangers for hot piping sized for the outside diameter of piping. Butt insulation to hanger or riser clamp for vertical pipe. Butt pipe insulation tightly at insulation joints. For hot pipes, apply 3" wide vapor barrier tape or band over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3" wide vapor barrier tape or band.

H. 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.

I. 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.

J. 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.

K. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

3.4 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.

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. 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 ≤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. Maintenance data for each piping specialty and valve specified for inclusion in Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."
5. Test reports specified in Part 3 of this Section.
6. 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. Wall, yard and roof hydrants

c. Backflow preventers isolating irrigation or mechanical make-up systems
d. Emergency mixing valves
e. 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. Flow Design, Inc., Autoflow Div
   b. Victaulic Company
   c. Calefi
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. Nibco, Inc.
   d. Prier, Inc.
   e. Watts Regulator Co.
   f. Woodford Mfg. Co.
5. Backflow Preventers:
   a. Cla-Val Co.
   b. Conbraco Industries, Inc.

c. Febco
d. Hersey Products, Inc.
e. Watts Regulator Co.
f. Zurn Industries Inc. Wilkins Regulator Div.

6. Relief Valves:
   a. Cash (A. W.) Valve Mfg. Corp.
   b. Conbraco Industries, Inc.
   c. Watts Regulator Co.
   d. Zurn Industries, Inc. Wilkins Regulator Div.
7. Piston Type Water Hammer Arresters:
   a. Amtrol, Inc.
   b. Josam Co.
   c. Precision Plumbing Products, Inc.
   d. PROFLO
   e. Sioux Chief Manufacturing Co.
   f. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
   g. Watts Regulator Co.
   h. Zurn Industries, Inc. Wilkins Regulator Div.
8. Point of Use Thermostatic Mixing Valves
   a. Acorn Engineering Co.
   b. Cash Acme
   c. Leonard Valve Co.
   d. Powers Process Controls
9. Master Thermostatic Mixing Valves
   a. Acorn Engineering Co.
   b. Bradley
   c. Lawler Manufacturing Co., Inc.
   d. Leonard Valve Co.
   e. Powers Process Controls
   f. Symmons industries, Inc.
10. Trap Primers and Distribution Units
    a. Precision Plumbing Products, Inc.
    b. MIFAB
    c. PROFLO
    d. Sioux Chief
11. Plumbing Pipe Support Brackets
    a. Holdrite
    b. PROFLO
    c. Sioux Chief
    d.

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. Steel Pipe: ASTM A53, Type E or S, schedule 40, Grade B, galvanized, threaded ends.

E. Ductile-Iron Pipe: AWWA C151 or AWWA C115 ductile-iron pipe, with AWWA C104 cement-mortar lining.

F. PVC Plastic Service Pipe: AWWA C900, Class 100 Polyvinyl Chloride (PVC) water pipe, with belled-end fittings.

G. 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. Galvanized Malleable Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern, for threaded joints. Threads shall conform to ASME B1.20.1.

C. Ductile-Iron Gasketed Fittings: AWWA C110 or AWWA C153, 150 psi rating, with cement mortar lining and AWWA C111 rubber gaskets.

D. Brass Fittings: Chrome plated ANSI B16, Class 125 with threaded connections.

E. Cast-Iron Threaded Flanges: ANSI B16.1, Class 125, raised ground face, bolt holes spot faced.

F. Bronze Flanges: ANSI B16.24, Class 150, raised ground face, bolt holes spot faced.

G. PVC to Ductile Iron Adapter Flanges: EBBA Iron, Inc. Series 2000PV or approved equivalent.

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 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, renewable composition disc, tee handle, 1/2- or 3/4-inch solder inlet, hose outlet.

C. 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.

D. Hose Bibbs: Bronze body with chrome- or nickel-plated finish, with renewable composition disc, integral vacuum breaker, wheel handle, 1/2- or 3/4-inch solder inlet, hose outlet.

E. Backflow Preventers: Comply with requirements of ASSE Standard 1013 and as specified on the drawings.

F. Pressure Reducing Valves: Comply with requirements of ASSE Standard 1003 and as specified on the drawings.

G. 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.

H. 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.

I. Bellows Type Water Hammer Arresters: Bellows type, with 304 stainless steel casing construction, threaded pipe connection, precharged upper chamber, sealed in stainless steel diaphragm, maximum working pressure of 150 psi, maximum shock pressure of 300 psi, tested and certified in accordance with PDI Standard WH-201.

1. Point of Use Thermostatic Mixing Valves:Lead free bronze or brass body meeting ASTM B584 with non-corrosive parts, tamper resistant temperature adjustment, checks, stops, other components as scheduled and meeting ASSE 1070. Valve shall be designed to fail to the cold side of the system. Maximum pressure drop shall not be exceeded for the scheduled flow rate.

J. Master Thermostatic Mixing Valves:

1. Lead free bronze body meeting ASTM B584 with non-corrosive parts, tamper resistant temperature adjustment, checks, stops, other components as scheduled and meeting ASSE 1017. Maximum pressure drop shall not be exceeded for the scheduled flow rate.

K. 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.

L. Pipe Support Brackets:

1. Sheet Stud Bracket: 20 gauge copper with nominal copper tube holes of ½” on 2” centers and holes of ¾” 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.

PART 3 - EXECUTION

3.1 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 galvanized steel pipe with threaded joints and fittings for 10 inches and larger, within the building.

C. Install chrome plated brass pipe and fittings for exposed water piping within the building where indicated on the drawings.

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 building, for pipe 3" and larger.

3.5 Install AWWA C900 PVC service pipe with belled-end joints from 5'-0" outside the building.

3.6 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 though 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. 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 "Basic Piping Materials and Methods" for special sealers and materials.

L. Install piping with 1/32-inch-per-foot (1/4 percent) downward slope towards drain point.

1. Install piping level with no pitch.

3.7 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 “Mechanical 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. Provide 304 stainless steel dual rods, nuts, washers, pre-engineered support struts and split two piece pipe clamps for supporting elbows on their back, tees on their back or side under slab as detailed on the drawings. Connect rods with rebar tie wires to reinforcing bars in top layer of slab.
9. 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.
10. 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.
11. Secure copper tubes for flush valve wall mounted water closets to the chair carrier with carrier brackets.

C. Install hangers for horizontal piping with the following maximum spacing and minimum rod sizes:

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	3/8
2-1/2	11	9	1/2
3	12	10	1/2
3-1/2	13	11	1/2
4	14	12	5/8 (1/2 for copper)
5	16	13	5/8 (1/2 for copper)
6	17	14	3/4 (5/8 for copper)
8	19	16	7/8 (3/4 for copper)
10	22	18	7/8 (3/4 for copper)
12	23	19	7/8 (3/4 for copper)

1. Support vertical steel pipe at each floor.
2. Support vertical copper tube at each floor and in intervals not to exceed 10 feet.
3. Support plastic pipe and tubing in accordance with manufacturer's recommendations.

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.

3.8 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".

3.9 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.

B. Throttling duty: Use globe, ball, and butterfly valves.

3.10 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 gate or 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 gate or 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. Wall Hydrants: Install where indicated with vacuum breaker.

G. Master Mixing Valves: Install on a sheet of plywood extending 6" beyond the physical boundary of the mixing valve and firmly attach backboard to the wall. Connect hot water return piping per the manufacturer's published recommendations. Set temperature as scheduled on the drawings.

H. 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 facuet."

3.11 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.

3.12 TRAP PRIMERS

A. Install trap primers where indicated and where required by local authorities having jurisdiction.

B. Connect trap primer supply line to the top of domestic cold water line no larger than 1 ½" in diameter.

C. Provide trap primer distribution units for trap primers serving more than one trap.

D. Install trap primer distribution level to insure even water distribution unit to each circuit.

E. Where applicable, adjust the trap primer for proper flow.

F. Install trap primers a minimum of 12 inches above finished floor for every 20 feet of horizontal outlet piping to floor drains served.

G. Install trap primers in an accessible location.

H. Refer to Division 22 Section "Sanitary Drainage and Vent Piping and Specialties" for trap primer outlet pipe requirements.

3.13 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.

3.14 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.

3.15 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.

3.16 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.

3.17 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.
3. Remove and clean strainers.
4. Check pumps for proper direction of rotation. Correct improper wiring.
5. Lubricate pump motors and bearings.

END OF SECTION 221100

SECTION 221123 - DOMESTIC WATER PUMPS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes the following types of plumbing pumps:

1. Cartridge type inline circulators

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 22 Section “Coordination” for basic requirements for electrical components that are an integral part of packaged system components.
2. Division 22 Section, “Basic Piping Materials and Methods” for rubber flexible connectors.
3. Division 26 Section “Common Work Results for Electrical” required electrical devices.
4. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.2 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. Product data including standard performance curves, weights (shipping, installed, and operating), furnished specialties, and accessories, plus installation and start-up instructions.
2. Shop drawings showing layout and connections for plumbing pumps. Include setting drawings with templates, and directions for installation of foundation bolts, anchor bolts, and other anchorages.
3. Wiring diagrams detailing wiring for power, signal, and control systems; differentiating between manufacturer-installed wiring and field-installed wiring.
4. Maintenance data for plumbing pumps, for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 22 Section "General Plumbing Requirements."
5. Submit certification that pumps, valves, fittings and specialties comply with NSF 61 Annex G.

1.3 QUALITY ASSURANCE

A. Hydraulic Institute Compliance: Design, manufacture, and install plumbing pumps in accordance with "Hydraulic Institute Standards."

B. National Electrical Code Compliance: Components shall comply with NFPA 70 "National Electrical Code."

C. UL Compliance: Plumbing pumps shall be listed and labeled by UL and comply UL Standard 778 "Motor Operated Water Pumps."

D. UL Compliance: Control panels shall be listed and labeled by UL and comply with Standard 508A “Control Panels”.

E. NEMA Compliance: Electric motors and components shall be listed and labeled NEMA.

F. Single-Source Responsibility: Obtain plumbing pumps of the same type from a single manufacturer.

G. Design Criteria: The Drawings indicate sizes, profiles, connections, and dimensional requirements of plumbing pumps and are based on the specific manufacturer types and models indicated. Pumps having equal performance characteristics by other manufacturers may be considered, provided that deviations in dimensions and profiles do not change the design concept or intended performance as judged by the Architect. The burden of proof for equality of plumbing pumps is on the proposer.

H. Comply with NSF 61 Annex G (pending) for wetted surfaces of valves, fittings and specialties containing no more than 0.25% lead by weight compliance for valves for domestic water service.

I. Valves, pumps and fittings shall be manufactured in plants located in the United States or certified that they comply with applicable ANSI, ASTM and MSS standards.

1.4 SPARE PARTS

A. Furnish spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Mechanical Seals: One mechanical seal for each pump.

1.5 WARRANTY

A. Warranty on Pumps: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, pumps with inadequate or defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement includes both parts and labor for removal and reinstallation.

1. Warranty Period: One year from date of substantial completion.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following:

1. Cartridge Type Inline Circulators:

a. Armstrong Pumps, Inc.

b. Bell & Gossett, ITT.

c. Grundfos Pumps, Corp.

d. Taco, Inc.

2. Aquastats:

a. Dayton

b. Honeywell

c. Penn

d. White-Rodgers

2.2 PUMPS, GENERAL

A. Pumps and circulators: factory assembled and factory tested.

B. Preparation for shipping: After assembly and testing, clean flanges and exposed machined metal surfaces and treat with an anticorrosion compound. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

C. Motors: Conform to NEMA standards; single, multiple, or variable speed with type of enclosure and electrical characteristics as indicated; have built-in thermal-overload protection and grease-lubricated ball bearings. Select motors that are non-overloading within the full range of the pump performance curve.

D. Apply factory finish paint to assembled, tested units prior to shipping.

2.3 CARTRIDGE TYPE CIRCULATOR PUMPS

A. General Description: Leakproof, inline, seamless, volute-type pump. Pump and motor shall be assembled on a common shaft in a single hermetically sealed unit, without stuffing boxes or mechanical seals. Accomplish sleeve bearings lubrication by circulating pumped liquid through the motor section. Isolate motor section from the motor stator windings with a thin corrosion-resistant, nonmagnetic, alloy liner. Pumps shall be rated for 125 psig working pressure and 225 deg F continuous water temperature.

B. Casings: Cast lead free bronze, with stainless steel liner and static O-ring seal to separate motor section from motor stator, and with union piping connections.

C. Impeller: Overhung, single-suction, closed or open nonmetallic impeller.

D. Pump Shaft and Sleeve: Stainless steel shaft with carbon steel bearing sleeve.

E. Motors: 1750 RPM one piece sealed type.

2.4 AQUASTATS:

A. Remote sensing bulb type, non-modulating, single pole double pole throw with surface mount sensing bulb and mounting bracket, adjustable direct reading scale for set point with adjustable differential.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install pumps in accordance with manufacturer’s installation instructions.

B. General: Comply with the manufacturer's written installation and alignment instructions.

C. Install pumps in locations and arrange to provide access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.

D. Support pumps and piping separately so that the weight of the piping system does not rest on the pump.

E. Suspend inline pumps with all thread hanger rod and vibration isolation hangers of sufficient size to support the weight of the pump independent from the piping system.

3.2 EXAMINATION

A. Examine areas, equipment foundations, and conditions with Installer present, for compliance with requirements for installation and other conditions affecting performance of plumbing pumps. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine rough-in for plumbing piping systems to verify actual locations of piping connections prior to installation.

3.3 ALIGNMENT

A. Align pump and motor shafts and piping connections after setting on foundations, after grout has been set and foundations bolts have been tightened, and after piping connections have been made.

1. Adjust alignment of pump and motor shafts for angular and parallel alignment by one of the two methods specified in the Hydraulic Institute "Centrifugal Pumps - Instructions for Installation, Operation and Maintenance."

B. After alignment is correct, tighten the foundation bolts evenly but not too firmly. Fill the base plate completely with nonshrink, nonmetallic grout, with metal blocks and shims or wedges in place. After grout has cured, fully tighten foundation bolts.

1. Alignment tolerances shall meet manufacturers recommendations.

3.4 CONNECTIONS

A. General: Install valves that are same size as the piping connecting the pump.

B. Install suction and discharge pipe sizes equal to or greater than the diameter of the pump nozzles.

C. Install a non-slam check valve and shutoff valve on the discharge side of pumps.

D. Install a gate valve and strainer on the suction side of inline pumps.

E. Install pressure gauges on the suction and discharge of each pump at the integral pressure gauge tappings provided.

F. Install pressure gauge connector plugs in suction and discharge piping around pump.

G. Install surface mounted aquastat on bare metal pipe, fastened securely to pipe upstream of circulator pump when indicated on the drawings.

H. Interlock aquastat and or timer with hot water recirculation pump motor. Electrical wiring and connections are specified in Division 26 section “Common Work Results for Electrical”.

I. Electrical wiring and connections are specified in Division 26 section “Common Work Results for Electrical”.

3.5 FIELD QUALITY CONTROL

A. Check suction lines connections for tightness to avoid drawing air into the pump.

3.6 STARTUP

A. Final Checks Before Start-Up: Perform the following preventative maintenance operations and checks before start-up:

1. Lubricate oil-lubricated bearings.
2. Remove grease-lubricated bearing covers and flush the bearings with kerosene and thoroughly clean. Fill with new lubricant in accordance with the manufacturer's recommendations.
3. Disconnect coupling and check motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.
4. Check that pump is free to rotate by hand. For pumps handling hot liquids, pump shall be free to rotate with the pump hot and cold. If the pump is bound or even drags slightly, do not operate the pump until the cause of the trouble is determined and corrected.

B. Starting procedure for pumps with shutoff power not exceeding the safe motor power:

1. Prime the pump, opening the suction valve, closing the drains, and prepare the pump for operation.
2. Open the valve in the cooling water supply to the bearings where applicable.
3. Open the sealing liquid supply valve if the pump is so fitted.
4. Open the warm-up valve of a pump handling hot liquids if the pump is not normally kept at operating temperature.
5. Open the recirculating line valve if the pump should not be operated against dead shutoff.
6. Start motor.
7. Open the discharge valve slowly.
8. Observe the leakage from the stuffing boxes and adjust the sealing liquid valve for proper flow to ensure the lubrication of the packing. Do not tighten the gland immediately, but let the packing run in before reducing the leakage through the stuffing boxes.
9. Check the general mechanical operation of the pump and motor.
10. Close the recirculating line valve once there is sufficient flow through the pump to prevent overheating.

C. If the pump is to be started against a closed check valve with the discharge gate valve open, the steps are the same except that the discharge gate valve is opened some time before the motor is started.

D. Start Up Services for Booster Pump:

1. Certification: Prepare certificates for factory compliance of the installation and completion of factory training signed by the factory-authorized service representative and turn over to the Architect upon completion of the project.

END OF SECTION 221123

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 22 Section "Identification for Plumbing Piping," for labeling and identification of drainage and vent piping.
3. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations, wall and floor penetrations and equipment pads
4. Division 22 Section "Basic Piping Material and Methods," for materials and methods for mechanical sleeve seals.
5. Division 22 Section "Hangers and Supports for Plumbing Piping," for materials and methods for hanging and supporting drainage and vent piping.
6. Division 22 Section "Plumbing Insulation," for materials and methods for insulating drainage piping.
7. 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 Section 013300 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. Regulatory Requirements: Comply with the provisions of the following codes:

1. 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. Josam Mfg. Co.
   b. Sioux Chief Manufacturing Co. Inc.
   c. Jay R. Smith Mfg. Co.
   d. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
   e. Watts Industries, Inc.
   f. Zurn Industries, Inc.; Hydromechanics Div.
2. Non-Metallic Trench Drains:
   a. ABT, Inc., Polydrain
   b. Dura TrenchJay R. Smith Mfg. Co.
   c. MEA-JOSAM
   d. NDS
   e. Sioux Chief Manufacturing Co. Inc.
   f. Zurn Industries, Inc.
3. Heavy Duty Hubless Couplings
   a. Anaco Husky HD-2000
   b. Clamp-All 80in. lb.
   c. Ideal Tridon “HD”
   d. ProFlo “HD”
   e. Mission Rubber Company, “Heavy Weight”
4. Cast Iron Soil Pipe and Fittings
   a. AB & I Foundry
   b. Charlotte Pipe and Foundry Company
   c. Tyler Pipe / Soil Pipe Division
5. Shielded Transition Couplings
   a. FERNCO, “Proflex 3000 Series”
   b. Mission Rubber Company, “Band Seal Specialty Couplings”
6. Underground Shielded Adapter Couplings
   a. FERNCO, “1056 Series with SR73 Shear Ring”
   b. Mission Rubber Company, “MR56 Series”
7. Trap Seals
   a. Jay R. Smith Mfg. Co.
   b. MIFAB
   c. Proset Systems “Trap Guard”
   d. Sure Seal, Inc.
   e. Zurn Industries, Inc.; Hydromechanics Div.
8. Hubless Couplings:
   a. Anaco
   b. Ideal Tridon
   c. Mission Rubber Company

d. ProFlo “PFNH”

e. Tyler Pipe / Soil Pipe Division

9. No-Hub Fitting Restraints

a. Holdrite

10. PVC DWV Expansion Joints

a. Charlotte Pipe and Foundry Company #133

b. Spears Manufacturing Company #S119

11. Heavy Duty Hubless Couplings for Below Slab

a. Anaco Husky HD-4000

b. Clamp-All 125in. lb.

2.2 ABOVE GROUND DRAINAGE AND VENT PIPE AND FITTINGS

A. 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.

2. Heavy duty couplings and compression gaskets: ASTM C1540 and meeting FM 1680.

B. 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.

C. 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.

D. 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.

a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Pressure Pipe and Fittings: Schedule 80 pipe meeting ASTM D1785 with “solid wall” PVC meeting ASTM D1784 with cell class 12454.

1. Solvent: ASTM D2564.

2. Fittings: Schedule 80 meeting ASTM D2467 with solvent cement socket joints.

a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Steel Pipe: ASTM A53, Type E or S, schedule 40, Grade B, galvanized, threaded ends.

1. Galvanized Malleable Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, for threaded joints. Threads shall conform to ASME B1.20.1.

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. 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 CIPSI and NSF.

1. Neoprene Compression Gaskets: ASTM C564.

B. 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.

a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. PVC Pressure Pipe and Fittings: Schedule 80 pipe meeting ASTM D1785 with “solid wall” PVC meeting ASTM D1784 with cell class 12454.

1. Solvent: ASTM D2564.

2. Fittings: Schedule 80 meeting ASTM D2467 with solvent cement socket joints.

a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. 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. Backwater Valves: Valve assembly shall be bronze fitted cast-iron, with bolted cover. Flapper shall provide a maximum 1/4 inch clearance between flapper and seat for air circulation. Valve ends shall suit piping material.

B. Expansion Joints: Cast-iron body with adjustable bronze sleeve, bronze bolts with wing nuts.

C. Cleanout Plugs: As specified on the drawings.

D. Floor Cleanouts: As specified on the drawings.

E. Wall Cleanouts: As specified on the drawings.

F. Floor Drains: As specified on the drawings.

G. Cast-iron Trench Drains: As specified on the drawings.

H. 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.

I. 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.

J. 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 ¾” 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. Install galvanized schedule 40 steel pipe and malleable iron fittings with ¾” minimum size for condensate connections from mechanical equipment inside the building and terminate over floor receptors with air gap.

E. Install Type M copper tube with wrought copper fittings with solder joints, 1” and smaller, with ¾” 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 condensate connections from mechanical equipment inside the building and terminate over floor receptors with air gap. Provide galvanic isolators as specified in Division 22 “Basic Piping Materials and Methods”.

F. Install PVC pipe with PVC fittings, 1” and smaller, with ¾” minimum size and install PVC Type DWV pipe with PVC Type DWV fittings for 1-1/4” and larger for condensate connections from mechanical equipment inside the building and terminate over floor receptors with air gap, except no plastic pipe shall be installed in return air plenums.

G. Install galvanized schedule 40 steel pipe and malleable iron fittings with ¾” minimum size for condensate connections from mechanical equipment outside the building and terminate over roof receptors with air gap at roof drains as indicated on the plans.

H. Install Type M copper tube with wrought copper fittings with solder joints, 1” and smaller, with ¾” 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 condensate connections from mechanical equipment outside the building and terminate over roof receptors with air gap at roof drains as indicated on the plans. Provide galvanic isolators as specified in Division 22 “Basic Piping Material and Methods”.

I. Install PVC pipe with PVC fittings, 1” and smaller, with ¾” minimum size and install PVC Type DWV pipe with PVC Type DWV fittings for 1-1/4” and larger for condensate connections from mechanical equipment outside the building and terminate <u>over roof receptors with air gap at roof drains</u> as indicated on the plans.

J. Install 1” schedule 40 fire-retardant polyvinylidene fluoride (PVDF) process pipe with fusion joints for condensate connections for high efficiency roof top units located in return air plenum ceilings.

K. Install PVC pressure pipe and fittings for sump pump discharge, except install no plastic pipe in return air plenums.

L. Install galvanized schedule 40 steel pipe and malleable iron fittings for sump pump discharge pipe.

M. Install type ”L” copper tube with wrought copper fittings with solder joints for sump pump discharge pipe.

N. Install ½” 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. Install PVC pressure pipe and fittings for sump pump discharge.

C. Install type ”K” soft copper tube with wrought copper fittings with solder joints for sump pump discharge pipe, 2” and smaller.

D. Install ½” 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 and 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

C. Install heavy duty hubless couplings for below slab on hubless soil, waste and vent piping ping below floor.

D. PVC DWV Pipe: Joining and installation of PVC drainage pipe and fittings shall conform to ASTM D2665.

E. 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.

F. Cast Iron to PVC Above Grade: Join cast iron to PVC with shielded transition couplings.

G. Cast Iron to PVC Below Grade: Join cast iron to PVC with underground shielded adapter 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-base 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. 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.

Q. Install 1 inch thick extruded polystyrene over underground building drain piping not under building. Width of insulation shall extend minimum of 12" beyond each side of pipe. Install directly over, and center on pipe center line.

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.

C. Install hangers at the following intervals and provide rods of diameter as listed below:

Nom. Pipe Size In Inches	Steel Pipe Max. Span In Feet	Copper Tube Max. Span. In Feet	Min. Rod Dia. - Inches Steel or Cast Iron	Min. Rod Dia. – Inches Copper or PVC
Up to 3/4	7	5	3/8	3/8
1	7	6	3/8	3/8
1-1/4	7	7	3/8	3/8
1-1/2	9	8	3/8	3/8
2	10	8	3/8	3/8
2-1/2	11	9	1/2	3/8
3	12	10	1/2	1/2
3-1/2	13	11	1/2	1/2
4	14	12	5/8	1/2
5	16	13	5/8	1/2
6	17	14	3/4	5/8
8	19	16	7/8	3/4
10	22	18	7/8	3/4
12	23	19	7/8	3/4

1. Support all sizes of service weight 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 sway brace on horizontal piping at not more than 40’ intervals to prevent horizontal movement. 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 all sizes of vertical of PVC piping every floor, but not to exceed fifteen feet.
5. Support piping within 12” of each elbow or tee.
6. Support each P-trap.

D. Support condensate piping located on roof with pre-engineered roof supports, pre-engineered roof supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping”. Conform to the table above for maximum spacing of supports. Adjust pipe support to maintain minimum pipe slope.

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 at minimum intervals of 50' for piping 4" and smaller and 75' for larger piping.

1. 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, FLOOR SINKS AND FLOOR TROUGHS

A. Install floor drains, floor sinks and floor troughs in locations indicated.

B. Install floor 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:

DEPRESSION IN INCHES	RADIUS OF AREA DRAINED - FEET
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, floor sinks and floor troughs 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 ½” 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 223400 - FUEL FIRED DOMESTIC WATER HEATERS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes commercial gas fired and oil fired water heaters.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 22 Section “Common Work Results for Plumbing” for concrete equipment pads.
2. Division 22 Section "Basic Piping Materials and Methods" for flexible metal braid connectors, pipe joining materials, specialties, unions, dielectric unions, dielectric flanges, dielectric flange kits and basic installation requirements.
3. Division 22 Section "Meters and Gauges for Plumbing Piping." for thermometers and their installation requirements.
4. Division 22 Section “Natural Gas Systems” for natural gas equipment connections.
5. Division 26 Section “Common Work Results for Electrical” required electrical devices.
6. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.2 SUBMITTALS

A. General: Submit the following in accordance with Section 013300 and Division 1 Specification Sections.

1. Product data including rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties, and accessories, and indicating dimensions, required clearances, and methods of assembly of components, and piping and wiring connections.
2. Wiring diagrams from manufacturers detailing electrical requirements for electrical power supply wiring to water heaters. Include ladder-type wiring diagrams for interlock and control wiring required for final installation of water heaters and controls. Differentiate between portions of wiring that are factory installed and portions that are to be field installed.
3. Certificates of shop inspection and data report as required by provisions of the ASME Boiler and Pressure Vessel Code.
4. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."

1.3 QUALITY ASSURANCE

A. UL Standards: Provide water heaters complying with the following:

1. UL 732, "Oil Fired Water Heaters."
2. UL 778, "Motor Operated Water Pumps."

B. NSF Standards: Provide water heaters complying with NSF No. 5, "Standard for Hot Water Generating Equipment for Food Service Establishments using Spray Type Dishwashing Machines," and bearing NSF label.

C. Electrical Component Standard: Provide components complying with NFPA 70 "National Electrical Code."

D. Listing and Labeling: Provide water heaters 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.

E. AGA Standards: Provide water heaters that bear the label of the American Gas Association.

F. ASME Code Compliance: Provide water heaters and safety relief valves that comply with ASME Boiler and Pressure Vessel Code and that bear the appropriate code symbols.

G. State Boiler Code Compliance: Provide rated water heaters, safety relief valve, gas train and accessories that comply with the state boiler code in effect.

H. ASHRAE Standards: Provide water heaters with performance efficiencies not less than prescribed in ASHRAE 90.1b, "Energy Conservation in New Building Design."

I. Design Concept: The drawings indicate types and capacities of water heaters and are based on specific descriptions and manufacturers indicated. Water heaters having equal performance characteristics by other manufacturers may be considered provided that deviations in capacities, dimensions, operation, 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 water heaters is on the proposer.

1.4 WARRANTY

A. Special Project Warranty: Submit a written warranty, executed by manufacturer, agreeing to repair or replace water heater units that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, controls, tanks, coils, heat exchangers, and burners. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the Contract Documents.

1. Commercial, Gas Fired, Storage Water Heaters:
   a. Storage Tank: Three years.
   b. Controls and Other Components: One year.
2. Instantaneous Gas Fired Water Heaters
   a. Heat Exchanger: Five years.
   b. Controls and Other Components: Five years.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Commercial Atmospheric Gas Fired Water Heaters:
   a. Bradford-White Corp.
   b. Lochinvar Water Heater Corp.
   c. PVI Industries, Inc.
   d. Rheem Mfg.
   e. Ruud Mfg. Div.; Rheem Mfg.
   f. A.O. Smith Water Products Co. Div.; A.O. Smith Corp.
   g. State Industries, Inc.
2. Commercial Gas-Fired Instantaneous Water Heaters:
   a. Noritz
   b. NAVIEN
   c. Rinnai
3. Thermal Expansion Tanks
   a. Armstrong Pumps, Inc.
   b. Amtrol, Inc.
   c. Bell & Gosset, ITT
   d. Elbi
   e. TACO, Inc.
   a. Watts
   b. Wessels Tank Co.

4. Pressure Relief Valves
    a. Apollo #16LF-202
    b. Cash ACME #FW
    c. Watts #LF53
    d. Wilkins #P1520XL
5. Vacuum Relief Valves
    a. Apollo #37
    b. Cash ACME #VR-801
    c. Watts #N36
    d. Wilkins #VR-10
6. Water Heater Drain Pans
    a. Holdrite
    b. Killarney Metals
    c. Oatey

2.2 ATMOSPHERIC GAS FIRED WATER HEATERS

A. Description: Automatic, commercial, gas-fired; with vertical, gas burner, integral controls, draft diverter, drain valve, gas regulator, and relief valve.
    1. Fuel: Natural gas.
    2. Fuel: Liquified petroleum (LP) gas.

B. Insulation: Fiberglass, surrounding tank.

C. Jacket: Steel, with baked-on enamel finish.

D. Tank: Glass-lined steel, with anode rods and drain valve.

E. Safety Controls: Automatic gas shutoff device to shut off entire gas supply in event of excessive temperature in tank.

F. Controls: Adjustable surface mounted thermostat, intermittent electronic ignition and flue damper control.

G. Temperature and Pressure Relief Valve: Lead free brass body meeting ANSI Z21.22.

2.3 COMMERCIAL GAS-FIRED INSTANTANEOUS WATER HEATERS:

A. Description: Packaged, wall-mounted, gas-fired, 160-psig rated, 3/8” copper tube and fin heat exchanger; with integral controls, sealed combustion chamber, modulating gas burner with fan assisted combustion, exhaust fan, automatic flow control valve configured to modulate to maintain set point temperature, gas train including gas regulator. Provide with factory vertical or horizontal combustion air cap and exhaust flue cap as specified.

B. Controls: Separate adjustable temperature control panel with digital input and output configured to support single or multiple heaters. Provide with factory wiring kit for interlock with single or multiple heaters.

C. Safety Controls: Automatic gas shutoff device to shut off entire gas supply in event of excessive temperature, low water cutout, low gas pressure, and low air pressure.

D. Water Heater Pressure Relief Valve: ASME rated and labeled three way combination de-liming valve with ¾” hose cap. Provide with three way combination de-liming inlet valve with ¾” hose cap.

E. Vent and Intake Piping: Factory condensate tee, vent and intake kits for sidewall or vertical venting as scheduled on the drawings.

F. Condensate Neutralization Kits: PVC body with socket weld inlets and outlets, minimum ¾”. Capacity to match heater input.

2.4 THERMAL EXPANSION TANKS

A. ASME Thermal Expansion Tanks: Provide size and number as indicated; construct of welded carbon steel ASME labeled for 150 psig working pressure, 200 deg F maximum operating temperature. Separate air charge from system water to maintain design expansion capacity, by

means of a FDA approved butyl rubber diaphragm securely sealed into tank. Provide taps for pressure gauge and air charging fitting and drain fitting. Support vertical tanks with steel legs or base. Tank, with taps and supports, shall be constructed, tested, and labeled in accordance with ASME Pressure Vessel Code, Section VIII, Division 1.

B. Thermal Expansion Tanks: Provide size and number as indicated; construct of welded carbon steel listed for 150 psig working pressure, 200 deg F maximum operating temperature. Separate air charge from system water to maintain design expansion capacity, by means of a FDA approved butyl rubber diaphragm securely sealed into tank. Provide taps for pressure gauge and air charging fitting and drain fitting. Support vertical tanks with steel legs or base.

2.5 VACUUM RELIEF VALVES

A. Lead free brass body meeting ANSI Z21.22 with silicon disc. Valve shall open at 0.5 inches HG vacuum and be rated for 200 psig working pressure and 250 F operating temperature.

2.6 PRESSURE RELIEF VALVES

A. Pressure Relief Valve: ½" lead free brass body meeting ANSI Z21.22 with screwed ends, stainless steel spring and factory set to relieve at 100 psig

2.7 WATER HEATER DRAIN PANS

A. Galvanized steel or aluminum with outside diameter minimum 2" greater than water heater diameter, with 3/4" screwed drain outlet.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

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

B. General: Install water heaters on concrete equipment bases. Set and connect units in accordance with manufacturer's installation–instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances. Orient so controls and devices needing servicing are accessible.

C. Install thermometers on water heater outlet piping. Thermometers are specified in Division 22 Section "Meters and Gauges for Plumbing Piping."

D. NFPA Compliance: Install gas-fired water heaters in compliance with NFPA 54, "National Fuel Gas Code."

E. NFPA Compliance: Install oil-fired water heaters in compliance with NFPA 31, "Installation of Oil Burning Equipment."

F. Install temperature and pressure relief valve furnished with water heater. The temperature shall be normally set to relieve at 210F and the pressure relief shall be equal to the tank pressure rating. Install line size relief valve discharge line to discharge to an approved receptor with air gap.

G. Vacuum Relief Valve: Install in cold water supply to each water heater downstream of the shutoff and check valves.

H. Water Heater Drain Pan: Install under water heater on wall or ceiling supports or resting on elevated floor slabs. Install drain pan drain line to discharge to an approved receptor with air gap.

I. Install pressure relief valve on cold water supply to water heater downstream of shutoff and check valves. The pressure relief shall be factory set to 100 psig. Install line size relief valve discharge line to discharge to an approved receptor with air gap.

J. Install condensate neutralization kit furnished with water heater condensate drain downstream of trap at condensate connection. Fill kit with water heater manufacturer recommended neutralization media.

3.2 CONCRETE EQUIPMENT BASES

A. Construct concrete equipment bases in accordance with Section "Basic Mechanical Materials and Methods" for setting of equipment.

3.3 EXPANSION TANK INSTALLATION

A. Support expansion tank from structure. Do not hang expansion tank from piping.

B. Charge expansion tank bladder with air to a pressure equal to the domestic water static pressure.

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 adjacent to equipment arranged to allow servicing and maintenance.

2. Connect hot and cold water piping to units with shutoff valves and unions. Connect hot water circulating piping to unit with shutoff valve, check valve, and union. Extend relief valve discharge to closest floor drain.

a. Where water heater piping connections are dissimilar metals, install dielectric waterway fittings or dielectric unions for joints 2” and smaller and dielectric flanges for joints 2-1/2” and larger. Dielectric waterway fittings, unions and flanges are specified in Division 22 Section "Basic Piping Materials and Methods."

b. Install vacuum relief valve in cold water inlet piping.

3. Connect gas supply piping to burner with drip leg, tee, gas cock, and union; minimum size same as inlet connection. Arrange piping to allow unit servicing. Gas piping is specified in Division 22 Section “Natural Gas Piping”.

a. Install vent piping from gas train pressure regulators and valves to outside the building. Terminate vent piping with brass screened vent cap fitting. Do not combine vents except with approval of local authority.

b. Install gas pressure regulators where indicated.

4. Install drain as indirect waste to spill into open drain or over floor drain.

a. Install drain valve at low point in water piping, for water heaters not having tank drain.

B. Electrical Connections:

1. Power wiring is specified in Division 26 Section “Common Work Results for Electrical”

2. Field-installed disconnects are specified in Division 26 Sections "Enclosed Switches and Circuit Breakers".

3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

C. Vent Connections for Instantaneous Gas Fired Water Heaters:

1. Connect gas-fired water heater vent outlet to the vent system with factory furnished vent and intake kits per the manufacturer’s published installation instructions. Unless otherwise indicated provide vent same size as outlet on heater. Comply with gas utility requirements.

2. Provide ¾” PVC indirect drain from condensate indirect drain connection furnished with water heater. Provide ¾” PVC P-trap with minimum 1” trap seal and route indirect drain to nearest floor drain, discharge to floor drain with air gap.

3. Install condensate neutralization kit furnished with water heater on floor adjacent to water heater in an accessible location.

3.5 FIELD QUALITY CONTROL

A. General: Provide the services of a factory-authorized service representative to test and inspect unit installation, provide start-up service, and demonstrate operation of equipment as specified below.

1. Test and adjust operating and safety controls. Replace damaged and malfunctioning controls and equipment.

3.6 STARTUP

A. Perform the following before start-up final checks:

1. Fill water heaters with water.

2. Piping systems test complete.

3. Check for piping connections leaks.
4. Check for adequate combustion air.
5. Check for clear vent.
6. Test operation of safety controls and devices.

B. Perform the following start-up procedures:
1. Energize circuits.
2. Adjust operating controls.
3. Adjust hot water outlet temperature setting.

3.7 TRAINING

A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of two four eight hours on the operation and maintenance of the equipment provided under this section.

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.
3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."

C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner’s designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner’s representative indicating agreement that the training has been provided.

D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

3.8 FACTORY START-UP FOR INSTANTANEOUS GAS FIRED WATER HEATERS

A. Provide factory start-up of water heating system installation by a trained factory representative.

B. Provide the architect with a certificate of a properly installed and functioning water heating system.

END OF SECTION 223400

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 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-supplied 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.

Examples of accessory below are toilet seats, grab bars, and soap dishes.

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 ≤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 Section 013300 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. Wiring diagrams for field-installed wiring of electrically operated units.

3. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."

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 ANSI Standard A117.1, "Buildings and Facilities -- Providing Accessibility and Usability for Physically Handicapped People," Public Law 90-480, "Architectural Barriers Act, 1968," with respect to plumbing fixtures for the physically handicapped and "Americans with Disabilities Act Accessibility Guidelines for Buildings 1991" with respect to plumbing fixtures for the physically handicapped.

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.

I. Waterless Urinal Sealant & Cartridges: Furnish quantity of sealant and manufacturer approved cleaner per waterless urinal not less than amount for one year of operation per the manufacturer's recommended maintenance schedule. For cartridge type waterless urinals, furnish quantity of cartridges per waterless urinal not less than the amount for one year of operation per manufacturer's recommended maintenance schedule.

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. Eljer; A Household International Co.
   c. Gerber Plumbing Fixture Corp.
   d. Kohler Co.
   e. Sloan Valve Co.
   f. TOTO KIKI USA, Inc.
   g. Zurn Plumbing Products Group
2. Urinals:
   a. American Standard, Inc.
   b. Eljer; A Household International Co.
   c. Gerber Plumbing Fixture Corp.
   d. Kohler Co.
   e. Sloan Valve Co.
   f. TOTO KIKI USA, Inc.
   g. Zurn Plumbing Products Group
3. Lavatories:
   a. [Acorn Engineering Co.]
   b. American Standard, Inc.
   c. Eljer; A Household International Co.
   d. Gerber Plumbing Fixture Corp.
   e. Kohler Co.
   f. Sloan Valve Co.
   g. TOTO KIKI USA, Inc.

h. Zurn Plumbing Products Group

4. Sinks:
   a. American Standard, Inc.
   b. Elkay Manufacturing Co.
   c. Just Manufacturing Co.
   d. Kohler Co.
   e. Moen Group; Stanadyne Corp.
5. Water Coolers:
   a. Acorn / Aqua
   b. Elkay Manufacturing Co.
   c. Filtrine Manufacturing Co.
   d. Halsey Taylor; A Household International Co.
   e. Haws Drinking Faucet Co.
6. 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.
7. Flushometers – Diaphragm Type:
   a. Coyne & Delany Co.
   b. Sloan Valve Co.
   c. Zurn Industries, Inc.; Flush Valve Operations.
8. 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.
9. Commercial/Industrial Cast-Brass Faucets:
   a. American Standard, Inc.
   b. Chicago Faucet Co.
   c. Delta-Commercial
   d. Kohler Co.
   e. Speakman Co.
   f. T & S Brass and Bronze Works, Inc.
   g. Zurn Industries, LTD. “Aqua Spec”
10. Commercial/Residential Cast-Brass and Cast-Brass Underbody Faucets:
    a. American Standard, Inc.
    b. Delta Faucet Co.; Div. of Masco Corp.
    c. Elkay Manufacturing Co.
    d. Grohe America, Inc.
    e. Kohler Co.
    f. Moen Group; Stanadyne Corp.

g. Symmons Industries, Inc.

11. Residential/Light Commercial Nonmetal Underbody Faucets:
    a. Gerber Plumbing Fixtures Corp.
    b. Moen Group; Stanadyne Corp.
    c. PROFLO
    d. Sterling Plumbing Group, Inc.
12. Thermostatic Mixing Valve Bath/Shower Faucets:
    a. Bradley Corp.
    b. Grohe America, Inc.
    c. Lawler Manufacturing Co., Inc.
    d. Leonard Valve Co.
    e. Powers Process Controls; A Unit of Mark Controls Corp.
    f. Symmons Industries, Inc.
    g. T & S Brass and Bronze Works, Inc.
13. Low Flow Shower Heads
    a. EcoTech Water LLC
    b. Niagra Conservation Corp.
    c. Zurn Plumbing Products Group
14. Sensor-Operated Faucets and Devices:
    a. Acorn Engineering Co.
    b. Sloan Valve Co.
    c. Speakman Co.
    d. Toto Kikki, USA
    e. Zurn Industries, LTD. “Aqua Spec”
15. 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. PROFLO
    g. T & S Brass and Bronze Works, Inc.
    h. Watts Brass and Tubular
    i. Zurn Industries
16. P-traps, Drains & Miscellaneous Fittings:
    a. Brass Craft Subsidiary; Masco Co.
    b. Dearborn Brass
    c. Engineered Brass Company
    d. McGuire Manufacturing Co., Inc.
    e. PROFLO
    f. Watts Brass and Tubular
    g. Zurn Industries
17. 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.

18. Water Filters:
    a. Aqua-Pure.
    b. Cuno.
    c. EBCO Manufacturing Co.
    d. Elkay.
    e. Filterite Div.; Memtec America Corp.
    f. Filtrine Manufacturing Co.
    g. Halsey Taylor; A Household International Co.
    h. Haws Drinking Faucet Co.
    i. Lawler Manufacturing Co., Inc.
    j. Sunroc Corp.
19. Insulation Kits
    a. Brocar
    b. McGuire
    c. Plumberex
    d. PROFLO
    e. Trap-Wrap
    f. 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.
    1. Electronic faucets shall be of the same manufacturer as the water closet and urinal flush valves.

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 MISCELLLANEOUS 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 electric water coolers and drinking fountains.
   d. Wall-hanging fixtures supported from wall construction.
2. Chair carriers for the following fixtures:
   a. Wall-hanging urinals.
   b. Wall-hanging lavatories and sinks.
   c. Wall-hanging drinking fountains and electric water coolers.

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 floor-mounted, floor-outlet water closets with closet flanges and gasket seals.

C. Install floor-mounted, back-outlet water closets with fittings and gasket seals.

D. Install wall-hanging, back-outlet water closets with support manufacturer's tiling frame or setting gauge.

E. Install wall-hanging, back-outlet urinals with gasket seals.

F. 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.

G. Fasten floor-mounted fixtures and special fixtures having holes for securing fixture to wall construction, to reinforcement built into walls.

H. Fasten wall-mounted fittings to reinforcement built into walls.

I. Fasten counter-mounting-type plumbing fixtures to casework.

J. Secure supplies behind wall or within wall pipe space, providing rigid installation.

K. Install stop valve in an accessible location in each water supply to each fixture.

L. Install trap on fixture outlet except for fixtures having integral trap.

M. 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.

N. 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.

O. 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. Operate and adjust disposers, hot water dispensers, and controls. Replace damaged and malfunctioning units and controls.

C. Adjust water pressure at drinking fountains, electric water coolers, and faucets, shower valves, and flushometers having controls, to provide proper flow and stream.

D. Replace washers of leaking and dripping faucets and stops.

E. Clean fixtures, fittings, and spout and drain strainers with manufacturers' recommended cleaning methods and materials.

F. Adjust faucet wrist blade handles perpendicular to the spout while in the closed position.

G. Review the data in Operating and Maintenance Manuals. Refer to Division 1 Section "Project Closeout."

H. Set each shower valve temperature limit stop to 110ºF. Perform work after the shower head is installed and the domestic water heater is in operation. Allow the hot water to run for 5 minutes minimum or until temperature reaches equilibrium. Allow cold to run for 5 minutes minimum or until temperature reaches equilibrium. Provide the architect a report and schedule indicating the hot, cold and mixed maximum water temperature at each shower.

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
Water Cooler or Drinking Fountain	
Standard Height	41" floor to spout
ADA Accessible	36" floor to spout
Child height	30" floor to spout
Shower Valves	
Standard Height	48” men and 42” women floor to centerline
ADA Accessible	38” minimum to 48” maximum floor to centerline
Shower heads	
Standard Height	6’-6” men, 6’-0” women floor to centerline

END OF SECTION 224000

SECTION 227000 - NATURAL GAS SYSTEMS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes distribution piping systems for natural gas, liquid petroleum-gas and manufactured gas within the building and extending from the point of delivery to the connections with gas utilization devices. Piping materials and equipment specified in this Section include:

1. Pipes, fittings, and specialties.
2. Special duty valves.
3. Pressure regulators.
4. Service meters.

B. Contractors Option:

1. The Division 22 contractor may provide mechanically joined joints for natural gas systems to connect couplings, fittings, valves and related components as an option in lieu of, in whole or in part, welded, threaded or flanged piping methods. Mechanically joined natural gas systems where used shall be provided in compliance with specification Section 227000 “Natural Gas Systems”.

C. This Section does not apply to liquid petroleum piping; industrial gas applications using such gases as acetylene and acetylenic compounds, hydrogen, ammonia, carbon monoxide, oxygen and nitrogen; gas piping, meters, gas pressure regulators and other appurtenances used by the serving gas supplier in distribution of gas.

D. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 22 Section "General plumbing Requirements," for trenching, excavation, backfill and compaction materials and methods for underground piping installations.
2. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations and wall and floor penetrations.
3. Division 22 Section "Basic Piping Material and Methods," for materials and methods for strainers, unions, dielectric flanges and mechanical sleeve seals.
4. Division 22 Section "Hangers and Supports for Plumbing Piping," for materials and methods for hanging and supporting gas distribution piping.
5. Division 26 Section “Common Work Results for Electrical” required electrical devices.

E. Gas pressures for systems specified in this Section are limited to 5 psig.

1.2 DEFINITIONS

A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).

B. Gas Distribution Piping: A pipe within the building which conveys gas from the point of delivery to the points of usage.

C. Gas Service Piping: The pipe from the gas main or other source of supply including the meter, regulating valve, or service valve to the gas distribution system of the building served.

D. Point of Delivery: The outlet of the service meter assembly, or the outlet of the service regulator (service shutoff valve when no meter is provided).

1.3 SUBMITTALS

A. Product data for each gas piping specialty and special duty valves. Include rated capacities of selected models, furnished specialties and accessories, and installation instructions.

B. Shop drawings detailing dimensions, required clearances, for connections to gas meter.

C. Coordination drawings for gas distribution piping systems in accordance with Division 22 Section "General Plumbing Requirements."

D. Maintenance data for gas specialties and special duty valves, for inclusion in operating and maintenance manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."

E. Welders' qualification certificates, certifying that welders comply with the quality requirements specified under "Quality Assurance" below.

F. Test reports specified in Part 3 below.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Installation and replacement of gas piping, gas utilization equipment or accessories, and repair and servicing of equipment shall be performed only by a qualified installer. The term qualified is defined as experienced in such work (experienced shall mean having a minimum of 5 previous projects similar in size and scope to this project), familiar with precautions required, and has complied with the requirements of the authority having jurisdiction. Upon request, submit evidence of such qualifications to the Architect.

B. Qualifications for Welding Processes and Operators: Comply with the requirements of ASME Boiler and Pressure Vessel Code, "Welding and Brazing Qualification."

C. Regulatory Requirements: Comply with the requirements of the following codes:

1. NFPA 54 - National Fuel Gas Code, for gas piping materials and components, gas piping installation and inspections, testing, and purging of gas piping systems.
2. 200_ International Fuel Gas Code
3. 200_ Uniform Plumbing Code

D. Local Gas Utility Requirements: Comply with local gas utility installation rules and regulations.

E. Pipe, pipe fittings and pipe specialties shall be manufactured in plants located in the United States or certified to meet the specified ASTM and ANSI standards.

1.5 SPARE PARTS

A. Valve Wrenches: Furnish to Owner, with receipt, 2 valve wrenches for each type of gas valve installed, requiring same.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide gas piping system products from one of the following:

1. Gas Ball Valves – 2” and Smaller:
   a. Apollo Valves # 77F-1XX-01
   b. Hammond Valve # 8901
   c. Milwaukee Valve # BA-475B
   d. Nibco Inc. # T-FP 600A
   e. Watts # FBV-3C
2. Gas Ball Valves – 2-1/2” to 4”:
   a. Apollo Valve # 77F-1XX-01
   b. Hammond Valve # 8901
   c. Milwaukee Valve # BA-475B
   d. Nibco Inc. # T-FP 600A
3. Gas Cocks – 2” and Smaller:
   a. Homestead # 601
   b. Milliken #200M
   c. RM Energy Systems # D125
4. Gas Cocks – 2-1/2” and Larger:
   a. Homestead # 602
   b. Milliken #200MF
   c. RM Energy Systems “Hercules” # D126

5. Gas Pressure Regulators
    a. American Meter Company
    b. Fisher
    c. Itron
    d. Sensus
    e. Maxitrol
6. CSA Listed Gas Pressure Regulators
    a. Karl Dungs, Inc.
    b. Maxitrol
    c. Pietro-Fiorentini
7. Gas Meters:
    a. American Meter Company
    b. Schlumberger / Acteris
    c. Roots
8. Insect Screens
    a. Northtown Pipe Protection Products “BUGSCRN Series”
9. Gas Relief Vents
    a. Richards “GV Series”

2.2 PIPE AND TUBING MATERIALS

A. General: Refer to Part 3, Article "PIPE APPLICATIONS" for identification of systems where the specified pipe and fitting materials listed below are used.

B. Steel Pipe: ASTM A 53, Grade B, Schedule 40, Type E electric-resistance welded or Type S seamless, black steel pipe, beveled ends.

C. Copper Tubing - Drawn Temper: ASTM B88, Type L.

D. Semi-rigid Corrugated Stainless Steel Tubing: Type 304 stainless tubing meeting ASTM A240, with UV resistant polyethylene jacket meeting ASTM E-84 flame and smoke rating and yellow brass auto-flare ends with stainless steel inserts.

E. Pre-sleeved Vent Capable Semi-rigid Corrugated Stainless Steel Tubing: Type 304 stainless tubing meeting ASTM A240, with UV resistant polyethylene jacket meeting ASTM E-84 flame and smoke rating, encased in a polyethylene ventable sleeve and yellow brass auto-flare ends with stainless steel inserts.

F. Plastic Pipe: High Density, SDR-11 iron pipe size polyethylene pipe, meeting ASTM D 2513, with heat fusion connections. Pipe shall meet Plastic Pipe Institute Material Designation of PE 2406.

2.3 FITTINGS

A. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 150, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.

B. Steel Fittings: ASTM A 234, seamless or welded, for welded joints.
    1. 1-1/4” and smaller shall be socket type
    2. 1-1/2” and larger shall be butt weld type.

C. Forged Steel Flanges and Flanged Fittings: ASME B16.5, Class 150, butt weld ends, standard pattern with bolts, nuts and gaskets of material group 1.1.

D. Wrought-Copper Fittings: ANSI B16.22, streamlined pattern.

E. Semi-rigid Corrugated Stainless Steel Tubing Mechanical Fittings: ANSI B16, yellow brass auto-flare ends with stainless steel inserts or double wall flare with Jacket Lock™, mechanical capture of the jacket and NPT male or female threaded ends, of the same manufacturer of the corrugated stainless steel tubing, tested and listed by CSA International for concealed use.

F. Semi-rigid Corrugated Stainless Steel Tubing Flanges: ANSI B16, yellow brass or malleable iron, of the same manufacturer of the corrugated stainless steel tubing, tested and listed by CSA International.

G. Plastic Fittings: Polyethylene socket fusion fittings, meeting ASTM D 2683 compatible with the piping system.

H. Transition Fittings – Steel to Polyethylene: Factory assembled and pressure tested one piece design, with steel half of Schedule 40 steel pipe with beveled edge for welding and polyethylene half shall be of ample length for making welds. Steel pipe shall have epoxy protective coating.

I. Insect screens: Black steel body with 20 mesh stainless steel screen and MNPT end.

J. Gas Relief Vents: Galvanized steel body with 90 degree inlet to screened outlet, 20 mesh stainless steel screen and FNPT end.

2.4 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (Silver).

B. Joint Compound: Suitable for the gas being handled.

C. Gasket Material: Thickness, material, and type suitable for gas to be handled, and for design temperatures and pressures.

2.5 PIPING SPECIALTIES

A. Gas Meters: Diaphragm-type, positive displacement gas meters with aluminum cases, temperature compensated, with internal corrosion-resistant components; threaded ends for 2 inch and smaller, flanged ends for 2-1/2 inch and larger; for gas working pressures, specific gravity, and volume flow indicated.

B. Gas Meters: Rotary-type, positive displacement gas meters meeting ASTM B109.3 with aluminum cases with maximum operating pressure of 175 psig, temperature compensated, with sealed mechanical totalizer, internal corrosion-resistant components and oil free design; threaded ends for 1-1/2 inch and smaller, flanged ends for 2 inch and larger; for gas working pressures, specific gravity, and volume flow indicated.

C. Protective Coating: When piping will be in contact with material or atmosphere exerting a corrosive action, pipe and fittings shall be factory-coated with polyethylene tape, having the following properties:

1. overall thickness; 20 mils;
2. synthetic adhesive;
3. water vapor transmission rate, gallons per 100 square inch: 0.10 or less.
4. water absorption, percent: 0.02 or less.

D. Prime pipe and fittings with a compatible primer prior to application of tape.

E. Strike Plates: 16 gauge carbon steel, tested and listed by CSA International.

F. In wall Strike Protection Hose: UL listed spiral wound interlocking galvanized steel reduced wall flexible conduit.

G. Non metallic Water Tight Conduit: Schedule 80 rigid PVC, UL 651, with fittings to match to conduit type and material.

H. Multiple Port Manifolds: ANSI LC1b, plastic coated malleable iron, of the same manufacturer of the corrugated stainless steel tubing, tested and listed by CSA International.

2.6 VALVES

A. Gas Ball Valves – 2” and Smaller: Full port brass body with brass ball, PTFE seats, threaded ends 150psi steam, 600 WOG, UL listed for natural gas service.

B. Gas Ball Valves – 2-1/2” to 4”: Standard port brass body with brass ball, PTFE seats, threaded ends 150psi steam, 400 WOG, UL listed for natural gas service.

C. Gas Cocks 2 Inch and Smaller: 175 psi, lubricated plug type, ASTM A126 Grade B semi-steel body, brass or semi-steel plug with full area rectangular port, straightaway pattern, square head, threaded ends.

D. Gas Cocks 2-1/2 Inch and Larger: 175 psi, lubricated plug type, ASTM A126 Grade B semi-steel body and plug with full area rectangular port, straightaway pattern, single gland, wrench operated, flanged ends.

E. Solenoid Valves: Aluminum body, 120 volts AC, 60 Hz, Class B continuous duty molded coil, NEMA 4 coil enclosure; electrically opened/normally closed with visual indication to indicate whether valve is open or closed; UL listed and labeled, FM approved for natural gas service.

F. Gas Line Pressure Regulators: Single stage, steel jacketed, corrosion-resistant gas pressure regulators; with atmospheric vent, elevation compensator; internal relief vent, vent limiter for indoor installation, with threaded ends for 2 inch and smaller, flanged ends for 2-1/2 inch and larger; for inlet and outlet gas pressures, specific gravity, and volume flow as indicated on the drawings.

1. CSA listed for 2 PSI gas systems
2. CSA listed for 5 PSI gas systems with factory overpressure protection device.

PART 3 - EXECUTION

3.1 INSTALLATION

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

3.2 PREPARATION

A. Precautions: Before turning off the gas to the premises, or section of piping, turn off all equipment valves. Perform a leakage test as specified in "FIELD QUALITY CONTROL" below, to determine that all equipment is turned off in the piping section to be affected.

B. Conform with the requirements in NFPA 54, for the prevention of accidental ignition.

3.3 PIPE APPLICATIONS

A. Install steel pipe with threaded joints and fittings for 2 inch and smaller, and with welded joints for 2-1/2 inch and larger.

B. Install Type L, hard-drawn copper tubing with wrought copper fittings and brazed joints for 2 inch and smaller, above ground, within building.

C. Install semi-rigid corrugated stainless steel tubing with yellow brass or malleable iron fittings and mechanical joints for 2 inch and smaller.

D. Install PE plastic pipe with fusion bond plastic fittings below grade outside the building slab.

E. Install pre-sleeved vent capable semi-rigid corrugated stainless steel tubing for single runs tubing underslab inside of building.

3.4 PIPING INSTALLATION

A. General: Conform to the requirements of NFPA 54 - National Fuel Gas Code.

B. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Design locations and arrangements of piping take into consideration pipe sizing, flow direction, slope of pipe, expansion, and other design considerations. So far as practical, install piping as indicated.

C. Concealed Locations: As specified below:

1. Inaccessible Above-Ceiling Locations: Install concealed gas piping in inaccessible above-ceiling spaces without valves or unions.
2. Accessible Above-Ceiling Locations: Gas piping may be installed in accessible above-ceiling spaces (subject to the approval of the authority having jurisdiction), whether or not such spaces are used as a plenum. Valves and unions shall not be located in such spaces used as a plenum.
3. In Floors: Install concealed gas piping in concrete floor slabs in an air-tight conduit constructed of Schedule 40 PVC with socket weld joints two pipe sizes larger than the gas pipe served. Extend conduit a minimum of 12" above finish floor and cap air tight at both ends. Vent conduit to the outside with a minimum 2" pipe and terminate with a screened vent cap.

4. Piping In Partitions: Install concealed gas piping in hollow partitions with welded joint (subject to the approval of the authority having jurisdiction) and protect gas piping against physical damage. Install gas piping passing through partitions with no joints or unions inside the partition.
5. Concrete or Masonry Walls: Do not install gas piping in masonry or concrete walls.
6. Prohibited Locations: Do not install gas piping in or through a circulating air duct, clothes chute, chimney or gas vent, ventilating duct, dumbwaiter or elevator shaft. This does not apply to accessible above-ceiling space specified above.

D. Fire Barrier Penetrations: Where pipes pass though 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.

E. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of No-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 "Basic Piping Materials and Methods” for special sealers and materials.

F. Exterior Wall Penetrations: Seal pipe penetrations through exterior wall constructions with sleeves, packing, and sealant. Refer to Division 22 Section “Common Work Results for Plumbing” for additional information.

G. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls with sleeves and mechanical sleeve seals. Refer to Division 22 Section “Basic Piping Material and Methods” for additional information.

H. Dirt legs and Sediment Traps: Install a dirt leg at points where condensate and impurities may collect, at the outlet of the gas meter, as close to the inlet of each gas appliance or equipment as possible, and in a location readily accessible to permit cleaning and emptying.

1. Construct dirt legs and sediment traps using a tee fitting with the bottom outlet plugged or capped. Provide a 3” length of pipe and screwed cap for the dirt leg. Use line size pipe for dirt leg, refer to the drawings for sizes. Enter the tee with flow from the top and exit the tee from the side outlet. Install the dirt leg a minimum of 3-1/2” above the roof or floor readily accessible to permit cleaning and emptying.
2. Install line size gas cock, union and dirt leg at each equipment connection; refer to the drawings for sizes. Provide reducers at the equipment connection as required. Unions are specified in Division 22 section “Basic Piping Materials and Methods”.

I. Use fittings for all changes in direction and all branch connections.

J. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

K. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

L. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

M. Install horizontal piping as high as possible allowing for specified slope and coordination with other components. Install vertical piping tight to columns or walls. Allow sufficient space above removable ceiling panels to allow for panel removal.

N. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

O. Install gas piping at a uniform grade of 1/4 inch in 15 feet, upward to risers, and from the risers to the meter, or service regulator when meter is not provided, or the equipment.

P. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.

Q. Connect branch outlet pipes from the top or sides of horizontal lines, not from the bottom.

R. Install unions in pipes 2 inch and smaller, adjacent to each valve, and elsewhere as indicated. Unions are not required on flanged devices. Unions are specified in Section “Basic Piping Materials and Methods”.

S. Joints Containing Dissimilar Metals: Provide dielectric unions for 2” and smaller and dielectric flanges for piping 2-1/2” and larger. Dielectric unions and flanges are specified in Section “Basic Piping Materials and Methods”.

T. Install flanges on valves, apparatus, and equipment having 2-1/2 inch and larger connections.

U. Install strainers on the supply side of each control valve, pressure reducing valve, pressure regulating valve, solenoid valve, and elsewhere as indicated.

V. Anchor piping to ensure proper direction of expansion and contraction. Install expansion loops and joints as indicated on the Drawings and specified in Division 22 Section "Expansion Fittings and Loops for Plumbing Piping."

W. Paint Exposed Outdoor Gas Piping.

1. Final color per the architect.

X. Install plastic pipe underground with socket weld plastic joints. Use transition fittings for joining steel to plastic pipe. Installation and pipe bedding shall be per the manufacturer’s published installation recommendations.

3.5 HANGERS AND SUPPORTS

A. General: Hanger, support, 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 clevis hangers, MSS SP-69 Type 1, for steel pipe 2-1/2” and larger for individual horizontal runs.
2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs.
3. Extension split ring pipe clamp, MSS SP-69 Type 12, for individual exposed runs on walls.
4. 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.
5. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

SIZE (NPS)	SPACING IN FEET	MIN. ROD SIZE IN INCHES
1/2” to 1”	7	3/8
1-1/4”	8	3/8
1-1/2”	9	3/8
2”	10	3/8
2-1/2”	11	1/2
3”	12	1/2
4”	14	5/8
6”	16	3/4

6. Support semi-rigid corrugated stainless steel tubing with the following maximum spacing:

SIZE (NPS)	HORIZONTAL SPACING IN FEET	VERTICAL SPACING IN FEET
3/8”	4	10
1/2”	6	10
3/4“ to 2”	8	10

C. Support vertical piping at every floor.

D. Support gas piping within 12” of each elbow or tee and for gas piping 2-1/2” and larger at each valve or pressure regulator.

E. Support gas piping located on the roof with 4” x 4” x 12” long ACQ rot-proof treated timber blocks. Rot-proof timber blocks are specified in Division 22 Section "Hangers and Supports for Plumbing Piping”. Conform to the table above for maximum spacing of supports.

F. Support gas piping located on roof with pre-engineered roof supports, pre-engineered roof supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping”. Conform to the table above for maximum spacing of supports. Support pipe at a minimum 7” above the roof.

G. Support semi-rigid corrugated stainless steel tubing located on the roof with strut/channel from support to support, running parallel beneath the pipe.

3.6 PIPE JOINT CONSTRUCTION

A. Welded Joints: Comply with the requirements in ASME Boiler and Pressure Vessel Code, Section IX.

B. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."

1. WARNING: Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.
2. CAUTION: Remove stems, seats, and packing of valves, and accessible internal parts of piping specialties before brazing.
3. Fill the tubing and fittings during brazing with an inert gas (nitrogen or carbon dioxide) to prevent formation of scale.
4. Heat joints to proper and uniform temperature.

C. Threaded Joints: Conform to ANSI 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. Refer to NFPA 54, for guide for number and length of threads for field threading steel pipe.
2. Align threads at point of assembly.
3. Apply thread compound for use with gas systems to the external pipe threads. Pipe thread tape is not accepted.
4. Assemble joint to appropriate thread depth. When using a wrench on valves place the wrench on the valve end into which the pipe is being threaded.
5. Damaged Threads: Do not use pipe with threads which are corroded, or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

D. Flanged Joints: Align flanges 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 to appropriate torque specified by the bolt manufacturer.

E. Fusion Welded: Joints shall be made by a qualified and approved operator in accordance with Title 49, CFR, Part 192.283 and be made in accordance with pipe manufacturer’s recommendations.

F. Semi-rigid Corrugated Stainless Steel Tubing: Joints shall be made by a qualified and approved operator in accordance with pipe manufacturer’s recommendations.

3.7 VALVE APPLICATIONS

A. General: The Drawings indicate valve types, locations, and arrangements.

B. Shut-off duty: Use gas cocks specified in Part 2 above.

3.8 VALVE INSTALLATIONS

A. Install valves in accessible locations, protected from physical damage. Tag valves with a metal tag attached with a metal chain indicating the piping systems supplied.

B. Install the emergency natural gas shutoff valve furnished with exhaust hood fire extinguishing system in an accessible location.

C. Install line size gas cock at the outlet of the gas meter set or gas riser and install a line size union downstream of the gas cock outside of the building.

D. Installation of Gas Pressure Regulators:

1. Install a gas cock 10 pipe diameters upstream of each gas pressure regulator. Where two gas pressure regulators are installed in series in a single gas line, a manual valve is not required at the second regulator.
2. Install line pressure regulators a minimum of 10 pipe diameters upstream of each atmospheric or power burner equipment connection.
3. Install line pressure regulators a minimum of 10’-0” upstream of each condensing boiler or water heater connection.
4. Install gas pressure regulator relief devices so they can be readily operated to determine if the valve is free; so they can be tested to determine the pressure at which they will operate; and examined for leakage when in the closed position.
5. Install gas pressure regulators with listed vent limiters indoors where allowed by the AHJ. Install with regulator dome vertically upright and level.
6. Install gas pressure regulators located outside the building with the relief port facing down to prevent the entry of moisture with the relief port a minimum of 18” above the roof or finish grade. Remove vent limiter and provide with line size (same size as gas vent relief port) insect screen or gas relief vent and 1” long schedule 40 black steel nipple.
   a. Where manufacturer does not allow the gas pressure regulator to be installed upside down, install gas pressure regulator with regulator dome in the horizontal or vertically upright with factory breather plug.
7. Gas Pressure Regulator Relief Vents: Provide for gas pressure regulators that require them or for vent less regulators where the AHJ requires them. Install steel pipe with threaded joints and fittings for 2 inch and smaller, and with welded joints for 2-1/2 inch and larger. Route vent to the outdoors thru building side wall and turn down or thru the roof and turn down minimum 18” above the roof or grade. Provide with line size (same size as gas relief) insect screen or gas relief vent. Provide vent sizes per the following developed length and include 3 feet of length for each elbow:
   a. 10 feet developed length = size vent one pipe size larger than relief vent outlet size
   b. 20 feet developed length = size vent two pipe size larger than relief vent outlet size
   c. 30 feet developed length = size vent three pipe size larger than relief vent outlet size
   d. 40 feet developed length = size vent four pipe size larger than relief vent outlet size

3.9 TERMINAL EQUIPMENT CONNECTIONS

A. Install line size gas cock upstream and within 6 feet of gas appliance. Install a line size union or flanged connection downstream from the gas cock to permit removal of controls. Install reducer at the gas appliance connection, if required.

B. Install stainless steel flexible gas pipe connector, of size and length as required to complete equipment hook-up of foodservice equipment. Verify appropriate length of flexible gas pipe connector for movement of the foodservice equipment for cleaning.

3.10 ELECTRICAL BONDING AND GROUNDING

A. Install above ground portions of gas piping systems, upstream from equipment shutoff valves electrically continuous and bonded to a grounding electrode in accordance with NFPA 70 - "National Electrical Code."

B. Do not use gas piping as a grounding electrode.

C. Conform to NFPA 70 - "National Electrical Code," for electrical connections between wiring and electrically operated control devices.

3.11 FIELD QUALITY CONTROL

A. Piping Tests: Inspect, test, and purge natural gas systems in accordance with NFPA 54, and local utility requirements.

END OF SECTION 227000

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:

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
AIA	Guidelines for Design and Construction of Hospital and Healthcare Facilities
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 Manufactures' 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."
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.

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.

1.5 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 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 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 SUBMITTALS

A. Refer to Section 013300, Division 01 and General Conditions for submittal requirements in addition to requirements specified herein.

B. Submittals and shop drawings shall not contain the firm name, logo, seal, or signature of the Engineer. They shall not be copies of the work product of the Engineer. If the Contractor desires to use elements of such product, the license agreement for transfer of information obtained from the Engineer must be used.

C. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples, and other submittals required by this Division.

D. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.

E. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.

F. Refer to individual Sections for additional submittal requirements.

G. Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time, plus to/from mailing time via the Architect, plus a duplication of this time for resubmittal if required. Transmit submittals as soon as possible after Notice to Proceed and before Mechanical construction starts.

H. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.

I. Submittals shall contain the following information:

1. The project name.
2. The applicable specification section and paragraph.
3. Equipment identification acronym as used on the drawings.
4. The submittal date.
5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
6. Submittals not so identified will be returned to the Contractor without action.

J. Refer to Division 01 for acceptance of electronic submittals for this project. For electronic submittals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 01. Contractor shall notify the Architect and Engineer that the submittals have been posted. If electronic submittal procedures are not defined in Division 01, 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 for 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 submittal.

K. The checking and subsequent acceptance by the Engineer and/or Architect of submittals shall not relieve responsibility from the Contractor for (1) deviations from Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Architect prior to implementing any deviation.

L. Provide welders’ qualification certificates.

1.8 ELECTRONIC DRAWING FILES

A. Refer to Division 01 and General Conditions for use of electronic files. 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 Section 007213, 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.

1.10 OPERATION AND MAINTENANCE MANUALS

A. Refer to Section 013300, Division 01 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.

B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.

C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.

D. Prior to Substantial Completion of the project, furnish to the Architect, for Engineer's review, and for the Owner's use, Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.

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 Section 013300, Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.

B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension from column lines.

C. Contractor shall provide As-builts to the designer as part of their closeout documents. Consultant will be then responsible for providing OA with Record Drawings.

1.13 TRAINING

A. Provide training as indicated in each specific section. Schedule training with the Owner at least 7 days in advance. Video record the training sessions in format as agreed to with the Owner. Provide three copies of each session to the Owner and obtain written receipt from the Owner.

1.14 PAINTING

A. Exposed ductwork and ferrous surfaces, including pipe, pipe hangers, equipment stands and supports shall be painted by the Contractor. 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.

1.15 DELIVERY, STORAGE AND HANDLING

A. Refer to Division 01 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.

B. Equipment and material shall be delivered to the job site in their original containers with labels intact, fully identified with manufacturer's name, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.

C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, to include the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which become rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Architect.

D. The Contractor shall be responsible for the safe storage of his own tools, material and equipment.

1.16 GUARANTEES AND WARRANTIES

A. Refer to Division 01 and General Conditions for Guarantees and Warranties in addition to requirements specified herein.

B. Each system and element thereof shall be warranted against defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in the Construction Documents or manufacturer's standard warranty. The Contractor shall remedy defects occurring within a period of one year from the date of Substantial Completion or as stated in the General Conditions.

C. The following additional items shall be guaranteed:

1. Piping shall be free from obstructions, holes or breaks of any nature.
2. Insulation shall be effective.
3. Proper circulation of fluid in each piping system.

D. The above guarantees shall include both labor and material; and repairs or replacements shall be made without additional cost to the Owner.

E. The remedial work shall be performed promptly, upon written notice from the Architect or Owner.

F. At the time of Substantial Completion, deliver to the Owner warranties with terms extending beyond the one year guarantee period, each warranty instrument being addressed to the Owner and stating the commencement date and term.

1.17 TEMPORARY FACILITIES

A. Refer to Division 01 and General Conditions for Temporary Facilities requirements in addition to requirements specified herein.

B. Temporary Utilities: The types of services required include, but are not limited to, water, sewerage, surface drainage and gas. When connecting to existing franchised utilities for required services, comply with service companies' recommendations on materials and methods, or engage service companies to install services. Locate and relocate services (as necessary) to minimize interference with construction operations.

1. Provide the necessary backflow prevention devices where connecting to the potable water system. Protect water service from freezing by draining system or by providing adequate heat. Where non-potable water is used, mark each outlet with health hazard warning signs.
2. Sewer Sediment: Maintain sewers and temporary connecting sewers in a clean, non-clogged condition during construction period.

C. Construction Facilities: Provide facilities reasonably required to perform construction operations properly and adequately.

1. Enclosures: When temporary enclosures are required to ensure adequate workmanship, weather protection and ambient conditions required for the work, provide fire-retardant

treated lumber and plywood; provide tarpaulins with UL label and flame spread of 15 or less; provide translucent type (nylon reinforced polyethylene) where daylighting of enclosed space would be beneficial for workmanship, and reduce use of temporary lighting.

2. Heating: Provide heat, as necessary, to protect work, materials and equipment from damage due to dampness and cold. In areas where building is occupied, maintain a temperature not less than 65 degrees Fahrenheit. Use steam, hot water, or gas from piped distribution system where available. Where steam, hot water or piped gas are not available, heat with self-contained LP gas or fuel oil heaters, bearing UL, FM or other approval labels appropriate for application. Vent fuel-burning heaters, and equip units with individual-space thermostatic controls. Use electric-resistance space heaters only where no other, more energy-efficient, type of heater is available and allowable.

1.18 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 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 his 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. Use of explosives is not permitted.

C. 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

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 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 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. Dirt and refuse resulting from the performance of the work shall be removed from the premises as required to prevent accumulation. The Mechanical Contractor shall cooperate in maintaining reasonably clean premises at all times.

B. Immediately prior to the final inspection, the Mechanical Contractor shall clean material and equipment installed under the Mechanical Contract. Dirt, dust, plaster, stains, and foreign matter shall be removed from surfaces including components internal to equipment. Damaged finishes shall be touched-up and restored to their original condition.

3.6 SUBSTANTIAL COMPLETION REVIEW

A. Prior to requesting inspection for "CERTIFICATE OF SUBSTANTIAL COMPLETION", the Contractor shall complete the following items:

1. Submit complete Operation and Maintenance Manuals.
2. Submit complete Record Drawings.
3. Perform special inspections.
4. Start-up testing of systems.
5. Removal of temporary facilities from the site.
6. Comply with requirements for Substantial Completion in the "General Conditions".

B. The Contractor's written request shall state that the Contractor has complied with the requirements for Substantial Completion.

C. Upon receipt of a request for review, the Architect/Engineer will either proceed with the review or advise the Contractor of unfulfilled requirements.

D. If the Contractor requests a site visit for Substantial Completion review prior to completing the above mentioned items, He shall reimburse the Architect/Engineer for time and expenses incurred for the visit.

E. Upon completion of the review, the Architect/Engineer will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.

F. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.

G. Prior to requesting a final review, the Contractor shall submit a copy of the final list of items to be completed or corrected. He shall state in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

END OF SECTION 230010

SECTION 230015 - 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 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.

C. Refer to Division 26, "ENCLOSED SWITCHES AND CIRCUIT BREAKERS" for specification of disconnect switches and enclosed circuit breakers.

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.

C.

TABLE 1: ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

ITEM	FURN BY	SET BY	POWER WIRING	CONTROL WIRING
Equipment motors	DIV23m	DIV23m	DIV26	---
Factory furnished motor starters contactors and disconnects	DIV23m	DIV23m	DIV26	DIV23m
Overload heaters	DIV23m	DIV26	---	---
Loose motor starters, disconnect switches, thermal overloads and heaters.	DIV26	DIV26	DIV26	DIV23m
Variable speed drives	DIV23m	DIV23m	DIV26	DIV23m
Control relays	DIV23m	DIV23m	DIV26	DIV23m
Thermostats (low voltage)	DIV23m	DIV23m	---	DIV23m
Thermostats (line voltage)	DIV23m	DIV23m	DIV26	---
Control power transformers furnished with equipment	DIV23m	DIV23m	DIV26	DIV23m
Motor and solenoid operated valves	DIV23m	DIV23m	DIV26	DIV23m
Damper operators, PE & switches	DIV23m	DIV23m	DIV26	DIV23m
Smoke dampers and combination fire/smoke dampers	DIV23m	DIV23m	DIV26	DIV28
Temporary heating connections	DIV23m	DIV23m	DIV26	DIV23m
Interlocks between air handling units and exhaust fans	---	---	---	DIV23m
Interlocks between HVAC fans and damper operators	---	---	DIV26	DIV23m

DIV23m = Mechanical Contractor
DIV26 = Electrical Contractor

END OF SECTION 230015

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes limited scope general construction materials and methods for application with mechanical installations as follows:

1. Access panels and doors in walls, ceilings, and floors for access to mechanical materials and equipment.
2. Mechanical equipment nameplate data.
3. Concrete for bases and housekeeping pads.
4. Non-shrink grout for equipment installations.
5. Sleeves for mechanical penetrations.
6. Drip Pans with detection.
7. Miscellaneous metals for support of mechanical materials and equipment.
8. Wood grounds, nailers, blocking, fasteners, and anchorage for support of mechanical materials and equipment.
9. Joint sealers for sealing around mechanical materials and equipment.
10. Sealing penetrations through noise critical spaces.
11. Plenum insulation for enclosure of combustible items located within fire-rated plenums.
12. Firestopping

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 23 Section "Basic Piping Materials and Methods," for materials and methods for mechanical sleeve seals.
2. Division 26 Section “Common Work Results for Electrical” required electrical devices.
3. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.2 SUBMITTALS

A. General: Submit the following in accordance with Section 013300, Division 01 and Division 23 Section General Mechanical Requirements.

1. Product data for the following products:
   a. Access panels and doors.
   b. Joint sealers.
   c. Through and membrane-penetration firestopping systems.
   d. Plenum insulation.
2. Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for mechanical 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.

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 Firestopping 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. 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. 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.

2. 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-wideexposed 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.

3. 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.

4. Locking Devices: Flush, screwdriver-operated cam locks.

5. 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 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.

2.3 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 AWPA 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 that 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. 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 manufacture. 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, 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. "Tremflex 834," Tremco, Inc.

d. “CP 506”, Hilti, Inc.

e. “CP 572”, spray application, Hilti, Inc.

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 plenums when enclosed within high-temperature insulation blanket where approved by the authority having jurisdiction.

B. Material: FyreWrap 0.5 Plenum Insulation, ETS Schaefer Plenumshield Blanket, Thermal Ceramics PlenumWrap+, or equivalent utilizing light weight, high temperature blanket enhanced for biosolubility. The encapsulating material shall be aluminum foil with fiberglass reinforcing scrim covering.

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 1” minimum layer with a density of 2 to 6 pounds per cubic foot.

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. Hilti
2. RectorSeal
3. Specified Technologies Inc.,
4. United States Gypsum Company
5. 3M Corp.

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.

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 openings sleeved through underground exterior walls shall be sealed with mechanical sleeve seals as specified in Division 23 Section “Basic Piping Materials and Methods”.

3.8 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 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 plenums where the use of plenum insulation is not approved.

END OF SECTION 230500

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes the following:

1. Horizontal-piping hangers and supports.
2. Hanger-rod attachments.
3. Spring hangers and supports.
4. Pre-engineered support strut systems.
5. Roof Equipment supports.
6. Pre-engineered roof pipe supports.

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 23 Section "HVAC Insulation," for high density insulation for protecting insulation vapor barrier and materials and methods for piping hanger installations.
2. Division 23 “Refrigerant Piping”, for pipe hanger types and spacing for horizontal and vertical refrigerant piping of sizes and materials indicated.

1.2 SUBMITTALS

A. General: Submit the following in accordance with conditions of contract and Division 01 specification Sections.

1. Product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support.
2. Product certificates signed by the manufacturer of hangers and supports certifying that their products meet the specified requirements.
3. Welder certificates signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" Article.
4. Assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.
5. Maintenance data for supports and anchors for inclusion in Operating and Maintenance Data specified in Division 01 and Division 23 Section "General Mechanical Requirements."
6. Submit style and type of anchors to Architect or Structural Engineer for approval prior to installation.

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. Qualify welding processes and welding operators in accordance with ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

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.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. Hangers and Supports:

1. Armacell.
2. Anvil International.

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. Power-Strut.
11. Unistrut.

B. Pre-Insulated Supports:
1. Calcium Silicate Shield Supports:
a. Buckaroos, Inc.
b. Cooper B-Line, Inc.
c. Armacell

C. Pre-Engineered Thermal Hanger Inserts:
1. Armacell “Armafix”.
2. Buckaroos, Inc.
3. Cooper B-Line, Inc.

D. Roof Equipment Supports:
1. Custom Curb, Inc.
2. Pate Company.
3. Thybar.

E. Pre-Engineered Roof Pipe Supports:
1. Airtec.
2. Anvil International.
3. Cooper B-Line, Inc.
4. Elite Components.
5. ERICO/Michigan Hanger Co./Caddy.
6. Ferguson/FNW.
7. MIRO.
8. PHP Systems/Design.
9. Roof Top Blox.

2.2 SUPPORT MATERIALS

A. Hangers and support 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.

2.3 SADDLES AND SHIELDS

A. Metallic Pipe Covering Protection Saddles:
1. Meet MSS SP-58 Type 39A or B, 100-psi average compressive strength, with center rib for pipes 12” and larger. Saddles shall cover approximately one sixth of the circumference of the pipe and shall be 12” long.

B. Pre-Insulated Supports:

1. Calcium Silicate Shield Supports:
    1. Waterproofed calcium silicate conforming to ASTM C795 encased with an insulation protection shield.
2. Pre-Engineered Thermal Hanger Inserts:
    1. Flexible elastomeric insulation conforming to ASTM C534, Type I with integral high density pipe support.

C. Insulation Protection Shield:
1. Sheet metal construction, meeting MSS 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.
3. For pipes 2 inch and smaller 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) 5	6	7	8	9	10
		Hanger Spacing, (ft)					
	0.5	5	6	8	-	-	-
	1	3	5	5	-	-	-
≤ 1	1.5	3	5	5	-	-	-
	2	3	3	3	-	-	-
	3	3	3	3	-	-	-
	0.5	8	8	11	11	12	14
	1	5	6	8	9	11	11
≤ 2	1.5	5	6	8	8	9	9
	2	5	5	6	6	8	8
	3	5	5	6	6	6	8

4. 360 Degree 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.

D. Hangers with pre-manufactured polymer inserts:
1. Strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts designed to receive butted insulation internally may be used in lieu of other insulated pipe support systems. 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. Note: Metal shields are not required with clevis hangers of this type. Approved manufacturers include:
    1. Anvil International.
    2. Holdrite.
    3. Klo-Shure.

2.4 HANGER-ROD ATTACHMENTS

A. Threaded Rods: Threaded rods are not allowed for vertical, floor-mounted pipe 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.

2.5 PRE-ENGINEERED SUPPORT STRUT SYSTEMS

A. Support strut systems shall comply with MSS SP-69, Type 59. Shop- or field-fabricated pipe-support assembly shall be made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts. Minimum 14 gauge galvanized steel with factory-punched attachment holes. Two piece straps shall be captivated at the shoulder when attachment nut is tightened and designed for use with strut system. Long or short pipe rollers designed for use with strut system, where indicated, shall attach to the channel with brackets and

nuts. Provide plastic galvanic isolators for connecting bare copper pipe for use with pre-engineered support strut system where indicated. All nuts, brackets and clamps shall have the same finish as the channels.

2.6 ROOF EQUIPMENT SUPPORTS

A. Provide factory-fabricated roof equipment support with the following features:

1. Base plate.
2. Fully mitered 3-inch raised cant.
3. Welded, 18 gauge galvanized steel shell, internally reinforced to load bearing factors of equipment being supported.
4. Factory installed treated wood nailer.
5. 4 inch, 18 gauge nailer jacket.
6. Counterflashing.
7. Minimum height: 12 inches.

2.7 PRE-ENGINEERED ROOF PIPE SUPPORTS

A. Nominal 10”, 12”, 16”, or 24” long (as applicable) by nominal 4” thickness and minimum 4” width, closed cell polyethylene blocks with embedded pre-engineered support strut or pre-engineered support struts with factory plastic bases. Two piece straps shall be captivated at the shoulder when attachment nut is tightened and designed for use with strut system. All nuts, brackets and clamps shall have the same finish as the channels.

2.8 MISCELLANEOUS MATERIALS

A. Steel Plates, Shapes, and Bars: Conforming to ASTM A 36.

B. 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 INSTALLATION, GENERAL

A. Install products in accordance with manufacturer’s instructions.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

A. Install hangers, supports, clamps and attachments to support piping properly from building structure.

B. Do not attach to ceilings, equipment, ductwork, conduit and other non-structural elements such as floor and roof decking.

C. 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 Section 230700 for definition of hot and cold piping and required insulation thickness.

D. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible. Install supports with maximum spacing specified within Division 23 piping sections. Where piping of various sizes is supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.

E. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length specified in Division 23 piping sections. 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. 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.

F. 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.

G. Field-Fabricated, Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS D-1.1.

H. 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.

I. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

J. 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.

K. Insulated Piping: Comply with the following installation requirements.

1. Riser Clamps: Attach riser clamps, including spacers (if any), to piping with riser clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9. 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”.

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.

3. Insulation Protection Shield:

1. Install insulation protection shield with high density insulation insert where vapor barrier is indicated, sized for the insulation thickness used as specified in Division 23 Section “HVAC Insulation”. Do not use polymer-based shields for hot piping.

2. Exception for horizontal cold piping with fiberglass, cellular glass, flexible elastomeric, or polyisocyanurate 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.

L. Pre-Engineered Roof Pipe Supports: Set supports on an 18” X 18” (up to 12” length support), 24” X 18” (16” length support), or 30” X 18” (24” length support) x 3/16” thick roof walkway material compatible with the roof material.

3.3 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. Anchor 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.

3.4 ROOF EQUIPMENT SUPPORTS

A. Attach roof equipment support to the roof structure.

B. Provide 1-1/2” thick, 3 pound rigid insulation around base section of support.

C. Fabricate structural steel supports to suspend equipment from structure above or support equipment from floor.

D. 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.

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.

3.6 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. 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.

1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

C. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION 230529

SECTION 230550 - VIBRATION ISOLATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. It is the intent of this specification to provide vibration isolation supports for HVAC piping and equipment. HVAC piping includes condensate piping.

B. This work shall include all materials and labor required for the installation of the vibration isolation devices.

C. Vibration isolators shall be selected by the weight distribution to produce reasonably uniform deflection. Deflections shall be as noted on the equipment schedule included at the end of this Section.

D. All vibration isolation equipment shall be furnished by one manufacturer unless specifically approved otherwise in writing by the Engineer.

E. All vibration isolation devices shall be treated for corrosion resistance using galvanization for exterior applications and painting for interior applications.

1.2 WORK INCLUDED

A. Provide complete vibration isolation systems as shown or specified and in accordance with the requirements of the Contract Documents. System shall be complete with:

1. Foundations, vibration isolation, and supports for rigidly supported equipment.

2. Vibration isolation for ductwork and piping.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Consult all other Section to determine the extent of work specified elsewhere but related to this Section. This work shall be properly coordinated to produce an installation satisfactory to the Owner. This work includes, but is not limited to the following:

1. Piping

2. Ductwork

3. Heating and Cooling Equipment

1.4 CONTRACTOR'S RESPONSIBILITY

A. The Contractor shall be responsible for verifying the completeness of the isolation installation and the overall suitability of the equipment to meet the intent of this specification. Any additional equipment needed to meet the intent of this specification, even if not specifically mentioned herein or in the Contract Documents, shall be supplied by the Contractor without claim for additional payment.

B. Performance or waiving of inspection, testing or surveillance for any portion of the Work shall not relieve the Contractor of the responsibility to conform strictly with the Contract Documents. The Contractor shall not construe performance or waiving of inspection, testing or surveillance by the Owner or Architects to relieve the Contractor from total responsibility to perform in strict accordance with the Contract Documents.

1.5 MANUFACTURER'S RESPONSIBILITIES

A. Manufacturer of vibration isolation equipment shall have the following responsibilities:

1. Determine vibration isolation for all equipment and systems in accordance with the local governing code.

2. Calculate the static deflection requirements for all equipment and systems.

3. Provide piping and equipment isolation systems as scheduled or specified.
4. Guarantee specified isolation system deflection.
5. Provide installation instructions, drawings and field supervision to assure proper installation and performance.
6. The vibration isolation systems shall be guaranteed to have deflection indicated on the schedule on the drawings. Mounting sizes shall be determined by the mounting manufacturer, and the sizes shall be installed in accordance with the manufacturer's instructions.
7. The vibration isolator vendor shall ensure that all equipment to be isolated has sufficient support structure to distribute equipment loads onto isolators. Where additional support structure is required, this shall be provided by vibration isolator vendor.

1.6 SUBMITTALS

A. Submittal data shall show type, size, and deflection of each isolator proposed. Include clearly outlined procedures for installing and adjusting the isolators.

B. Submit a vibration isolation system schedule indicating the following:

1. Manufacturer, type, model number, size
2. Height when uncompressed and static deflection of each isolation element
3. Spring constant of each isolation element
4. Estimated imposed load on each isolation element
5. Spring o.d., free operating, and solid heights
6. Design of supplementary bases.
7. Layout of isolator hangers, mounts, and other elements shown on an outline of the isolated equipment, including complete details of attachment to load-bearing structure or supplementary framing.
8. Piping isolators shown and identified on piping layout drawings.
9. All concrete foundations and supports (and required reinforcing and forms) will be furnished and installed by another trade. However, this trade shall furnish shop drawings showing adequate concrete reinforcing steel details and templates for all concrete foundations and supports, and all required hanger bolts and other appurtenances necessary for the proper installation of his equipment. Although another trade will complete all concrete work, all such work shall be shown in detail on the shop drawings, prepared by this trade which drawings shall be submitted showing the complete details of all foundations including necessary concrete and steel work, vibration isolation devices, etc.

1.7 QUALITY ASSURANCE

A. It is the objective of this Specification to provide for the control of vibration due to the operation of machinery or equipment, and/or due to interconnected piping, ductwork or conduit.

B. The installation of all vibration isolation systems shall be under the supervision of the manufacturer's representative.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. All vibration isolation equipment and materials shall be provided by a single manufacturer. The following manufacturers are approved provided systems are in compliance with the specified design and performance requirements:

1. Amber Booth.
2. BRD Noise & Vibration Control.
3. Caldyn, California Dynamics Corp.
4. Kinetics Noise Control.
5. Mason Industries, Inc.
6. Vibration Eliminator Co., Inc.
7. Vibration Mounting and Controls.
8. Vibro-Acoustics

2.2 GENERAL

A. All equipment provided for vibration isolation shall be new and manufactured specifically for the purpose intended.

2.3 VIBRATION ISOLATORS

A. GENERAL

1. The static deflection of isolators shall be as given in the equipment schedule and specified below. The isolator schedule shall take precedence.
2. Vibration isolator sizes and layout shall be determined by the vibration isolator supplier.
3. All vibration isolators shall have either known undeflected heights or calibration markings so that, after adjustment, the amount of deflection can be verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is being provided according to the design.
4. All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range of not less than 50% above the design deflection.
5. The theoretical vertical natural frequency for each support point, based upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than ±10%.
6. All neoprene mountings shall have a Shore hardness of 30 to 60 ±5, or as specified herein, after minimum aging of 20 days or corresponding over-aging.
7. Housed or caged spring isolators are not acceptable.
8. Where steel spring isolation systems are described in the specifications, the mounting assemblies shall utilize bare springs with the spring diameter not less than 0.8 of the loaded operating height of the spring. Each spring isolator shall be designed and installed so that the ends of the spring remain parallel during and after the spring installation. All isolators shall operate in the linear portion of their load versus deflection curve and have 50% excess capacity without becoming coil bound.
9. All mounting systems exposed to weather and other corrosive environments shall be protected with factory corrosion resistance. All metal parts of mountings (except springs and hardware) shall be hot dip galvanized. Springs shall be cadmium plated and neoprene coated. Nuts and bolts shall be cadmium plated.

B. ISOLATOR TYPE SPNH

1. Type SPNH (Spring and Neoprene Hangers) shall consist of a steel spring in series with a neoprene isolating element. The spring shall have a minimum additional travel to solid equal to 50% of the specified deflection. The neoprene element shall have a static deflection of not less than 0.3 inches with a strain not exceeding 15%.
2. Unless otherwise specified, the static deflection of SPNH hangers shall be 2 inches.

3. Spring diameter and hanger box hole size shall be large enough to permit the hanger rod to swing through a 30 degree arc. A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 3/4 inch larger than the diameter of the hanger rod. When installed, the spring element shall not be cocked, and the hanger box shall be allowed to rotate through a full 360 degree arc without encountering any obstructions.

4. Type SPNH: Mason Industries Type 30N or as approved.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Contractor shall work in accord with best trade practices, shall fabricate and install all items in accordance with manufacturer's recommendations and Architect's directions, and shall consult with trades doing adjoining work in order to provide an installation of first class quality.

B. All equipment shall be mounted on or suspended from approved foundations and supports, all as specified herein, or as shown on the drawings.

C. Furnish and install neoprene mounting sleeves for hold-down bolts to prevent any metal to metal contact.

D. Lateral restraining isolators shall have the same static deflection as the vertical isolators for the equipment being isolated.

E. Unless otherwise indicated, all equipment mounted on vibration isolators shall have a minimum operating clearance of 2 inches between the bottom of the equipment and the bolt heads beneath the equipment. The clearance shall be checked by the Contractor to ensure that no material has been left to short- circuit the vibration isolators. There shall be a minimum 4 inch clearance between isolated equipment and the walls, ceiling, floors, columns and any other equipment not installed on vibration isolators.

F. Piping, ductwork, conduit or mechanical equipment shall be supported from building structure, not hung from or supported on other equipment, pipes, or ductwork.

G. Equipment connected to water or other fluid piping shall be erected on isolators or isolated foundations at correct operating heights prior to connection of piping and blocked-up with temporary shims to final operating height. When the system is assembled and fluid is added, the isolators shall be adjusted to allow removal of the shims.

H. All HVAC piping and equipment not specifically identified in this specification that contains rotating or vibrating elements, and any associated electrical apparatus installed by this division that contains transformers or inductors shall be installed on Type DDNM or RNM neoprene isolators as appropriate.

I. All wiring connections to mechanical equipment on isolators shall be made with a minimum 18 inch long flexible conduit in a “U” shaped loop.

J. Elastomeric isolators that will be exposed to temperatures below 32 degrees F shall be fabricated from natural rubber instead of neoprene.

K. Springs shall be designed and installed so that ends of springs remain parallel and all springs installed with adjustment bolts.

L. Springs shall be sized to be non-resonant with equipment forcing frequencies or support structure natural frequencies.

M. Refer to Vibration Isolation Schedule at the end of this Section.

3.2 SUSPENDED AIR HANDLING UNITS

A. External spring isolators are not required if unit is provided with internal spring isolation. If external spring isolators are provided, internal spring isolation will not be approved.

B. Fans suspended from overhead structure and which are not internally isolated shall be hung on Type SPNH spring isolators.

C. Minimum static deflection shall be 2" unless scheduled otherwise.

D. Fans shall be suspended from above only if expressly noted as such on the drawings and schedules. Thrust restraint shall be by pre-compressed isolators.

3.3 WIRING

A. All wiring connections to mechanical equipment on vibration isolators (either spring or neoprene type) shall be made with a minimum 18 inch long flexible conduit in a “U” shaped loop. This Contractor shall coordinate wiring connections with the Division 26 Contractor.

3.4 ADJUSTMENT AND TESTING

A. Site Access: During installation of equipment, Contractor shall arrange for access as necessary for inspection of isolation and noise control equipment by Architect and his representatives.

B. Contractor’s Report: The vibration isolation vendor shall inspect and approve the installation of the vibration isolators and shall submit a report to the Owner which verifies that all of the isolation equipment has been properly installed and that the installation is in full conformance with the specification. The report shall record the vibration isolator identification and model or type. For isolators containing steel springs the report shall also record the size and uncompressed height, design static deflection and measured static deflection of the isolators provided.

C. Consultant’s Inspection: Upon completing installation and adjustment for suitable operation of all work specified under this section, the Contractor shall notify the Architect in writing. The letter shall certify that all work specified under this section is complete, operational and adjusted in every respect, and that all work is ready for the completion checkout. The notification letter shall be accompanied by a copy of the air balancing report and the vibration isolation report.

3.5 GUARANTEE

A. If, in the actual installation, any equipment fails to meet the vibration control requirements specified herein, that equipment shall be corrected or replaced without claim for additional payment, inclusive of all labor and material costs. Such corrective measures shall be done within a time schedule specified by the Owner.

3.6 SCHEDULE OF VIBRATION ISOLATORS

EQUIPMENT	BASE TYPE	ISOLATOR TYPE	STATIC DEFLECTION
Suspended AHUs		SPNH	2”

END OF SECTION 230550

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. Extent of Mechanical work to be identified as required by this Section is indicated on drawings and/or specified in other Division 23 Sections.

B. Types of identification devices specified in this Section include the following:

1. Painted Identification Materials

2. Plastic Equipment Markers

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.

B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

C. Maintenance Data: Include product data and schedules in Maintenance Manuals as specified in Division 1.

1.4 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide mechanical identification materials of one of the following:

1. Allen Systems, Inc.

2. Brady (W.H.) Co.; Signmark Div.

3. Industrial Safety Supply Co., Inc.

4. Seton Name Plate Corp.

1.5 MECHANICAL IDENTIFICATION MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 23 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

1.6 PAINTED IDENTIFICATION MATERIALS

A. 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.

1.7 PLASTIC EQUIPMENT MARKERS

A. General: Provide manufacturer's standard laminated plastic, color coded equipment markers. Conform to the following color code:

1. Yellow/Green: Combination cooling and heating equipment and components.

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.

1.8 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical 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 2 - EXECUTION

2.1 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 mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

2.2 MECHANICAL EQUIPMENT IDENTIFICATION

A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:

1. HVAC units.

2. Electric heaters and heating and cooling units.

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).

END OF SECTION 230553

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SECTION 230593 - TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies the requirements and procedures for total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.

B. This section includes:

1. Pre-testing of existing air systems.

C. Test, adjust, and balance the following mechanical systems:

1. Supply air systems, all pressure ranges.

D. This Section does not include:

1. Testing boilers and pressure vessels for compliance with safety codes;
2. Specifications for materials for patching mechanical systems;
3. 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.
4. Requirements and procedures for piping and ductwork systems leakage tests.

1.2 DEFINITIONS

A. Systems testing, adjusting, and balancing is the process of checking and adjusting all the building environmental systems to produce the design objectives. It includes:

1. Balance of air distribution;
2. Adjustment of total system to provide design quantities;
3. Electrical measurement;
4. Verification of performance of all equipment and automatic controls;

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: Test data sheets arranged for collecting test data in logical order for submission and review. These 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. These are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.

H. Main: Duct or pipe containing the system's major or entire fluid flow.

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I. Submain: Duct or pipe containing part of the systems' 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. Agency Data:

1. Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.

B. Engineer and Technicians Data:

1. Submit proof that the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.

C. Procedures and Agenda: Submit a synopsis of the testing, adjusting, and balancing procedures and agenda proposed to be used for this project.

D. Maintenance Data: Submit maintenance and operating data that include how to test, adjust, and balance the building systems. Include this information in maintenance data specified in Division 1 and Section “General Mechanical Requirements”.

E. Sample Forms: Submit sample forms, if other than those standard forms prepared by the NEBB, AABC, or TABB are proposed.

F. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:

1. Draft reports: Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on the approved forms. 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.

2. 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.

3. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:

a. General Information and Summary

b. Air Systems

c. Temperature Control Systems

4. Report Contents: Provide the following minimum information, forms and data:

a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, Contractor, Owner, Architect, Engineer, and Project. Include addresses, and contact names and telephone numbers. Also include a certification

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sheet containing the seal and name address, telephone number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration.

b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the NEBB, AABC, OR TABB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.

G. Preconstruction Test Report:

1. Submit preconstruction test report of existing systems as indicated on the drawings. Submit report prior to start of construction on the affected systems for review and comment by the engineer. Reference Part 3 for test procedures.

2. Report format shall follow Draft Report procedures specified above.

3. Report shall include all information requested by the procedures for each system covered by the scope of work. Information omitted or missed during the initial or subsequent pretests shall be documented via additional site visits at no additional cost to the owner.

H. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

1.4 QUALITY ASSURANCE

A. Test and Balance Engineer's Qualifications: A certified Test and Balance Engineer on staff and having at least 5-years of successful testing, adjusting, and balancing experience on projects with testing and balancing requirements similar to those required for this project.

B. Agency Qualifications:

1. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.

2. The independent testing, adjusting, and balancing agency shall be certified by National Environmental Balancing Bureau (NEBB) or Associated Air Balance Council (AABC) or Testing Adjusting and Balancing Bureau (TABB) in those testing and balancing disciplines required for this project. Agency shall have at least one Professional Engineer certified by NEBB or AABC or TABB as a Test and Balance Engineer. The project shall be staffed at all times by qualified personnel.

C. Codes and Standards:

1. NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

2. AABC: "National Standards For Total System Balance".

3. TABB: SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing".

4. ASHRAE: ASHRAE Handbook, HVAC Applications Volume, Chapter “Testing, Adjusting, and Balancing”, most current edition.

5. ASHRAE: ASHRAE Handbook, HVAC Applications Volume, Chapter “Sound and Vibration Control”, most current edition.

6. NEBB: "Procedural Standards for the Measurement and Assessment of Sound and Vibration."

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D. Balancing Tolerances:

1. Air Systems: Balance individual terminal devices and branch lines to ± 10 percent and main ducts and air handling equipment to ± 5 percent of specified airflow.

1.5 PROJECT CONDITIONS

A. Systems Operation: Systems shall be fully operational prior to beginning procedures.

1.6 COORDINATION OF WORK

A. Coordinate mechanical work including ductwork, piping and controls to provide complete, properly tested, adjusted and balanced systems. Division 23 Contractor shall submit progress reports to communicate status of work so that the testing, adjusting and balancing work is completed in a timely manner. Division 23 Contractor shall ensure that duct systems are sealed, piping systems have been tested for leaks and equipment is operational and capable of producing the scheduled capacity requirements.

B. Coordinate with the Division 26 Contractor to verify that electrical work for mechanical equipment is complete, properly tested and operational prior to beginning procedures.

C. 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.

D. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

E. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.7 SEQUENCING AND SCHEDULING

A. Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.

B. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 5 deg. F wet bulb temperature of maximum summer design condition, and within 10 deg. F dry bulb temperature of minimum winter design condition. Take final temperature readings during seasonal operation.

PART 2 - PRODUCTS AND MATERIALS

(Not Used)

PART 3 - EXECUTION

3.1 PROCEDURES FOR ALL SYSTEMS

1. Measure and record the ambient conditions at the time of testing and balancing. Include the following:

a. Dry bulb temperature.

b. Relative humidity.

c. Cloud cover.

d. Wind speed.

e. Time.

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3.2 PRE-TESTING OF HVAC SYSTEMS

A. Perform preconstruction testing of existing air systems. Submit test report to engineer for approval. Construction or demolition of the pre-tested systems shall not proceed until the engineer has reviewed and approved the preconstruction test report.

3.3 PROCEDURES FOR PRE-TESTING OF EXISTING AIR SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

B. Contractor Responsibilities shall include the following but shall not be limited to:

1. Testing, Adjusting, and Balance Contractor:

a. Measure and record the operating speed, airflow, and total and external static pressure of each fan system. Provide individual pressure drop readings across all coils, filter banks, dampers and other internal fan system components

b. Measure motor voltage and amperage. Compare the values to motor nameplate information.

c. Check the condition of filters.

d. Check the condition of coils.

e. Check the operation of the drain pan and condensate-drain trap.

f. Check bearings and other lubricated parts for proper lubrication.

g. Report on the results of the measurements taken and any deficiencies.

2. Mechanical Contractor:

a. Check the refrigerant charge.

b. Report on the operating condition of the equipment and any deficiencies.

3.4 PRELIMINARY PROCEDURES FOR AIR SYSTEM BALANCING

A. Before operating the system, perform these steps:

1. Obtain design drawings and specifications and become thoroughly acquainted with the design intent.

2. Obtain copies of approved shop drawings of air handling equipment, outlets (supply, return, and exhaust) and temperature control diagrams.

3. Compare design to installed equipment and field installations.

4. Walk the system from the system air handling equipment to terminal units to determine variations of installation from design.

5. Check filters for cleanliness.

6. Check dampers (both volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans.

7. Verify volume dampers are installed at locations needed for balancing the air systems.

8. 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.

9. Determine best locations in main and branch ductwork for most accurate duct traverses.

10. Place outlet dampers in the full open position.

11. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.

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12. Lubricate all motors and bearings.
13. Check fan belt tension.
14. Check fan rotation.

B. Procedure for establishing minimum and absolute minimum outdoor air damper position on air handling units:

1. Open the minimum outdoor air damper and return air damper fully. Close the economizer air damper.
2. Operate supply fan at design speed and measure the outdoor airflow.
3. If the outdoor airflow is above the scheduled minimum ventilation airflow, adjust the damper linkage on the minimum outdoor air damper so that outdoor airflow equals the scheduled minimum ventilation airflow with damper fully stroked.
4. If outdoor airflow is below the scheduled minimum ventilation airflow, adjust the damper linkage on the return air damper so that outdoor airflow equals the schedule minimum ventilation airflow with the damper fully stroked.
5. Repeat this procedure to determine damper position for absolute minimum ventilation.

3.5 MEASUREMENTS

A. Provide all required instrumentation to obtain proper measurements, calibrated to the tolerances specified in the referenced standards. Instruments shall be properly maintained and protected against damage.

B. Provide instruments meeting the specifications of the referenced standards.

C. Use only those instruments which have the maximum field measuring accuracy and are best suited to the function being measured.

D. Apply instrument as recommended by the manufacturer.

E. Use instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.

F. 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 identical values are obtained.

G. Take all reading with the eye at the level of the indicated value to prevent parallax.

H. Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.

I. Take measurements in the system where best suited to the task.

3.6 PERFORMING TESTING, ADJUSTING, AND BALANCING

A. Perform testing and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards.

B. Cut insulation, ductwork, and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.

C. Patch insulation, ductwork, and housings, using materials identical to those removed.

D. Seal ducts and piping, and test for and repair leaks.

E. Seal insulation to re-establish integrity of the vapor barrier.

F. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.

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1. Energize fan motors, 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.

G. 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.

H. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

3.7 RECORD AND REPORT DATA

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. Record data obtained during testing, adjusting, and balancing including sound and vibration measurements in accordance with, and on the forms recommended by the referenced standards, and as approved on the sample report forms.

C. Prepare and submit report of recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced.

D. Prepare and submit report of recommendations for correcting any sound or vibration levels that are outside of manufacturer's tolerances, ASHRAE standards and/or values specified in the contract documents.

END OF SECTION 230593

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. Extent of Mechanical insulation required by this Section is indicated on drawings and schedules, and by requirements of this Section.

B. Types of Mechanical insulation specified in this Section include the following:

1. Piping Systems Insulation:

a. Fiberglass

b. Cellular Glass

c. Calcium Silicate

d. Flexible Elastomeric

e. Polyisocyanurate (closed cell)

2. Ductwork System Insulation:

a. Fiberglass

b. Cellular Glass

c. Flexible Elastomeric

C. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 23 Section "Hangers & Supports for HVAC Piping & Equipment," for insulation shields and pipe saddles for protecting insulation vapor barrier and materials and methods for piping installations.

1.2 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.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. 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 E 84 (NFPA 255) method.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

C. Samples: Submit manufacturer's sample of each piping insulation type required, and of each duct and equipment insulation type required. Affix label to sample completely describing product.

PART 2 - PRODUCTS AND MATERIALS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. Aeroflex USA, Inc.
2. Armacell LLC.
3. CertainTeed Corp.
4. Johns Manville
5. Knauf Insulation
6. K-Flex USA
7. Owens Corning
8. Pittsburgh Corning Corp.
9. ITW Insulation Systems, Inc.
   a. Trymer Supercel for return air plenums.
   b. Trymer 2000 in non-return air plenums.
10. Dyplast Products.

2.2 PIPING INSULATION MATERIALS

A. Flexible Elastomeric Piping Insulation: ASTM C534, Type I.

B. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.

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
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.
2. Water vapor permeability of the insulation material when tested in accordance with Test Methods E96.

C. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

1. Vapor Barrier Coating: Comply with MIL-PRF-19565C, Type II.
   a. Water-Based Mastic

1) Permeance in accordance with ASTM C755 for insulation application and service conditions and tested in accordance ASTM E96.

a) Pipe and vessels (33 deg. F to Ambient): 0.05 perms or less.

b) Pipe and vessels (-40 deg. F to 32 deg. F): 0.02 perms or less.

c) Ducts (40 degrees F to Ambient): 0.02 perms or less.

2) Foster 30-80, Childers CP-38 or equal.

b. Solvent-Based Mastic: Permeance shall be 0.05 perms or less at 35 mils dry per ASTM F 1249.

2. Lagging Adhesive: Comply with MIL-A-3316C, Class 1, Grade A. Provide Foster 30-36, Childers CP-50AHV2 or equal.

3. 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.

D. Insulation Diameters: Comply with ASTM C585 for inner and outer diameters of rigid thermal insulation.

E. Pipe, Valve and Fitting Covers: Comply with ASTM C450 for fabrication of fitting covers for pipe, valves and fittings.

F. High Density Insulation:

1. Flexible elastomeric piping insulation conforming to ASTM C534, Type 1.

2.3 DUCTWORK INSULATION MATERIALS

A. Rigid Fiberglass Ductwork Insulation: UL/ULC classified, meeting ASTM C612, Types IA or IB.

1. Density:

a. 3.0 pounds per cubic foot.

B. Flexible Fiberglass Ductwork Insulation: UL/ULC classified, meeting ASTM C553, Type II.

1. Density:

a. 1.5 pounds per cubic foot.

C. Cellular Glass Ductwork Insulation: ASTM C552, Type I.

D. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, pins with insulation retaining washers, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

E. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

1. Vapor Barrier Coating: Comply with MIL-PRF-19565C, Type II.

a. Water-Based Mastic: Permeance shall be 0.013 perms or less at 43 mils dry per ASTM E 96. Provide Fosters 30-80, Childers CP-38 or equal.

b. Solvent-Based Mastic: Permeance shall be 0.05 perms or less at 35 mils dry per ASTM F 1249.

2. Fiberglass 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.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. 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.

3.2 PIPING SYSTEM INSULATION

A. General: Reference Insulation Schedules at the end of this specification for minimum insulation conductivity and thickness requirements.

B. Insulation Omitted: 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; and

5. Flexible connections and expansion joints in pipes with fluids above ambient temperatures.

C. Exterior Piping: Insulate all exterior HVAC piping with cellular glass or flexible elastomeric of thickness noted.

D. Sub-Zero Piping (Below 0 degrees F) (-18 degrees C)):

1. Application Requirements: Insulate the following piping systems:

a. Low temperature refrigerant piping.

2. Insulate each piping system specified above with one of the following types of insulation:

a. Flexible Elastomeric:

1) Piping 2 inch and smaller: 1-1/2 inches thick.

2) Piping over 2 inches: Flexible elastomeric insulation not allowed.

E. Cold Piping (40 degrees F (4.4 degrees C) to ambient):

1. Application Requirements: Insulate the following piping systems:

a. Air conditioner condensate drain piping.

2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:

a. Flexible Elastomeric

F. Warm Temperature Piping (100 degrees to 140 degrees F (38 to 94 degrees C)):

1. Application Requirements: Insulate the following piping systems:

a. Refrigerant hot gas lines between the compressor and condensing unit.

b. Refrigerant liquid lines between the condensing unit and expansion valve.

2. Insulate each piping system specified above with one of the following types of insulation.

a. Flexible Elastomeric

3.3 DUCTWORK SYSTEM INSULATION

A. Insulation Omitted: Do not insulate fibrous glass ductwork, or lined ductwork. Refer to Section “Metal Ducts” for requirements for duct liner material.

B. Application Requirements:

1. Insulate the following duct systems:

a. Supply Air.

2. Insulate each ductwork system specified above with one of the following types and thickness of insulation:

a. Rigid Fiberglass:

1) 2” thick, minimum R-8.0.

b. Flexible Fiberglass:

1) 3” thick, minimum R-8.0

2) Meet R-value installed at maximum 25% compression, application limited to concealed locations.

3.4 INSTALLATION OF PIPING INSULATION

A. Maintain continuous thermal and vapor-retarder integrity throughout entire installation.

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. Clean and dry pipe surfaces prior to insulating.

E. 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.

3. 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.

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.

6. Provide PVC or metal jacket to protect insulation that is exposed in mechanical rooms and exposed below 10 feet.

a. Do not install PVC jacketing in return air plenums.

F. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

G. Exterior Piping:

1. Flexible Elastomeric Pipe Insulation Exposed to Weather: Protect elastomeric piping insulation using one of the following:

a. After adhesive has fully cured, apply two coats of insulation manufacturer’s recommended protective coating.

b. Provide multi-ply, polymeric blend laminate jacketing, 16 mils thick with approved adhesive. Provide insulation shields so that the piping supports do not puncture, cut or break the jacket. Seal all vertical joints with tape.

2. Locate longitudinal seams of outer shell (aluminum, flexible elastomeric, or cladding as applicable) at bottom of pipe. Install cladding in strict conformance with cladding manufacturer's instructions and apply coatings in strict conformance with insulation manufacturer's instructions. Provide insulation shields so that the piping supports cannot puncture, cut or break the jacket.

3.5 INSTALLATION OF DUCTWORK INSULATION

A. Install insulation materials with smooth and even surfaces.

B. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

C. Maintain integrity of vapor-barrier on ductwork insulation, and protect it to prevent puncture and other damage,

D. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.

3.6 EXISTING INSULATION REPAIR

A. Repair existing mechanical insulation that is 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. 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. 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.

3.8 PIPE INSULATION SCHEDULES

A. IECC – 2018 Requirements, Pipe Insulation

	Minimum Pipe Insulation Thickness						
	Insulation Conductivity		Nominal Pipe or Tube Size (in.)				
Fluid Operating Temp. Range (°F) And Usage	Conductivity, Btu·in./(hr·ft²·°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. 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.

END OF SECTION 230700

SECTION 232300

REFRIGERANT PIPING

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes refrigerant piping used for air conditioning applications. This Section includes:

1. Pipes, tubing, fittings, and specialties.
2. Special duty valves.
3. Refrigerants.

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 23 Section "Identification for HVAC Piping & Equipment," for labeling and identification of refrigerant piping.
2. Division 23 Section "Common Work Results for HVAC" for materials and methods for wall and floor penetrations and equipment pads.
3. Division 23 Section "Basic Piping Material and Methods," for materials and methods for mechanical sleeve seals.
4. Division 23 Section "Hangers & Supports for HVAC Piping & Equipment," for insulation shields, saddles and materials and methods for hanging and supporting refrigerant piping.
5. Division 23 Section "HVAC Insulation," for materials and methods for insulating refrigerant piping.

1.2 SUBMITTALS

A. Product data for the following products:

1. Each type valve specified.
2. Each type refrigerant piping specialty specified.

B. Shop Drawings showing layout of refrigerant piping, specialties, and fittings including, but not necessarily limited to, pipe and tube sizes, valve arrangements and locations, slopes of horizontal runs, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and proximate to equipment.

C. Brazer's Certificates signed by Contractor certifying that brazers comply with requirements specified under "Quality Assurance" below.

D. Test reports specified in Part 3 below.

E. Maintenance data for refrigerant valves and piping specialties, for inclusion in Operation and Maintenance Data specified in Division 01 and Division 23 Section "General Mechanical Requirements."

1.3 QUALITY ASSURANCE

A. Qualify brazing processes and brazing operators in accordance with ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications".

B. Regulatory Requirements: Comply with provisions of the following codes:

1. ASME/ANSI B16.22: Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
2. ASME/ANSI B31.5: ASME Code for Pressure Piping - Refrigerant Piping.
3. ANSI/ASHRAE Standard 15: Safety Code for Mechanical Refrigeration.
4. Mechanical Code.

C. Pipe, pipe fittings and pipe specialties shall be manufactured in plants located in the United States or certified to meet the specified ASTM and ANSI standards.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Refrigerant Valves and Specialties:

a. Alco Controls Div, Emerson Electric.

b. Danfoss Electronics, Inc.

c. EATON Corporation, Control Div.

d. Henry Valve Company.

e. Parker-Hannifin Corporation, Refrigeration and Air Conditioning Division.

f. Sporlan Valve Company.

2.2 PIPE AND TUBING MATERIALS

A. General: Refer to Part 3, Article "PIPE APPLICATION" for identification of systems where the below specified pipe and fitting materials are used.

B. Copper Tubing:

1. ASTM B280, Type ACR, seamless, hard-drawn straight lengths and soft-annealed coils. Tubing shall be factory cleaned, ready for installation, and have ends capped to protect cleanliness of pipe interiors prior to shipping.

2. ASTM B88, Type L, seamless, hard-drawn straight lengths and soft-annealed coils.

3. ASTM B88, Type K, seamless, hard-drawn straight lengths and soft-annealed coils.

C. Refrigerant Line Kits:

1. Type ACR seamless copper roll of refrigerant tubing with pipe diameters as recommended by the manufacturer and of length as required for the installation.

2. Factory or field installed flexible unicellular insulation:

a. Minimum thickness as required per Division 23 section “HVAC Insulation”.

3. Quick-connect flare tubing compression fittings or solder connections as required to match the connections of the condensing unit and evaporator coil.

2.3 FITTINGS

A. Wrought-Copper Fittings for Solder-joint: ANSI B16.22, streamlined pattern.

B. Mechanical Flared Fittings: ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tube.

2.4 JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, 95-5 Tin-Antimony.

B. Brazing Filler Metals:

1. AWS A5.8, Classification BAg-5.

a. Silver (Ag) 44.0 – 46.0%

b. Zinc (Z) 23.0 – 27.0%

c. Copper (Cu) 29.0 – 31.0%.

2. AWS A5.8, Classification BCuP – 5.

a. Phosphorus (P) 4.8 - 5.2%

b. Silver (Ag) 14.5 - 15.5%

c. Copper (Cu) remainder.

2.5 VALVES

A. General: Complete valve assembly shall be UL-listed and designed to conform to AHRI 760. Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

B. Globe: 450 psig maximum operating pressure, 275 deg. F maximum operating temperature; cast bronze body, with cast bronze or forged brass wing cap and bolted bonnet; replaceable resilient

seat disc; plated steel stem. Valve shall be capable of being repacked under pressure. Valve shall be straight through or angle pattern, with solder-end connections.

C. Check Valves - Smaller Than 7/8 inch: 500 psig maximum operating pressure, 300 deg. F maximum operating temperature; cast brass body, with removable piston, Teflon seat, and stainless steel spring; straight through globe design. Valve shall be straight through pattern, with solder-end connections.

D. Check Valves - 7/8 inch and Larger: 450 psig maximum operating pressure, 300 deg. F maximum operating temperature; cast bronze body, with cast bronze or forged brass bolted bonnet; floating piston with mechanically retained Teflon seat disc. Valve shall be straight through or angle pattern, with solder-end connections.

E. Solenoid Valves: 250 deg. F temperature rating, 400 psig working pressure; forged brass, with Teflon valve seat, two-way straight through pattern, and solder end connections. Provide manual operator to open valve. Furnish complete with NEMA 1 solenoid enclosure with 1/2 inch conduit adapter, and 24 volt, 60 Hz. normally closed holding coil.

F. Evaporator Pressure Regulating Valves: pilot-operated, forged brass or cast bronze; complete with pilot operator, stainless steel bottom spring, pressure gage tappings, 24 volts DC, 50/60 Hz, standard coil; and wrought copper fittings for solder end connections.

G. Thermal Expansion Valves: thermostatic adjustable, modulating type; size as required for specific evaporator requirements, and factory set for proper evaporator superheat requirements. Valves shall have copper fittings for solder end connections; complete with sensing bulb, a distributor having a side connection for hot gas bypass line, and an external equalizer line.

2.6 REFRIGERANT PIPING SPECIALTIES

A. General: Complete refrigerant piping specialty assembly shall be UL-listed and designed to conform to AHRI 760.

B. Strainers: 500 psig maximum working pressure; forged brass body with Monel 80-mesh screen, and screwed cleanout plug; Y-pattern, with solder end connections.

C. Moisture/liquid Indicators: 500 psig maximum operation pressure, 200 deg. F maximum operating temperature; forged brass body, with replaceable polished optical viewing window, and solder end connections.

D. Filter-driers: 500 psig maximum operation pressure; steel shell, flange ring, and spring, ductile iron cover plate with steel capscrews, and wrought copper fittings for solder end connections. Furnish complete with replaceable filter-drier core kit, including gaskets, as follows:

1. Standard capacity desiccant sieves to provide micronic filtration.

E. Suction Line Filter-Drier: 350 psig maximum operation pressure, 225 deg. F maximum operating temperature; steel shell, and wrought copper fittings for solder end connections. Permanent filter element shall be molded felt core surrounded by a desiccant for removal of acids and moisture for refrigerant vapor.

F. Suction Line Filters: 500 psig maximum operation pressure; steel shell, flange ring, and spring, ductile iron cover plate with steel capscrews, and wrought copper fittings for solder end connections. Furnish complete with replaceable filter core kit, including gaskets, as follows:

G. Flanged Unions: 400 psig maximum working pressure, 330 deg. F maximum operating temperature; two brass tailpiece adapters for solder end connections to copper tubing; flanges for 7/8 inch through 1-5/8 inch unions shall be forged steel, and for 2-1/8 inch through 3-1/8 inch shall be ductile iron; four plated steel bolts, with silicon bronze nuts and fiber gasket. Flanges and bolts shall have factory-applied rust-resistant coating.

H. Flexible Connectors: 500 psig maximum operating pressure; seamless tin bronze or stainless steel core, high tensile bronze braid covering, solder connections, and synthetic covering; dehydrated, pressure tested, minimum 7 inch in length.

2.7 REFRIGERANT

A. Refrigerant No. 410A, in accordance with ASHRAE Standard 34.

PART 3 - EXECUTION

3.1 PIPE APPLICATIONS

A. Above Grade:

1. Type L or Type ACR tubing.

B. If other than Type ACR tubing is used, clean and protect inside of tubing as specified in Article "CLEANING" below.

C. At contractor's option, use refrigerant line kits for refrigerant systems of 5 tons and smaller capacity.

3.2 PIPING INSTALLATIONS

A. General: Install refrigerant piping in accordance with ASHRAE Standard 15 - "The Safety Code for Mechanical Refrigeration" and the equipment manufacturer's installation requirements.

B. Install piping in as short and direct arrangement as possible to minimize pressure drop.

C. Install piping for minimum number of joints using as few elbows and other fittings as possible.

D. Arrange piping to allow normal inspection and servicing of compressor and other equipment. Install valves and specialties in accessible locations to allow for servicing and inspection.

E. Provide adequate clearance between pipe and adjacent walls and hanger, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full thickness insulation.

F. Insulate piping per Division 23 Section "HVAC Insulation."

1. Do not install insulation until system testing has been completed and all leaks have been eliminated.

G. Install branch tie-in lines to parallel compressors equal length, and pipe identically and symmetrically.

H. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.

I. Slope refrigerant piping as follows:

1. Install horizontal hot gas discharge piping with 1/2" per 10 feet downward slope away from the compressor.

2. Install horizontal suction lines with 1/2 inch per 10 feet downward slope to the compressor, with no long traps or dead ends which may cause oil to separate from the suction gas and return to the compressor in damaging slugs.

3. Install traps and double risers where indicated, and where required to entrain oil in vertical runs.

4. Liquid lines may be install level.

J. Use fittings for all changes in direction and all branch connections.

K. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

L. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

M. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, unless indicated to be exposed to view.

N. 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.

O. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

P. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6 inch shall be steel; pipe sleeves 6 inch and larger shall be sheet metal. Refer to Division 23 Section “Basic Piping Materials and Methods” for additional information.

Q. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of No-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 23 Section "Common Work Results for HVAC” for special sealers and materials.

R. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.

S. Install unions to allow removal of solenoid valves, pressure regulating valves, expansion valves, and at connections to compressors and evaporators.

3.3 HANGERS AND SUPPORTS

A. General: Hanger, supports, and anchors are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Conform to the table below for maximum spacing of supports:

1. Pipe attachments shall be copper-plated or have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing. Provide plastic galvanic isolators for copper tubing where indicated.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet in length.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
3. Pipe rollers complete supports for multiple horizontal runs, 20 feet or longer supported by a trapeze.
4. Spring hangers to support vertical runs.
5. Provide insulation saddles and protection shields as specified in Section “Hangers & Supports for HVAC Piping & Equipment”. Provide insulation inserts as specified in Section “HVAC Insulation”.

C. Install hangers with the following minimum rod sizes and maximum spacing:

NOM. PIPE SIZE	MAX. SPAN-FT	MIN. ROD SIZE – INCHES
Up to 3/4	5	3/8
1	6	3/8
1-1/4	7	3/8
1-1/2	8	3/8
2	8	3/8

D. Support vertical runs at each floor.

E. Install a support within one foot of each change of direction.

3.4 PIPE JOINT CONSTRUCTION

A. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."

1. WARNING: Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.
2. CAUTION: When solenoid valves are being installed, remove the coil to prevent damage. When sight glasses are being installed, remove the glass. Remove stems, seats, and packing of valves, and accessible internal parts of refrigerant specialties before brazing. Do not apply heat near the bulb of the expansion valve.

B. Copper-to-copper joints shall be made using BCuP-5 brazing filler metal without flux.

C. Dissimilar metals such as copper and brass shall be joined 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.

D. 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.

E. Heat joints using oxy-acetylene torch. Heat to proper and uniform brazing temperature.

3.5 VALVE AND PIPING SPECIALTIES INSTALLATIONS

A. General: Install refrigerant valves where indicated, and in accordance with manufacturer's instructions.

B. Install globe valves on each side of strainers and driers, in liquid and suction lines at evaporators, and elsewhere as indicated.

C. Install a full sized, 3-valve bypass around each drier.

D. Install solenoid valves ahead of each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at the top.

1. Electrical wiring for solenoid valves is specified in Division 26. Coordinate electrical requirements and connections.

E. Thermostatic expansion valves may be mounted in any position, as close as possible to the evaporator.

1. Where refrigerant distributors are used, mount the distributor directly on the expansion valve outlet.

2. Install the valve in such a location so that the diaphragm case is warmer than the bulb.

3. Secure the bulb to a clean, straight, horizontal section of the suction line using two bulb straps. Do not mount bulb in a trap or at the bottom of the line.

4. Where external equalizer lines are required make the connection where it will clearly reflect the pressure existing in the suction line at the bulb location.

F. Install pressure regulating and relieving valves as required by ASHRAE Standard 15.

G. Install strainers immediately ahead of each expansion valve, solenoid valve, hot gas bypass valve, compressor suction valve, and as required to protect refrigerant piping system components.

H. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

1. Install moisture/liquid indicators in lines larger than 2-1/8 inch OD, using a bypass line.

3.6 EQUIPMENT CONNECTIONS

A. The Drawings indicate the general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow servicing and maintenance.

3.7 FIELD QUALITY CONTROL

A. Inspect, test, and perform corrective action of refrigerant piping in accordance with ASME Code B31.5, Chapter VI. Provide test report summarizing the test procedures and results of the tests.

B. Repair leaking joints using new materials, and retest for leaks.

C. Field Test: Every refrigerant-containing part of every system that is erected on the premises, except safety devices, pressure gauges, control mechanisms, compressors, evaporators, and systems that are factory-tested, shall be tested and proved tight after complete installation and before operation. The high side and low side of each system shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure-relief device protecting the high side and low side of the system, respectively.

D. Testing Procedure: Tests shall be performed with dry nitrogen. The means used to build up the test pressure shall have either a pressure-limiting device or a pressure-reducing device and a gage on the outlet side. The pressure-relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system’s components.

3.8 CLEANING

A. Before installation of copper tubing other than Type ACR tubing, clean the tubing and fitting using following cleaning procedure:

1. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through the tubing by means of a wire or an electrician's tape.
2. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
3. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
4. Finally, draw a clean, dry, lintless cloth through the tube or pipe.

3.9 ADJUSTING AND CLEANING

A. Verify actual evaporator applications and operating conditions and adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.

B. Clean and inspect refrigerant piping systems in accordance with requirements of Division 23 Basic Mechanical Materials and Methods section "Pipes and Pipe Fittings".

C. Adjust controls and safeties. Replace damaged or malfunctioning controls and equipment with new materials and products.

3.10 STARTUP

A. Charge system using the following procedure:
   1. Install core in filter dryer after leak test but before evacuation.
   2. Evacuate refrigerant system with vacuum pump; until temperature of 35 deg F is indicated on vacuum dehydration indicator.
   3. During evacuation, apply heat to pockets, elbows, and low spots in piping.
   4. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.
   5. Break vacuum with refrigerant gas, allow pressure to build up to 2 psi.
   6. Complete charging of system, using new filter dryer core in charging line. Provide full operating charge.

B. Train Owner's maintenance personnel on procedures and schedules related to start-up and shut-down, troubleshooting, servicing, and preventative maintenance of refrigerant piping valves and refrigerant piping specialties.

C. Review data in Operating and Maintenance Manuals per Division 01.

D. Schedule training with Owner through the Architect, with at least 7 days advance notice.

END OF SECTION 232300

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SECTION 233113 - METAL DUCTS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes:

1. Rectangular, round, and flat-oval metal ducts and plenums for heating, ventilating, and air conditioning systems in pressure classes from minus 2 inches to plus 10 inches water gauge.

2. Wire rope hanging system.

B. Related Sections:

1. Division 23 Section "Identification for HVAC Piping & Equipment," for labeling and identification of metal ducts.

2. Division 23 Section "Common Work Results for HVAC," for materials and methods for wall penetrations and equipment pads.

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.

2. Fire-Stopping Materials.

B. Shop drawings from duct fabrication shop, drawn to a scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as the Contract Drawings, detailing:

1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.

2. Duct layout, indicating pressure classifications, duct gauge and sizes in plan view. For exhaust ducts systems, indicate the classification of the materials handled as defined in this Section.

3. Fittings.

4. Reinforcing details and spacing.

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5. Seam and joint construction details.
6. Penetrations through fire-rated and other partitions.
7. Terminal heating and cooling unit, coil, humidifier and duct silencer installations.
8. Locations of fire and fire/smoke dampers and associated duct access doors.
9. Location of manual balancing dampers.
10. Duct smoke detector locations. Refer to electrical drawings for general locations and coordinate locations with the electrical contractor.
11. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.

C. Coordination drawings for ductwork installation in accordance with Division 23 Section "General Mechanical Requirements." In addition to the requirements specified in "General Mechanical Requirements" show the following:

1. Coordination with ceiling suspension members.
2. Spatial coordination with other systems installed in the same space with the duct systems.
3. Coordination of ceiling- mounted access doors and panels required to provide access to dampers and other operating devices.
4. Coordination with ceiling-mounted lighting fixtures and air outlets and inlets.

D. 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.

E. Welding certificates including welding procedures specifications, welding procedures qualifications test records, and welders' qualifications test records complying with requirements specified in "Quality Assurance" below.

1.5 QUALITY ASSURANCE

A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel" for hangers and supports and AWS D9.1 "Sheet Metal Welding Code."

B. Qualify each welder in accordance with AWS qualification tests for welding processes involved. Certify that their qualification is current.

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.
3. NFPA 96, "Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors for Commercial Cooking Equipment," Chapter 3, "Duct System," for kitchen hood duct systems, except as indicated otherwise.

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.

F. National Air Duct Cleaners Association, Inc. (NADCA): Clean ductwork systems in accordance with the standard Assessment, Cleaning and Restoration of HVAC Systems (ACR 2002).

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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.

B. Replace duct liner that is damaged and cannot be repaired satisfactorily, 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 installing new duct liner.

PART 2 - PRODUCTS AND MATERIALS

2.1 SHEET METAL MATERIALS

A. Sheet Metal, General: Provide sheet metal in thickness indicated (minimum 26 gauge), packaged and marked as specified in ASTM A 700.

2.2 DUCT LINER

A. General:

1. Comply with NFPA Standard 90A and North American Insulation Manufacturers Association (NAIMA) Standard AHC-101.

2. Liner shall have a flame spread rating of not more than 25 without evidence of continued progressive combustion and a smoke developed rating of no higher than 50, when tested in accordance with ASTM E84.

3. Duct sizes on mechanical plans indicate clear inside airflow dimensions. Sheet metal sizes for ductwork with duct liner shall be increased accordingly to account for liner thickness.

B. Fiberglass: ASTM C 1071, Type I or II, glass fibers firmly bonded together with a thermosetting resin with surface exposed to airstream coated to prevent erosion of glass fibers. Liner surface shall serve as a barrier against infiltration of dust and dirt, shall meet ASTM C 1338 for fungi resistance and shall be cleanable using duct cleaning methods and equipment outlined by NAIMA Duct Cleaning Guide. Duct liner shall be rated for air velocity of 6,000 fpm.

1. Rectangular fiberglass duct liner shall be Certainteed ToughGard T, JohnsManville Linacoustic RC, Knauf Atmosphere, Owens Corning QuietR or approved equal.

a. Thickness and Density:

1) 1 inch, 1-1/2 pounds.

2. Round fiberglass duct liner shall be Certainteed ToughGard UltraRound, JohnsManville Spiracoustic Plus, Owens Corning QuietZone Spiral, or approved equal.

a. Thickness and Density:

1) 1 inch, 4 pound.

3. Thermal Performance: Meet minimum "K-Factor" equal to 0.28 (Btu·in/h·sq ft·F) or better, at a mean temperature of 75°F and rated in installed condition in accordance with ASTM C518 and/or ASTM C177.

4. Liner Adhesive: Comply with NFPA Standard 90A /UL 181 classified with flame spread/smoke development less than 25/50 and ASTM C 916. Adhesive shall be a minimum 50% solid content, water-based, non-oxidizing and have a service temperature of –20 to 200 F. Water-based adhesive shall be one of the following:

a. Armacell LLC Armsflex 520 BLV low VOC.

b. Design Polymerics DP 2502.

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c. Duro Dyne WIT.

d. Foster 85-60.

e. Childers CP-127.

f. Johns Manville SuperSeal HV.

g. Hardcast 951.

h. United McGill Uni-Tack.

5. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct.

a. Fastener Pin Length: As required for thickness of insulation, and without projecting more than 1/8 inch into the airstream.

b. Adhesive For Attachment of Mechanical Fasteners: Comply with the "Fire Hazard Classification" of duct liner system.

C. Flexible Elastomeric Duct Liner: Insulation material shall be a flexible, closed cell, elastomeric insulation in sheet form that complies with ASTM C534. Material shall have a maximum thermal conductivity of 0.27 Btu-in/h-sf-F and a minimum water vapor transmission of 0.08 perm-inches. Liner shall be 1 inch thick or greater to meet local code requirements.

1. Manufacturers:

a. Aeroflex USA, Inc Aerocel Sheet.

b. Armacell LLC Armaflex SA.

c. K-Flex USA Liner Gray.

D. Flexible elastomeric acoustical and conformable duct liner: Flexible elastomeric thermal, acoustical and conformable insulation. Compliance with ASTM C 534 Grade 1, Type II or ASTM C 1534, NFPA 90A or NFPA 90B, Thickness: 1/2 inch and 1 inch, Thermal Conductivity: 0.25 BTU-in/hr sq ft F at 75 F mean temp, ASTM C 518, Noise Reduction Coefficient: 0.6, ASTM C 423, Sound Transmission Class (STC) 25, ASTM E 90, EPA registered anti-microbial additive to inhibit mold and mildew, ASTM G21.

1. Manufacturers:

a. Aeroflex USA, Inc PLUS Acoustical Duct Liner.

b. Armacell LLC AP Coilflex.

c. Johns Manville.

E. Polyester Duct Liner: Duct liner shall be an engineered nonwoven, thermally bonded polyester with a smooth and durable FSK facing. Liner shall have a noise reduction coefficient of at least 0.65 per ASTM C423 and have thermal values greater or equal to an R-5 at 1 inch, R-6 at 1-1/2 inch and R-8 at 2 inch, respectively. Polyester liner must be able to withstand a constant internal temperature up to 250 F, must be compliant with Greenguard Environmental Institute, and contain zero VOCs per ASTM D5116. Liner must comply with NFPA 90A, NFPA 90 B and UL 181. Liner must meet ASTM C518 for thermal conductance properties and ASTM G-21 for fungal resistance properties. Liner must consist of at least 25 percent recycled content.

1. Manufacturers:

a. Ductmate Industries “PolyArmor.”

b. K-Flex USA

c. Johns Manville.

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2.3 SEALING MATERIALS

A. Joint and Seam Sealants, General:

1. 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.

2. Duct tape shall not be used as a sealant on any ducts.

3. 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.

B. Joint and Seam Tape: 2 inches wide, glass-fiber-reinforced fabric.

C. 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.

D. 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 70 percent solids.

1. Manufacturers:

a. Childers CP-140.

b. Duro Dyne SGD.

c. Fosters 32-14.

d. Approved equal.

E. Water-Based Joint and Seam Sealant, Non-Fibrated: UL 181 listed. Sealant shall be rated to ±15 inches w.g. Sealant shall have a service temperature of –25 to 200 F and be freeze/thaw stable through 5 cycles.

1. Manufacturers:

a. Childers CP-146.

b. Design Polymerics DP 1010.

c. Ductmate Proseal/Fiberseal.

d. Duro Dyne Duroseal.

e. Fosters 32-19

f. United Duct Sealer (Water Based).

g. Hardcast 601.

F. Flanged Joint Mastics: One-part, acid-curing, silicone elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

G. 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.

1. Manufacturers:

a. Design Polymerics DP 1040.

b. Ductmate 440.

c. Hardcast 1902.

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2.4 FIRE-STOPPING

A. Fire-Resistant Sealant: Two-part, foamed-in-place, fire-stopping silicone sealant formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

B. Fire-Resistant Sealant: One-part elastomeric sealant formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

C. Products: Subject to compliance with requirements, provide one of the following:

1. "3M Fire Stop Foam"; 3M Corp.
2. "SPECSEAL Pensil 200 Silicone Foam"; Specify Technology, Inc.
3. 3M Fire Stop Sealant"; 3M Corp.
4. "3M Fire Barrier Caulk CP-25"; Electrical Products Div./3M.
5. "Fyre Putty"; Standard Oil Engineered Materials Co.
6. “FS-ONE”, Hilti, Inc.

2.5 HANGERS AND SUPPORTS

A. 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.

B. Hangers: Galvanized sheet steel, or round, uncoated steel, threaded rod.

1. Hangers Installed In Corrosive Atmospheres: Electro-galvanized, all-thread rod or hot-dipped-galvanized rods with threads painted after installation.
2. Straps and Rod Sizes: Conform with SMACNA HVAC Duct Construction Standards, 2005 Edition, for sheet steel width and gauge and steel rod diameters.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes conforming to ASTM A 36.

1. Where galvanized steel ducts are installed, provide hot-dipped-galvanized steel shapes and plates.
2. For stainless steel ducts, provide stainless steel support materials.
3. For aluminum ducts, provide aluminum support materials, except where materials are electrolytically separated from ductwork.

2.6 RECTANGULAR DUCT FABRICATION

A. General: Except as otherwise indicated, fabricate rectangular ducts with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Tables 2-1 through 2-28, including their associated details. Conform to the requirements in the referenced standard for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals.

1. Fabricate rectangular ductwork of minimum 26 gauge sheet metal.
2. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.

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3. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

B. Crossbreaking or Cross Beading: Crossbreak 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.

C. Field Painted Ductwork: Provide mill phosphatized finish on exposed surfaces of rectangular ductwork and duct fittings to be field painted.

2.7 RECTANGULAR DUCT FITTINGS

A. 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.

B. 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.

C. 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.

D. Provide full radius elbows for ductwork installed in noise critical spaces. Refer to Section "Basic Mechanical Materials and Methods" for noise critical spaces. Where space does not permit the installation of radius elbows, provide mitered elbows with sound attenuating, acoustical turning vanes. Refer to Section "Ductwork Accessories" for acoustical turning vanes.

2.8 SHOP APPLICATION OF LINER IN RECTANGULAR DUCTS

A. Adhere a single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness is prohibited.

B. Apply a coat of adhesive to liner facing in direction of airflow not receiving metal nosing.

C. Butt transverse joints without gaps and coat joint with adhesive.

D. Fold and compress liner in corners of rectangular ducts or cut and fit to assure butted edge overlapping.

E. Longitudinal joints in rectangular ducts shall not occur except at corners of ducts, unless the size of the duct and standard liner product dimensions make longitudinal joints necessary.

1. Apply an adhesive coating on longitudinal seams in ducts exceeding 2,500 FPM air velocity.

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F. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely around perimeter; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

G. Secure transversely oriented liner edges facing the airstream with metal nosings that are either channel or "Z" profile or are integrally formed from the duct wall at the following locations:

1. Fan discharge.

2. Intervals of lined duct preceding unlined duct.

3. Upstream edges of transverse joints in ducts where duct velocity is greater than 2,500 FPM.

H. Terminate liner with duct buildouts installed in ducts to attach dampers, turning vane assemblies, and other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to the duct wall with bolts, screws, rivets, or welds. Terminate liner at fire dampers at connection to fire damper sleeve through fire separation.

2.9 ROUND DUCT FABRICATION

A. General: "Basic Round Diameter" as used in this article is the diameter of the size of round duct that has a circumference equal to the perimeter of a given sized of flat oval duct. Except where interrupted by fittings, provide round and flat oval ducts in lengths not less than 12 feet.

1. Fabricate round and flat oval ductwork of minimum 26 gauge sheet metal.

B. Round Ducts: Fabricate round supply ducts using seam types identified in SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figure 3-2, RL-1, RL-4, or RL-5 except where diameters exceed 72 inches. Seam Types RL-2 or RL-3 may be used for ducts smaller than 72 inches in diameter if spot-welded on 1-inch intervals. Fabricate ducts having diameters greater than 72 inches with longitudinal butt-welded seams. Comply with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Table 3-5 through 3-13 for galvanized steel gauges. For round duct with static pressure classification of 2 inches water gauge or lower, round supply ducts may be fabricated using snaplock seam types identified in SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figure 3-2, RL-6A, RL-6B, RL-7 or RL-8.

2.10 FACTORY-MANUFACTURED DUCTWORK

A. Manufacturers:

1. Hercules Industries.

2. Lewis & Lambert.

3. Lindab Safe.

4. Linx Industries, Inc.

5. Semco.

6. Approved equal.

B. General: At the Contractor’s option, factory-manufactured ductwork can be provided instead of fabricated ductwork for round and oval ductwork. The round duct system shall consist of fittings that are factory fitted with a sealing gasket and spiral duct which, when installed according to the manufacturer's instructions, will seal the duct joints without the use of duct sealer.

C. Duct Construction

1. Unless otherwise noted, all duct and fittings shall be constructed from galvanized steel in accordance with SMACNA's Duct Construction Standards for +10” water gauge pressure with thickness as shown in the following tables:

Single Wall Round Duct:

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Diameter (Inches)	Galvanized Spiral Duct	Galvanized Fittings
3-14	28	24
15-24	26	24
26-42	24	22
42-60	22	20

2. Duct shall be calibrated to manufacturer's published dimensional tolerance standard.
3. All duct 14" diameter and larger shall be corrugated for added strength and rigidity.
4. Spiral seam slippage shall be prevented by means of a flat seam and a mechanically formed indentation evenly spaced along the spiral seam.
5. Ducts shall be constructed using spiral lock seam sheet metal construction.
6. Ductwork to be installed in exposed locations shall have the surface prepared in the factory for field painting.

D. Fittings:

1. All fitting ends for round duct and transitions and divided flow fittings smaller than 50” diameter that convert oval duct to round duct shall come factory equipped with a double lipped, U-profile, EPDM rubber gasket. Gasket shall be manufactured to gauge and flexibility so as to insure that system will meet all of the performance criteria set forth in the manufacturer's literature. Gasket shall be classified by Underwriter's Laboratories to conform to ASTM E84-91a and NFPA 90A flame spread and smoke developed ratings of 25/50.
2. All fittings shall be calibrated to manufacturer's published dimensional tolerance standard and associated spiral duct.
3. All fitting ends from 5" to 60" diameter shall have rolled over edges for added strength and rigidity.
4. All elbows from 5" to 12" diameter shall be 2 piece die stamped and continuously stitch welded. All elbows 14" diameter and larger shall be standing seam gorelock construction and internally sealed.
5. The radius of all 90° and 45° elbows shall be 1.5 times the elbow diameter, unless otherwise noted on the contract documents to be 1.0. The radius of all 15°, 30° and 60° elbows shall be 1.0 times the elbow diameter.
6. All fittings that are of either spot welded or button punched construction shall be internally sealed. When contract documents require divided flow fittings, only full body fittings will be accepted. The use of duct taps is unacceptable except for retrofit installations.
7. Double wall duct and fittings shall consist of a perforated or solid inner liner, a 1 inch, 1.50 lb/ft3 (unless otherwise specified) layer of fiberglass insulation and a solid outer pressure shell. Perforated inner liner shall have a retaining fabric wrapped between the perforated inner and the fiberglass insulation. This fabric shall provide fiberglass tear retention while maintaining the desired acoustical properties. For 1 inch thick insulation, the outer pressure shell diameter shall be 2 inches larger than the inner liner.
8. All volume dampers shall be Lindab Safe type DRU, DSU or DTU or approved equal. Damper shall be fitting sized to slip into spiral duct. Damper shall have the following features:
   a. Locking quadrant with blade position indicator.
   b. 2" sheet metal insulation stand-off.
   c. Integral shaft/blade assembly.
   d. Shaft mounted, load bearing bushings.

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e. Gasketed shaft penetrations to minimize leakage.

2.11 SNAP-LOCK DUCT SYSTEM

A. General: At Contractor's option, snap-lock round ductwork can be provided instead of fabricated ductwork for round ductwork up to 14" in diameter in air systems with pressures between negative 1" and positive 2" w.c..

B. Duct Construction:

1. Material:

a. Galvanized steel conforming to ASTM A653 and A924 with G-60 galvanized coating conforming to ASTM A653 and ASTM A90.

2. Duct shall be minimum 26 gauge. Duct shall be self-locking and incorporate a factory applied gasket in the longitudinal seam and the female end of the traverse joint to provide a system that meets SMACNA Seal Class A.

3. Fittings: Minimum 26 gauge. All high-efficiency take-offs, conicals, and collars shall have a factory applied gasket along all rivets, co-latches, and flanges. Dampered fittings shall have low leakage hardware with closed-end bearings.

C. Gaskets: Butyl and EPDM rubber that meets flame spread index of 25 and smoke spread index of 50 according to ASTM E84.

D. Manufacturers:

1. Ductmate GreenSeam.

2. Hercules Industries.

3. Alpine.

4. Approved equal.

2.12 WIRE ROPE HANGING SYSTEMS

A. Manufacturers:

1. Ductmate.

2. Duro Dyne.

3. Gripple.

4. Approved equal.

B. General: At Contractors option, provide wire rope mechanical system hangers with easy lightweight mechanical adjustment system for hanging ductwork.

C. Wire rope shall be 7 x 7 or 7 x 19 aircraft quality zinc coated cable by Ductmate or galvanized steel wire rope by Duro Dyne or Gripple of size appropriate for working load being supported, including a 5:1 safety factor. Provide Ductmate WR10 through 40, Duro Dyne WC2 through WC6 or Gripple No. 1 through No. 5 wire rope for duct hanging application.

D. Secure wire rope to duct using Ductmate Clutcher, Duro Dyne Cable Lock or Gripple Hang Fast easily adjustable attachment. Locking devices shall be constructed of cast zinc housings with stainless steel springs. For seismic applications, hangers shall be seismic tested, conforming to GR 63, level 4 seismic, with UL and SMACNA seismic approvals. Reference Division 23 Section 230548 "Seismic Controls for Mechanical Systems" for additional requirements.

E. Upper hanger attachment shall be compatible with wire rope hanger system and shall be by same manufacturer as wire rope duct attachment. Provide Ductmate EZ-Lock Wire rope beam clamp mechanical hanger with locking nut for easy adjustment or Duro Dyne or Gripple ceiling, beam or purlin clip as applicable for the structure to which it is attached.

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F. Wire rope, duct attachment, and upper end attachment to structure shall each have minimum 5 to 1 safety factor based upon the weight being supported.

G. Where approved by local code authority, the loop system may be swaged directly on to a seismic approved bracket or appropriate end fixing.

PART 3 - EXECUTION

3.1 DUCT MATERIAL APPLICATION

A. All ducts shall be galvanized steel:

3.2 DUCT LINER INSTALLATION

A. Fiberglass Duct Liner:

1. Attach fiberglass duct liner using fasteners that do not damage the liner when applied as recommended by the manufacturer, that do not cause leakage in the duct, and will indefinitely sustain a 50-pound tensile dead load test perpendicular to the duct wall.

B. Flexible Elastomeric Duct Liner:

1. Attach flexible elastomeric duct liner to clean, oil-free sheet metal surfaces with adhesive as recommended by the liner manufacturer.

2. Seal all seams with adhesive and install compression joints in accordance with manufacturer's instructions.

C. Application: Provide duct liner on the following interior air ducts and where specified on the drawings.

1. Supply Ductwork:

a. First 15 feet of ductwork downstream of equipment outlets.

3.3 DUCT INSTALLATION, GENERAL

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

B. Duct System Pressure Class: Construct and install each duct system except factory-manufactured ductwork for the specific duct pressure classification indicated. For factory-manufactured ductwork, refer to Paragraph "Factory-Manufactured Ductwork".

1. Supply Air Ducts: 3 inches water gauge.

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. 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.

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J. Provide clearance of 1 inch where furring is shown for enclosure or concealment of ducts, plus allowance for insulation thickness, if any.

K. Install insulated ducts with 1-inch clearance outside of insulation.

L. 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.

M. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

N. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

O. 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.

3.4 SEAM AND JOINT SEALING

A. General: Seal duct seams and joints as follows:

1. All transverse joints, longitudinal seams, and duct wall penetrations shall be sealed to meet SMACNA Seal Class A.

2. Seal class shall apply to all supply, return, outdoor air, and exhaust ductwork, regardless if the duct is positively or negatively pressurized.

B. Seal externally insulated ducts prior to insulation installation.

C. Ductwork installed exterior to the building shall have longitudinal and transverse joints welded or sealed airtight with weatherproof heavy liquid sealant applied according to manufacturer's instructions.

3.5 HANGING AND SUPPORTING

A. Install rigid round, rectangular, and flat oval metal duct with support systems indicated in Chapter 5 of the SMACNA "HVAC Duct Construction Standards", 2005 Edition.

B. The use of wire rope hanging systems is an acceptable alternate hanging methods when installed in strict accordance with manufacturer’s instructions. Wire rope hanger spacing shall not exceed 8 feet. Supported load shall not exceed manufacturer’s recommended load rating.

C. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.

D. Support vertical ducts at a maximum interval of 16 feet and at each floor.

E. 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.

F. Install concrete insert prior to placing concrete.

G. Install powder actuated concrete fasteners after concrete is placed and completely cured.

3.6 PENETRATIONS

A. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of No-Fire Rated Walls and Concrete Slab on Grade Penetrations: Seal ducts that pass through waterproof floors, non-fire rated walls, partitions and ceilings or concrete slab on grade. Refer to Division 23 Section "Basic Mechanical Materials and Methods” for special sealers and materials.

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3.7 CONNECTIONS

A. Equipment Connections: Connect equipment with flexible connectors in accordance with Division 23 Section "Air Duct Accessories."

B. Branch Connections: Comply with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figures 4-5 and 4-6.

C. Outlet and Inlet Connections: Comply with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figures 7-6 and 7-7. 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."

D. Fan Connections: Comply with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figure 7-8.

3.8 FIELD QUALITY CONTROL

A. Remove temporary protection devices over ductwork prior to starting equipment and turning the system over to the owner.

B. 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.

3.9 ADJUSTING AND CLEANING

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. Vacuum duct systems prior to final acceptance to remove dust and debris.

3.10 CLEANING NEW SYSTEMS

A. Contractor shall clean the HVAC systems in accordance with NADCA.

B. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.

C. Use service openings, as required, for physical and mechanical entry and for inspection.

1. Create other openings to comply with duct standards.

2. Disconnect flexible ducts as needed for cleaning and inspection.

3. Remove and reinstall ceiling sections to gain access during the cleaning process.

D. Vent vacuuming system to the outside. Provide filtration and/or containment systems to keep debris removed from HVAC systems from contaminating other spaces. Locate exhaust down wind and away from air intakes and other points of entry into building.

E. Clean the following metal duct systems by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).

2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.

3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.

4. Coils and related components.

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5. Return air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
6. Supply and outdoor air ducts, dampers, actuators, and turning vanes.

F. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment while the system is under negative pressure; do not permit duct liner to get wet.
5. Clean coils and coil drain pans according to ACR 2002. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

G. Disposal: Debris collected from the HVAC system shall be disposed of in accordance with applicable federal, state and local requirements.

H. Cleanliness Verification:

1. Visually inspect metal ducts for contaminants.
2. Where contaminants are discovered, re-clean and re-inspect ducts.

3.11 CLEANING EXISTING SYSTEMS

A. Contractor shall clean the HVAC systems in accordance with NADCA.

B. Use service openings, as required, for physical and mechanical entry and for inspection.

1. Use existing service openings where possible.
2. Create other openings to comply with duct standards.
3. Disconnect flexible ducts as needed for cleaning and inspection.
4. Reseal rigid fiberglass duct systems according to NAIMA recommended practices.
5. Remove and reinstall ceiling sections to gain access during the cleaning process.

C. Mark position of dampers and air-directional mechanical devices before cleaning, and restore to their marked position on completion.

D. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron size (or larger) particles.
2. When venting vacuuming system to the outside, use filtration to contain debris removed from HVAC system, and locate exhaust down wind and away from air intakes and other points of entry into building.

E. Clean the following metal duct systems by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.

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3. Coils and related components.

4. Supply air ducts, dampers, actuators, and turning vanes.

F. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.

2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.

3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.

4. Clean fibrous-glass duct liner with HEPA vacuuming equipment while the system is under negative pressure; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.

5. Clean coils and coil drain pans according to ACR 2002. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

6. Provide operative drainage system for wash down procedures.

7. Biocidal Agents and Coatings: Apply biocidal agents, Design Polymer DP 2545, Foster 40-20 or approved equal, if fungus is present. Apply biocidal agents according to manufacturer's written instructions after removal of surface deposits and debris.

G. Disposal: Debris collected from the HVAC system shall be disposed of in accordance with applicable federal, state and local requirements.

H. Cleanliness Verification:

1. Verify cleanliness after mechanical cleaning and before application of treatment, including biocidal agents and protective coatings.

2. Visually inspect metal ducts for contaminants.

3. Where contaminants are discovered, re-clean and re-inspect ducts.

I. Gravimetric Analysis: At discretion and expense of Owner, sections of metal duct system, chosen randomly by Owner, may be tested for cleanliness according to NADCA vacuum test gravimetric analysis.

1. If analysis determines that levels of debris are equal to or lower than suitable levels, system shall have passed cleanliness verification.

2. If analysis determines that levels of debris exceed suitable levels, system cleanliness verification will have failed and metal duct system shall be re-cleaned and re-verified.

J. Verification of Coil Cleaning: Cleaning must restore coil pressure drop to within 10 percent of pressure drop measured when coil was first installed. If original pressure drop is not known, coil will be considered clean only if it is free of foreign matter and chemical residue, based on thorough visual inspection.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. Extent of ductwork accessories work is indicated on drawings and in schedules, and by requirements of this Section.

B. Types of ductwork accessories required for project include the following:

1. Dampers.
   a. Low pressure manual dampers.
2. Flexible ductwork.

C. Refer to other Division 23 Sections for testing, adjusting, and balancing of ductwork accessories; not work of this Section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Codes and Standards:

1. SMACNA Compliance: Comply with applicable portions of SMACNA "HVAC Duct Construction Standards, Metal and Flexible", 2005 Edition.
2. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.
3. UL Compliance:
   a. Construct, test, and label fire dampers in accordance with current edition of UL Standard 555 "Fire Dampers". Construct, test, and label smoke dampers in accordance with current edition of UL Standard 555S "Smoke Dampers".
   b. Construct flexible ductwork in compliance with UL Standard 181 “Factory-Made Air Ducts and Connections”.
   c. Duct tape shall be labeled in accordance with UL Standard 181B and marked 181B-FX.
   d. Duct clamps shall be labeled in accordance with UL Standard 181B and marked 181B-C.
   e. Fire rated duct wrap shall meet the fire protection requirements defined by UL Standard 1479 “Fire Tests of Through-Penetration Firestops.”.
4. NFPA Compliance:
   a. Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories. Comply with NFPA 90B “Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
   b. Comply with NFPA 96 “Ventilation Control and Fire Protection of Commercial Cooking Operations” for fire-rated grease exhaust ducts.
5. ASTM Compliance: Products shall have flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 “Surface Burning Characteristics” (NFPA 255) method.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory including dimensions, capacities and materials of construction; and installation instructions. Submit performance data for duct silencers including insertion loss performance in octave bands from 63 Hz to 8,000 Hz and pressure drop at specified airflow.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components.

C. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.

1.4 SPARE PARTS

A. Furnish extra fusible links to Owner, one link for every 10 installed of each temperature range; obtain receipt.

PART 2 - PRODUCTS AND MATERIALS

2.1 DAMPERS

A. Low Pressure Manual Dampers: Provide dampers of single blade type or multi-blade type, constructed in accordance with SMACNA "HVAC Duct Construction Standards". Damper material shall be galvanized steel for standard air systems, aluminum for wet or natatorium environments and stainless steel for corrosive environments. Bearings shall be corrosion resistant, molded synthetic and axles shall positively lock into the damper blade. Extended shafts shall be metal material. Blade seals shall be neoprene for round dampers. Blade seals shall be silicone for rectangular dampers. Dampers shall be Greenheck Model MBD Series, or approved equal, with locking quadrant. Provide with standoff bracket and shaft extension as required for insulation requirements.

B. Manufacturer: Subject to compliance with requirements, provide dampers of one of the following:

1. Air Balance, Inc.
2. Arrow United Industries.
3. Cesco
4. Greenheck
5. Louvers & Dampers, Inc.
6. Nailor Industries, Inc.
7. Pottorff
8. Ruskin Mfg. Co.
9. TAMCO
10. Vent Products

2.2 TURNING VANES

A. Manufactured Turning Vanes: Provide turning vanes and runners fabricated from galvanized sheet metal, lock-forming quality, ASTM A 653, minimum Coating Designation G 60, of the same gauge thickness or greater as the ductwork in which they are installed. Vanes shall be rigidly fastened with guide strips to minimize noise and vibration. Vanes in ductwork over 30" deep shall be installed in multiple sections with vanes not over 30" long and shall be rigidly fastened. Turning vanes shall be constructed per SMACNA Duct Construction Standards Metal and Flexible – 2005 Edition, Figure 4-3 and set into side strips suitable for mounting in ductwork.

B. Manufacturer: Subject to compliance with requirements, provide turning vanes of one of the following:

1. Aero Dyne Co.
2. Anemostat Products Div.; Dynamics Corp. of America.
3. Ductmate Industries.
4. Duro Dyne Corp.
5. Elgen Manufacturing Co., Inc.
6. Hart & Cooley Mfg. Co.

7. Register & Grille Mfg. Co., Inc.
8. Sheet Metal Connectors, Inc.

2.3 DUCT HARDWARE

A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:
   1. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.
   2. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

B. Manufacturer: Subject to compliance with requirements, provide duct hardware of one of the following:
   1. Ductmate Industries.
   2. Elgen Manufacturing Co., Inc.
   3. Ventfabrics, Inc.
   4. Young Regulator Co.

2.4 DUCT ACCESS DOORS

A. General: Provide, where indicated on the drawings or where specified in Part 3 of this section, duct access doors of size allowable by duct dimensions with, unless otherwise noted on the drawings, minimum size of 10” by 10” and maximum size of 24” by 24”. Provide removable section of duct where duct size is too small for a 10” by 10” access door. Construct access doors in accordance with SMACNA “HVAC Duct Construction Standards – Metal and Flexible” and as specified herein. Label access doors for fire and smoke dampers as specified in Paragraph “Installation of Ductwork Accessories.

B. Construction: Construct of same or greater gage as ductwork served, provide insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one size hinged, other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors.

C. Manufacturer: Subject to compliance with requirements, provide duct access doors of one of the following:
   1. Air Balance Inc.
   2. Ductmate Industries.
   3. Duro Dyne Corp.
   4. Register & Grille Mfg. Co., Inc.
   5. Ruskin Mfg. Co.
   6. Ventifabrics, Inc.
   7. Vent Products.
   8. Zurn Industries, Inc.; Air Systems Div.

2.5 FLEXIBLE DUCT.

A. Construction: Provide flexible ductwork conforming to UL 181-Class I, NFPA 90A and NFPA 90B and as follows. Duct types of manufacturers are indicated for reference in regards to required quality of construction and materials. Flexible duct shall have fire retardant polyethylene or reinforced metalized protective vapor barrier as follows:
   1. Low pressure (duct pressure class up to and including 2” w.g.) and medium pressure (duct pressure class greater than 2” up to and including 6” w.g.)
      a. Fire retardant polyethylene vapor barrier
         1) ATCO 80 Series
         2) Flexmaster Type 5B

3) JPL Type PR Series
4) Thermaflex Type G-KM

b. Reinforced metalized vapor barrier
1) ATCO 30 Series
2) Flexmaster Type 5M
3) JPL Type MHP Series
4) Thermaflex Type M-KE

2. Flexible ductwork shall have CPE liner with steel wire helix mechanically locked or permanently bonded to the liner.
3. Provide acoustical, fiberglass insulated duct with minimum R-value of R-6.0.

B. Manufacturer: Subject to compliance with requirements, provide flexible ductwork of one of the following:
1. ATCO Rubber Products.
2. Flexmaster.
3. JPL (J.P. Lamborn Co)
4. Thermaflex.

2.6 METAL DUCT CONNECTORS

A. Description: Factory-fabricated, slide-on transverse flange connectors, corners, cleats, gaskets, and components. Material, gauge, and shape shall match the connecting ductwork.

B. Manufacturers: Subject to compliance with requirements, provide duct connectors by one of the following or approved equal:
1. Ductmate Industries.
2. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
3. Flexmaster.
4. Approved equal.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF DUCTWORK ACCESSORIES

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Provide balancing dampers at branch takeoffs from main ducts. Unless otherwise noted on drawings, provide prefabricated 45 degree, high efficiency, rectangular/round branch duct takeoff fittings with manual balancing damper and locking quadrant for branch duct connections and take-offs to individual diffusers, registers and grilles.

C. Provide turning vanes, of same gauge as ductwork, rigidly fastened with guide strips in ductwork having an offset of 45 degrees or more. Vanes 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.

D. Provide duct access doors to maintain and/or clean components internal to ductwork including, but not limited to, coils, airflow stations, motorized and backdraft dampers, humidifiers, etc, and equipment at the following locations: Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.

1. At each change in direction and at maximum 50-foot (15-m) spacing.
2. Upstream from turning vanes.
3. Upstream or downstream from duct silencers.

E. Provide duct access door(s) as scheduled below, at each fire and smoke damper within 12 inches of the device to allow for testing and maintenance. Label each door (with minimum 1” lettering) indicating which damper type is served. Door should be capable of being fully opened or provide removable door.

DUCT ACCESS DOOR SCHEDULE

Duct Width/Depth	Door Size	Quantity
10” TO 12”	10 X 10	1
14” TO 18”	12 X 12	1
20” TO 36”	14 X 14	1
38” TO 54”	18 X 18	1
56” TO 72”	18 X 18	2 (1 EACH END)
74” TO 96”	20 X 20	2 (1 EACH END)

F. Install flexible duct in accordance with manufacturer’s instructions. At a minimum, install two wraps of duct tape around the inner core connection and a metallic or non-metallic clamp over the tape and two wraps of duct tape or a clamp over the outer jacket.
1. Flexible duct runs shall not exceed 5 feet in length. Utilize the minimum length of duct to make the connections.
2. Flexible ductwork shall be installed straight as possible avoiding tight turns with a maximum of one 90 degree bend in any length. Install flexible duct fully extended minimizing compression.
3. Provide continuous length with no intermediate joints.
4. Support flexible duct from structure and not from ceiling tile, light fixtures or air terminals. Support for maximum sag of 1/2-inch per foot.
5. Avoid incidental contact with metal fixtures, water lines, pipes, or conduit.
6. Support straps/saddles shall be minimum 1-1/4” wide. Use of wire hanging systems shall utilize strap and connect wire to strap.
   a. Factory installed suspension systems are acceptable
7. Ductwork shall not be crimped against joist or truss members, pipes, conduits, etc.
8. The bend radius at the center line shall be equal to or greater than one duct diameter.
   a. Support bends approximately one duct diameter on both sides of bends.
9. Connections to ductwork and air devices shall have at least 1” overlap.

G. Provide rigid duct elbow or flexible elbow assembly where a 90 degree elbow is required at connection to air devices.

H. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.3 FIELD QUALITY CONTROL

A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

3.4 ADJUSTING AND CLEANING

A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.

B. Label access doors in accordance with Division 23 section "Identification for HVAC Piping and Equipment".

C. Final positioning of manual dampers is specified in Division 23 section "Testing, Adjusting, and Balancing for HVAC".

D. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION 233300

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SECTION 233713 - DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this Section.

B. Types of outlets and inlets required for project include the following:

1. Ceiling air diffusers.
2. Wall registers and grilles.

C. Refer to other Division 23 sections for ductwork and duct accessories required in conjunction with air outlets and inlets; not work of this Section.

D. Refer to other Division 23 sections for balancing of air outlets and inlets; not work of this Section.

1.2 QUALITY ASSURANCE

A. Codes and Standards:

1. AHRI Compliance: Test and rate air outlets and inlets in accordance with AHRI 650 "Standard for Air Outlets and Inlets".
2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
3. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".
4. ADC Seal: Provide air outlets and inlets bearing ADC Certified Rating Seal.
5. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".
6. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.
7. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.3 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.
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. Indicate selections on data.
4. 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.
5. 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.

B. Coordination Drawings: Reflected ceiling plans drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.

C. Color Samples for Initial Selection: Manufacturer’s color charts showing the full range of colors available for diffusers, registers, and grilles with factory-applied color finishes.

D. Samples for Verification: Provide samples of diffusers, registers, and grilles, in manufacturer’s standard sizes, showing the full range of colors. Prepare Samples from the same material to be used for the Work.

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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 AND MATERIALS

2.1 CEILING AIR DIFFUSERS

A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers 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.

B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility: Provide diffusers 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 ceiling air diffuser.

D. Types: Provide ceiling diffusers of type, capacity, and with accessories and finishes as scheduled on the drawings.

E. Manufacturers: Subject to compliance with requirements, provide diffusers of one of the following:

1. Carnes Co.
2. Price Industries, Inc.
3. Krueger Mfg. Co.
4. Metalaire; Metal Industries, Inc.
5. Nailor Industries, Inc.
6. Titus HVAC
7. Tuttle & Bailey; Div. of Air Systems Components, Inc.

2.2 REGISTERS AND GRILLES

A. 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.

B. Performance: Provide wall 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.

C. 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.

D. Types: Provide registers and grilles of type, capacity, and with accessories and finishes as scheduled on the drawings.

E. Manufacturers: Subject to compliance with requirements, provide registers and grilles of one of the following:

1. Carnes Co.
2. Price Industries, Inc.
3. Krueger Mfg. Co.
4. Metalaire; Metal Industries, Inc.
5. Nailor Industries, Inc.
6. Titus HVAC
7. Tuttle & Bailey; Div. of Air Systems Components, Inc.

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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 in accordance with manufacturer's written instructions, design drawings, referenced standards, and in accordance with recognized industry practices to insure 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 or, at Contractor’s option, a flexible elbow assembly as specified in Division 23 section “Metal Ducts”.

D. Locate ceiling air diffusers 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 diffusers to air patterns indicated, or as directed, before beginning air balance.

3.4 CLEANING

A. After installation of diffusers, registers, and 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 235100 - BREECHINGS, CHIMNEYS AND STACKS

PART 1 - GENERAL REQUIREMENTS

1.1 SECTION INCLUDES

A. Condensing gas vents.

1.2 SUBMITTALS

A. Product Data: Submit product data including materials, dimensions, weights, and accessories.

B. Shop Drawings: Show fabrication and installation details for breechings, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other Work. Detail assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, hangers and seismic restraints, and location and size of each field connection.

C. Quality Control Submittals:

1. Certificates: Submit certificates of materials compliance with specified ASTM, UL, and ASHRAE requirements.

2. Certificates: Submit Welders' Qualification Certificates.

3. Certificates: Submit complete engineering report certifying that stacks meet the design wind and seismic loads.

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. NFPA: Comply with NFPA 211 "Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances."

2. UL: Comply with applicable portions of UL safety standards; provide products which have been UL listed and labeled.

3. SMACNA: Comply with SMACNA's "HVAC Duct Construction Standards" for fabricated breeching and smokepipe and with SMACNA's "Guide for Steel Stack Design and Construction" for steel stacks.

4. AWS: All welders and procedures shall be certified in accordance with AWS D1.1, "Structural Welding Code-Steel," for hangers and supports and in accordance with AWS Standard D9.1, "Sheet Metal Welding Code" for duct joining and seam welding.

5. ASHRAE: Comply with the ASHRAE Systems and Equipment Handbook, Chapter 30, for Chimney, Gas Vent, and Fireplace Systems material requirements and design criteria.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Handle breeching and stack components carefully to prevent damage, denting and scoring. Do not install damaged components; replace with new.

PART 2 - PRODUCTS AND MATERIALS

2.1 SPECIAL GAS VENT – CONCENTRIC DOUBLE WALL FOR INSTANTANEOUS GAS WATER HEATERS

A. Manufacturers: Subject to compliance with requirements, provide special gas vents of one of the following:

1. Noritz "DVC"

2. Metal-Fab “Corr/Guard Vent / Air Intake System”

3. Rinnai / Ubbink “Rolux Vent System”

4. Selkirk Metalbestos “Saf-T-Vent SC System”

B. Description: Concentric, double-wall metal vents, where outer wall can be used for combustion air intake, tested according to UL 1738 and rated for 550 deg F continuously, with positive or negative flue pressure complying with NFPA 211 and suitable for condensing-gas appliances.

C. Construction: Inner shell and outer jacket separated by at least a 1/2-inch annular space.

D. Inner Shell: ASTM A 959, Type AL29-4C stainless steel.

E. Outer Jacket: Stainless steel.

F. Accessories: UL labeled tees, adjustable and variable lengths, elbows, increasers, draft hood connectors, dampers, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

1. Provide round chimney top designed to exclude 98 percent of rainfall.

2.2 CONDENSING GAS FURNACE AND APPLIANCE VENT:

A. Materials: Schedule 40 CPVC plastic pipe complying with ASTM F441/F441M. CPVC shall not exceed flame spread rating of 25 and smoke spread rating of 50 per ASTM E84.

B. Fittings: Schedule 40 CPVC plastic fittings complying with ASTM F438 with socket type joints.

C. CPVC Solvent Cement: ASTM F493.

2.3 GUYING AND BRACING MATERIALS

A. Cable: Galvanized, stranded wire of the following thickness:

1. Minimum Size: 1/4 inch in diameter

2. For ID Sizes 4 to 15 inches: 5/16 inch in diameter.

3. For ID Sizes 18 to 24 inches: 3/8 inch in diameter.

4. For ID Sizes 27 to 30 inches: 7/16 inch in diameter.

5. For ID Sizes 33 to 36 inches: 1/2 inch in diameter.

6. For ID Sizes 39 to 48 inches: 9/16 inch in diameter.

7. For ID Sizes 51 to 60 inches: 5/8 inch in diameter.

B. Pipe: 1-1/4 inch diameter, galvanized steel.

C. Angle Iron: Galvanized steel 2 by 2 by 1/4 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Listed Special Gas Vent for Instantaneous Gas Water Heaters: concentric double wall.

3.3 INSTALLATION, GENERAL

A. Install products in accordance with manufacturer's instructions and UL listing. Maintain minimum clearances from combustibles specified in UL listing.

3.4 INSTALLATION OF SPECIAL GAS VENTS

A. Connect and seal joints between sections of venting system per manufacturer's installation instructions. Use only sealants or gaskets at joints that are approved by manufacturer.

B. Support vents at intervals recommended by the manufacturer to support the weight of the vent and all accessories, without exceeding loading of appliances. Install guy wires and/or braces where maximum unsupported lengths of stacks are exceeded.

C. Connect special gas vents to high efficiency water heater PVC DWV elbow outlets with universal appliance adapters connected to the elbow outside socket.

D. Slope: Minimum 1/4" per foot or manufacturer's recommended installation instructions, whichever is more stringent.

E. Install condensate drains at all low points in the venting system, including at appliance connections. Terminate condensate drains at code approved drain receptor.

F. Transitions: Provide flat bottom transition where required to maintain continuous slope in the vent.

G. Where polypropylene pipe is installed in a return air plenum, wrap the pipe with fire rated plenum insulation.

1. Refer to Division 23 Section "Common Work Results for HVAC" for plenum-rated fire wrap.

3.5 INSTALLATION OF CONDENSING APPLIANCE GAS VENTS

A. Support vents at intervals recommended by the manufacturer to support the weight of the vent and all accessories, without exceeding loading of appliances. Install guy wires and/or braces where maximum unsupported lengths of stacks are exceeded.

B. Slope: Minimum 1/4" per foot or manufacturer's recommended installation instructions, whichever is more stringent.

C. Install condensate drains at all low points in the venting system, including at appliance connections. Terminate condensate drains at code approved drain receptor.

D. Transitions: Provide flat bottom transition where required to maintain continuous slope in the vent.

E. Provide special gas vent in lieu of CPVC if plenum-rated CPVC is not available.

F. Coordinate vent material compatibility with the appliance manufacturer's installation instructions prior to installation.

3.6 INSTALLATION OF DAMPERS

A. Locate as close to draft hood collar as possible.

3.7 PROTECTION

A. Temporary Closure: At ends of breechings and chimneys that are not completed or connected to equipment, provide temporary closure that will prevent entrance of dust and debris until installations are completed.

3.8 ADJUSTING AND CLEANING

A. Clean breechings internally during installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth.

END OF SECTION 235100

SECTION 238126 - SPLIT SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1. Indoor evaporator fan coil units.
2. Outdoor condenser units.

1.2 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division1 Specification Sections apply to this Section.

B. Section 221300 – Sanitary Drainage and Vent Piping for condensate drains.

C. Section 230500 – Common Work Results for HVAC for concrete, reinforcement, and formwork requirements.

D. Section 230529 – Hangers and Supports for HVAC Piping and Equipment.

E. Section 230593 - Testing, Adjusting, and Balancing for HVAC for unit balancing.

F. Section 232300 – Refrigerant Piping for refrigerant piping connecting the system.

G. Section 233113 – Metal Ducts for ductwork connecting to units.

H. Section 260502 – Equipment Wiring Systems.

1.3 REFERENCE STANDARDS

A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; most current edition.

B. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; most current edition.

C. NFPA 70 – National Electric Code.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, type of refrigerant used, refrigerant pipe sizing, and electrical characteristics. Provide short circuit current rating of units with factory mounted starter or variable frequency drive.

B. Shop Drawings: Provide drawings that indicate size, profile, dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

C. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

D. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, accessories, and trouble-shooting guide.

1. Include manufacturer’s recommended maintenance schedule of units installed in a seacoast application, within 5 miles of the coast.

E. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

B. 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.

C. Units shall be designed to operate with HCFC-free refrigerants.

D. Units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995 and bear the Listed Mark.

E. The system components shall be rated in accordance with AHRI Standard 210/240, Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment.

1.6 COORDINATION

A. Coordinate layout and installation of units and suspension components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations with roof construction and actual equipment provided. Roof specialties are specified in Division 7 Sections. Concrete, reinforcement and formwork are specified in Division 3 Sections.

1.7 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: A written warranty, executed by the manufacturer and signed by the Contractor, agreeing to replace components that fail in materials or workmanship within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.

1. Warranty Period, Compressors: Manufacturers standard, but not less than 5 years after date of Substantial Completion.

1.8 SPARE PARTS

A. General: Furnish to Owner, with receipt, the following spare parts described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Fan Belts: One set for each belt-drive fan.
2. Gaskets: One set for each access door.
3. One set of spare filters of each type required for each unit.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Comfort Star.
2. Carrier.
3. Daikin US Corporation.
4. Fujitsu.
5. LG.
6. Lennox Industries, Inc..
7. Mitsubishi Electric & Electronics USA, Inc.
8. Panasonic.
9. Trane.
10. York.

2.2 INDOOR UNITS

A. General: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating and cooling element(s), controls, and accessories; wired for single power connection with control transformer. Unit designed for recessed, ceiling mounted installation.

B. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.

C. Supply Fan: Centrifugal type rubber mounted with direct or belt drive with adjustable variable pitch motor pulley.

D. Motor: Comply with NEMA designation temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

E. Air Filters: Washable type for wall-mount units, minimum 1 inch thick throwaway type for all other units, unless scheduled otherwise.

F. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.

G. Controls: Unit-mounted panel with main fan contactor, compressor contactor, compressor start capacitor, control transformer with circuit breaker, solid-state temperature- and humidity-control modules, humidity contactor, time-delay relay, reheat contactor, and high-temperature thermostat. Provide solid-state, wall-mounted control panel with start-stop switch and adjustable temperature set point.

H. Provide condensate lift pump with a built-in safety cutoff switch and integral check valve on discharge.

2.3 OUTDOOR UNITS

A. General: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.

B. Air-Cooled Condenser:

1. General: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.

2. Casing: Steel, baked enamel finish, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

3. Compressor: Hermetic scroll-type with resilient suspension system, oil strainer, crankcase heater, start capacitor, relay, contactor, and internal motor overload protection.

4. Accessories:

a. Liquid line filter drier.

b. High pressure switch (manual reset).

c. Low pressure switch (automatic reset).

d. Service valve with gauge ports.

e. Thermometer well in liquid line.

f. Low-ambient kit where scheduled.

g. Compressor short-cycling controls.

h. Reversing valve for heat pump units.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine area for compliance with requirements for installation tolerances and other conditions affecting performance of units. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Verify that flooring or ceiling system is ready to receive work and opening dimensions are as indicated on Shop Drawings.

C. Verify that power supply is available and of the correct characteristics.

3.2 INSTALLATION

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

B. Install unit level and plumb.

C. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

D. Install roof-mounted, compressor-condenser components on roof equipment supports with vibration isolation. Anchor units to supports with removable, cadmium-plated fasteners.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping. The following are specific connection requirements:

1. Arrange piping installations adjacent to units to allow unit servicing and maintenance.
2. Connect piping to air-handling units with flexible connectors.
3. Connect water supply piping to the air leaving side of water coils.
4. Connect hydronic piping to supply and return coil connections with shut-off duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

C. Route unit condensate drain to location shown on the drawings. Provide trap at drain pan, minimum of 1 inch deeper than fan pressure in inches of water and install cleanouts at changes in direction. Size condensate drain piping in accordance with local code and the following:

Piping Length	Size
Less than 10 feet	Same size as unit connection
More than 10 feet	One pipe size larger than unit connection

3.4 ADJUSTING, CLEANING, AND PROTECTING

A. Adjust fan for required airflow in accordance with Section "Testing, Adjusting and Balancing." Tighten belts as required for proper operation.

B. Adjust water coil flow, with control valves to full coil flow, to indicated gpm.

C. Adjust damper linkages for proper damper operation.

D. Set initial temperature and humidity set points.

E. Clean the entire unit including cabinet interiors just prior to substantial completion to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, intake plenum cabinet, heat exchange surfaces, cooling/heating coil sections, filter sections, access sections, etc.

3.5 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. Verify vibration isolation and flexible connections are installed correctly.
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.
6. Set outside-air and return-air mixing dampers to minimum outside-air setting.
7. Comb coil fins for parallel orientation.

8. Install new filters at completion of installation and prior to testing, adjusting, and balancing. Do not operate air handling unit without pre-filters installed.
9. Verify manual and automatic volume control, and fire and smoke dampers in connected ductwork systems are in the full-open position.
10. Disable automatic temperature control operators.

B. Start-Up Services: Start-up 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. Measure and record motor electrical values for voltage and amperage.
      c. Shut unit down and reconnect automatic temperature control operators.
      d. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for procedures for system testing, adjusting, and balancing.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.7 DEMONSTRATION

1. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of two hours on the operation and maintenance of the equipment provided under this section.
2. Content: Training shall include but not be limited to:
   a. Overview of the system and/or equipment as it relates to the facility as a whole.
   b. 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 per Division 1.
3. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner’s designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner’s representative indicating agreement that the training has been provided.
4. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION 238126

SECTION 238500 - ELECTRIC HEATING UNITS

PART 1 - GENERAL REQUIREMENTS

1.1 SECTION INCLUDES:

A. Cabinet Unit Heaters

1.2 SUBMITTALS

A. Submit Shop Drawings as required by Division 1.

B. Submit product data for each type and size of electric heater.

C. Shop Drawings shall indicate volts, phase, watts and all options that are to be provided.

D. Wiring diagrams detailing wiring for power and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.

E. Shop Drawings showing fabrication and installation of electric resistance heating units including plans, elevations, sections, details of components, and attachments to other units of Work.

F. Color Samples: Submit color samples for each type of cabinet finish furnished for Architect selection.

G. Maintenance data for electric resistance heaters to include in the operation and maintenance manual specified in Division 1. Include detailed manufacturer's instructions for cleaning.

1.3 REGULATORY REQUIREMENTS

A. Manufacturer Qualifications: Engage a firm experienced in manufacturing radiant heating panels similar to those indicated for this Project and that have a record of successful in-service performance.

B. Comply with NFPA 70 for components and installation.

C. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

3. Fire-resistance-rated, gypsum board assemblies are identical to design designations in listing and labeling agency's product directory.

D. Provide products listed and classified by Underwriter’s Laboratories, Inc. as suitable for purpose intended.

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL

A. Provide electric heaters of voltage, size and capacity as indicated on the Drawings.

B. Electric heaters shall be designed for a single circuit supply and provided with a single integral, factory-mounted power disconnect switch. Heating elements, motor and control circuits shall be subdivided and fused.

C. Elements shall consist of helically coiled nickel chromium alloy resistance wire embedded and completely surrounded in magnesium oxide, enclosed in corrosion resistant sheaths and permanently attached to corrosion resistant steel fins.

D. Motors shall be totally enclosed type, permanently lubricated and equipped with thermal overload protection with automatic reset. Motors shall be mounted on a heavy gauge formed metal bracket. After the thermostat has been satisfied, the fan shall continue to run until residual heat has been dissipated.

E. Electric heaters shall be equipped with an automatic reset thermal cutout which disconnects elements and motors in the event normal operating temperatures are exceeded.

F. Contactors, relays and control transformers shall be factory assembled and wired.

G. Provide 24 volt factory wired thermostat.

2.2 DOWNFLOW CEILING HEATERS

A. Horizontal unit heaters shall be

1. Berko
2. Brasch
3. Erincraft
4. King Electric
5. Markel
6. Q Mark
7. Raywall
8. Redd-i Products
9. Trane
10. Chromalox

B. Enclosures shall be fabricated from 20-gauge galvanized steel, with baked enamel finish. Enclosures shall house all components as called for by this Specification.

C. Heater enclosure shall be recess mounted and have supply and return from the face of the heater. Provide with trim ring for surface mounting.

D. Thermostats, disconnect switch and all interlock relays shall be installed within the heater enclosure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify conditions are acceptable prior to beginning installation.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Locate each unit in the position indicated.

C. Install units with sufficient clearance from adjacent construction, piping, ductwork and other obstructions to allow access for service and maintenance.

D. Support unit heaters from structure.

E. Install flush units tight to the wall. The unit trim shall cover the opening.

3.3 FIELD QUALITY CONTROL

A. Verify operation of each electric heating unit by measuring input voltage and current simultaneously for period of ten minutes of continuous operation.

3.4 DEMONSTRATION

A. Demonstrate location and setting procedures for thermostats and other heating controls.

END OF SECTION 238500

SECTION 260010 - GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General 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 and ME, generally describe these systems, but the scope of the electrical work includes all such work indicated in all of the Contract Documents.

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. 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 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.

B. 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.

C. The following definitions apply to excavation operations:

1. Additional Excavation: Where excavation has reached indicated sub-grade 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. Sub-base: as used in this section refers to the compacted soil layer used in pavement systems between the sub-grade and the pavement base course material.
3. Sub-grade: as used in this section refers to the compacted soil immediately below the slab or pavement system.
4. Unauthorized excavation consists of removal of materials beyond indicated sub-grade elevations or dimensions without specific direction from the Contract Administrator.

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
ADA Americans with Disabilities Act
AIA Guidelines for Design and Construction of Hospital and Healthcare Facilities
AEIC Association of Edison Illuminating Companies
ANSI American National Standards Institute
ASTM American Society of Testing Materials
AWS American Welding Society
AWWA American Water Works Association
CSA/USA Canadian Standards Association/USA
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 Manufactures' 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. Provide materials with trim that will fit properly the types of ceiling, wall, or floor finishes actually installed.

E. 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.

F. Work of this Division shall progress according to the "Construction Schedule" as described in Division 01 and as approved by the Contract Representative. 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 Section 013300 Division 01 and General Conditions for submittal requirements, in addition to requirements specified herein.

B. Submittals and shop drawings shall not contain Henderson Engineer’s firm name or logo, nor shall they contain the Henderson Engineer’s seal and signature. They shall not be copies of Henderson Engineer’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.

C. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples, and other submittals required by this Division. Provide the number of submittals required by Division 1; if hard-copy sets are provided, submit a minimum of seven (7) sets. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.

D. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.

E. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.

F. Refer to individual sections for additional submittal requirements.

G. Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time, plus to/from mailing time via the Contract Administrator, plus a duplication of this time for resubmittals, if required. Transmit submittals as soon as possible after Notice to Proceed and before electrical construction starts.

H. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.

I. Submittals shall contain the following information:

1. The project name.
2. The applicable specification section and paragraph.
3. Equipment identification acronym as used on the drawings.
4. The submittal date.
5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
6. Submittals not so identified will be returned to the Contractor without action.

J. Refer to Division 1 for acceptance of electronic submittals for this project.

K. The checking and subsequent acceptance by the Engineer and/or Contract Administrator of submittals shall not relieve responsibility from the Contractor for (1) deviations from the Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Contract Administrator prior to implementing any deviation.

1.8 SUBSTITUTIONS

A. Refer to Section 007213, Division 1 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. Refer to Division 01 and General Conditions for use of electronic files. 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.

1.10 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 Section 013300, Division 1 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.

B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.

C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.

D. Prior to Substantial Completion of the project, furnish to the Contract Administrator, for Engineer's review, and for the Owner's use, four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.

E. Each manual shall contain equipment data, approved submittals, shop drawings, diagrams, capacities, spare part numbers, manufacturer service and maintenance data, warranties and guarantees.

F. Refer to Division 1 for acceptance of electronic manuals for this project.

1.12 SPARE PARTS

A. Provide to the Owner the spare parts specified in the individual sections of this Division.

1.13 RECORD DRAWINGS

A. Refer to Section 013300, Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.

B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension from column lines.

C. Contractor shall provide As-builts to the designer as part of their closeout documents. Consultant will be then responsible for providing OA with Record Drawings.

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.

B. Deliver equipment and material to the job site in their original containers with labels intact, fully identified with manufacturer's name, make, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.

C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, including the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which becomes rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Architect.

D. Be responsible for the safe storage of tools, material and equipment.

1.15 WARRANTIES

A. Refer to Division 01 and General Conditions for Warranties in addition to requirements specified herein.

B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

C. Warrant each system and each element thereof against all defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in these Construction Documents or manufacturer's standard warranty exceeds 12 months. Remedy all defects, occurring within the warranty period(s), as stated in the General Conditions and Division 01.

D. Also warrant the following additional items:

1. All raceways are free from obstructions, holes, crushing, or breaks of any nature.
2. All raceway seals are effective.
3. The entire electrical system is free from all short circuits and unwanted open circuits and grounds.

E. The above warranties shall include labor and material. Make repairs or replacements without any additional costs to the Owner.

F. Perform the remedial work promptly, upon written notice from the Contract Administrator or Owner.

G. At the time of Substantial Completion, deliver to the Owner all warranties, in writing and properly executed, including term limits for warranties extending beyond the one year period, each warranty instrument being addressed to the Owner and stating the commencement date and term.

PART 2 - PRODUCTS AND MATERIALS

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.

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.

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. Channel walls and floors as required to produce the desired result; however, obtain permission from the Contract Administrator for all 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.

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. Provide 208Y/120 volt, three-phase, four-wire, temporary electrical service and temporary lighting system to facilitate construction.

B. 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.

C. 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.

D. Install all temporary wiring in accordance with applicable codes, and maintain in an OSHA-approved manner.

E. Provide an adequate number of GFCI type power distribution centers, rated 208Y/120V, four-wire, and not less than 60A, with sufficient fuse blocks or breakers for lighting and hand tool circuits, 60A four-wire feeders, all mounted within pre-fabricated enclosures UL listed for this application or on suitable wood panels bolted to columns or upright wood supports as required.

F. Install circuits to points on each level of each building so that service outlets can be reached by a 50-foot extension cord for 120V power and a 100-foot extension cord for 208V power (or as required by OSHA or local authorities).

G. Provide one lighting outlet per 30 linear feet of corridor and at least one light in each room and for every 800 square feet of floor area. Temporary lighting shall comply with OSHA requirements.

H. If additional service is required for electrical welders or for electric motors over 1/2 HP per unit, such additional service shall become the responsibility of the trade involved.

I. When the permanent wiring for lighting and power is installed, with approval of the Contract Administrator and Owner, the permanent system may be used, provided the Contractor assumes full responsibility for all electrical material, equipment, and devices contained in the systems and provided that roof drainage system and roofing are complete.

J. When directed by the Contract Administrator, remove all temporary services, lighting, wiring and devices from the property.

3.6 SELECTIVE DEMOLITION

A. Refer to Division 01 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 so as 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. Provide all necessary cutting of walls, floors, ceilings and roofs for work under this Division.

B. Cut no structural member without permission from Contract Representative.

C. Patch around all openings to match adjacent construction.

D. After the final waterproofing membrane has been installed, roofs may be cut only with written permission by the Contract Administrator.

3.10 PAINTING

A. Refer to Section 099123 “Interior 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. Remove dirt and refuse, resulting from the performance of the Work, from the premises as required to prevent accumulation. Cooperate in maintaining reasonably clean premises at all times.

B. Immediately prior to final inspection, make a final cleanup of dirt and refuse resulting from the Work and assist in making the premises broom clean. Clean all material and equipment installed under this Division.

C. Remove dirt, dust, plaster, stains, and foreign matter from all surfaces.

D. Touch up and restore damaged finishes to their original condition.

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. Each power, lighting and control circuit shall be energized, tested and proved free of breaks, short-circuits and unwanted grounds.

B. After all systems have been inspected and adjusted, confirm all operating features required by the Drawings and Specifications and make final adjustments as necessary.

C. Demonstrate that all equipment and systems perform properly as designed per Drawings and Specifications.

D. 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 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.

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. Building service entrance voltage and amperes at each phase.
   2. Electrical service grounding conditions and grounding resistance.
   3. Proper phasing throughout the entire system.
   4. Voltages (phase-to-phase and phase-to-neutral) and amperes at each phase for each panelboard, switchboard, and the like.
   5. Phase voltages and amperes at each three-phase motor.
   6. Test all wiring devices for electrical continuity and proper polarity of connections.

D. Promptly correct all failures or deficiencies revealed by these tests as determined by the Engineer.

3.15 SUBSTANTIAL COMPLETION REVIEW

A. Prior to requesting a site observation for "CERTIFICATION OF SUBSTANTIAL COMPLETION", complete the following items:
   1. Submit complete Operation and Maintenance Data.
   2. Submit complete Record Drawings.
   3. Perform all required training of Owner's personnel.
   4. Turn over all spares and extra materials to the Owner, along with a complete inventory of spares and extra materials being turned over.
   5. Perform start-up tests of all systems.
   6. Remove all temporary facilities from the site.
   7. Comply with all requirements for Substantial Completion in the Division 01 and General Conditions.

B. Request in writing a review for Substantial Completion. Give the Contract Administrator at least seven (7) days notice prior to the review.

C. Upon receipt of a request for review, the Contract Administrator will either proceed with the review or advise the Contractor of unfilled requirements.

D. If the Contractor requests a site visit for Substantial Completion review prior to completing the above-mentioned items, he shall reimburse the Contract Administrator and Engineer for time and expenses incurred for the visit.

E. Upon completion of the review, the Contract Administrator will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.

F. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.

G. Prior to requesting a final review, submit a copy of the final list of items to be completed or corrected. State in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

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.
4. Sealing penetrations through noise critical spaces.

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. NBR: Acrylonitrile-butadiene rubber
6. NRTL: Nationally Recognized Testing Laboratory
7. 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 Section 013300, Division 01 and Division 26 Section “General Electrical Requirements”:

1. Product data for the following products:

a. Sleeve seals.
b. Through and membrane penetration firestopping systems.
c. Joint sealers
d. Acoustical sealers

2. Shop drawings for:
   a. Detailed fabrication drawings of access panels and doors.
3. Through and Membrane Penetration Firestopping Systems Product Schedule: Provide UL listing, location, wall or floor rating and installation drawing for each penetration fire stop system.
   a. Where Project conditions require modification to qualified testing and inspecting agency's illustrations for a particular 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. Qualifications data for testing agency.
4. Record Drawings: Submit Record Drawings as required by Division 1 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 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   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.

B. Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference.

2.2 ACCESS TO EQUIPMENT

A. Available 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
   10. Locking Devices: Flush, screwdriver-operated cam locks.

2.3 SLEEVES

A. Steel sleeves for raceways and cables
   1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends and drip rings.

B. Cast iron wall pipe sleeves for raceways and cables

1. Manufacturers
   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. Cast-iron sleeve with integral clamping flange with clamping ring, and nuts for membrane flashing.
   a. Underdeck Clamp: Clamping ring with setscrews.
3. Sleeves for rectangular openings: Galvanized sheet steel with minimum 0.052- or 0.138- inch thickness as indicated and of length to suit application.
4. Coordinate sleeve selection and application with selection and application of firestopping to be used.

2.4 SEALANTS

A. SLEEVE SEALS

1. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
2. Available Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. O-Z/Gedney
   e. Pipeline Seal and Insulator, Inc.
3. Sealing Elements: Interlocking or solid sealing links shaped or pre-drilled to fit surface of cable or raceway. Include type and number required for material and size of raceway or cable.
   a. EPDM
   b. NBR
   c. Neoprene
4. Pressure Plates: Include two for each sealing element. For multi-phase circuits, use slotted pressure plates if metal.
   a. Plastic
   b. Carbon steel
   c. Stainless steel
   d. PVC-coated steel
5. Connecting Bolts and Nuts: of length required to secure pressure plates to sealing elements. Include one for each sealing element.
   a. Carbon steel with corrosion-resistant coating
   b. Stainless steel

B. 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.
3. Elastomeric Joint Sealers: Provide the following types:
   a. 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.

b. 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, 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.

c. Products: Subject to compliance with requirements, provide one of the following:

1) One-Part, Nonacid-Curing, Silicone Sealant:

a) "Dow Corning 790," Dow Corning Corp.

b) "Dow Corning 795," Dow Corning Corp.

c) "Silglaze N SCS 2801," General Electric Co.

d) "Silpruf SCS 2000," General Electric Co.

e) "864," Pecora Corp.

f) ."Omniseal," Sonneborn Building Products Div

g) "Spectrem 1," Tremco, Inc.

h) "Spectrem 2," Tremco, Inc.

2) One-Part, Mildew-Resistant, Silicone Sealant:

a) "Dow Corning 786," Dow Corning Corp.

b) "Sanitary 1700," General Electric Co.

c) "898 Silicone Sanitary Sealant," Pecora Corp.

d) "OmniPlus," Sonneborn Building Products Div.

e) "Tremsil 600 White," Tremco Corp.

4. Acrylic-Emulsion Sealants: One-part, non-sagging, 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.

a. Products: Subject to compliance with requirements, provide one of the following:

1) "Chem-Calk 600," Bostik

2) "AC-20," Pecora Corp.

3) "Sonolac," Sonneborn Building Products Div.

4) "Tremflex 834," Tremco, Inc.

C. 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.

a. Available Manufacturers:

1) Hilti, Inc.

2) RectorSeal.

3) Specified Technologies Inc.

4) 3M Corp.

5) United States Gypsum Company.

D. ACOUSTICAL SEALANTS sealants

1. Foam Backer Rod: Closed cell polyethylene suitable for use as a backing for non-hardening sealant.

2. Non-Hardening Penetration Sealant: 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.

3. 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).

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Coordinate seals with wall, ceiling, roof or floor materials and rating of the surface (sound, fire, waterproofing, etc.)

C. Comply with NECA 1.

D. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items, unless indicated otherwise.

E. 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.

F. 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.

G. Right of Way: Yield to raceways and piping systems installed at a required slope.

3.2 SLEEVES AND SLEEVE SEALS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Provide sleeves for required openings in all concrete and masonry construction and fire, smoke, or both, partitions, for all electrical work that passes through such construction. Coordinate with all other trades and divisions to dimension and lay out all such openings.

C. Only those openings specifically indicated on the Architectural or Structural Drawings will be provided under other divisions.

D. New Construction:

1. Coordinate with Divisions 03 and 04 for installation of sleeves and sleeve seals integrally in cast-in-place, precast, and masonry walls and horizontal slabs where indicated on the Drawings or as required to support raceway penetrations.

E. 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 Contract Administrator, Owner, or both. Seal sleeves into concrete walls or slabs with a waterproof non-shrink grout acceptable to the Contract Administrator.

F. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls. Do not cut or core drill new construction without written approval from the Contract Administrator and Structural Engineer.

G. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

H. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.

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 0.138 inch.

I. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

J. Install pipe and rectangular sleeves in above-grade walls and slabs, where penetrations are not subject to hydrostatic water pressures. Ensure that drip ring is fully encased and sealed within the wall or slab.

K. Cut sleeves to length for mounting flush with both surfaces of walls.

L. Extend sleeves installed in floors 2 inches above finished floor level.

M. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed; in which case, size sleeves as recommended by the seal manufacturer.

N. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

O. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint

P. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials.

Q. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

R. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (or larger, if required by the seal manufacturer) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

S. Above Grade Concrete or Masonry Penetrations

1. Provide sleeves for cables or raceways 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. Install schedule 40 galvanized steel pipe for sleeves smaller than 6 inches in diameter.
   b. Install galvanized sheet metal for sleeves 6 inches in diameter and larger, thickness shall be 0.138 inches.
   c. Install galvanized sheet metal for rectangular sleeves
   d. Schedule 40 PVC pipe sleeves are acceptable for use in areas without return air plenums.
2. Seal elevated floor, exterior wall and roof penetrations watertight and weather tight with non-shrink, non-hardening commercial sealant. Pack with mineral wool and seal both ends with minimum of ½" of sealant.

T. Underground, Exterior-Wall Penetrations: Install cast-iron wall pipes for sleeves. Size sleeves to allow for 1-inch (or larger, if required by the mechanical sleeve manufacturer) annular clear space between sleeve and cable or raceway. 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. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
2. Inspect installed sleeve and sleeve-seal installation for damage and faulty work. Verify watertight integrity of sleeves and seals installed below grade to seal against hydrostatic pressure.

U. Elevated Floor Penetrations of waterproof membrane:

1. Provide cast-iron wall pipes for sleeves. Size wall pipe for minimum ½" annular space between wall pipe and cable or raceway.
2. Pack with mineral wool and seal both ends with minimum of ½" of waterproof sealant.
3. Secure waterproof membrane flashing between clamping flange and clamping ring.
4. Extend bottom of wall pipe below floor slab as required and secure underdeck clamp to hold wall pipe rigidly in place.

V. Interior Foundation Penetration: Provide sleeves for horizontal raceway passing through or under foundation. Sleeves shall be cast iron soil pipe two normal pipe sizes larger than the pipe served.

W. Interior Penetrations of Non-Fire-Rated Walls: Seal annular space between sleeve and cable or raceway, 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.

X. Exterior Wall Penetrations: Seal annular space between sleeve and raceway or duct, using joint sealant for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½" of waterproof sealant.

Y. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

Z. Sleeve-Seal Installation

1. Install sleeve seals for all underground raceway penetrations through walls at elevations below finished grade. Additionally, install seals inside raceways, after conductors or cables have been installed, in all raceway penetrations through walls at elevations below finished grade.
2. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

AA. Inspect installed sleeve and sleeve-seal installations for damage and faulty work. Verify watertight integrity of sleeves and seals installed below grade and above grade where installed to seal against hydrostatic pressure.

3.3 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire/smoke-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.4 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.

C. Installation of Fire-Stopping Sealant: Install sealant, including forming, packing, and other accessory materials, to fill openings around electrical raceways penetrating floors and walls, to provide fire-stops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

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.

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.

3.2 INSTALLATION, GENERAL

A. Install in accordance with manufacturer’s instructions.

3.3 ELECTRICAL DEVICES

A. Install disconnect switches, controllers, control stations, and control devices (other than temperature control devices) specified in other divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this Contract.

3.4 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.

3.5 HVAC 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 260510 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes general construction materials and methods, communications equipment coordination, and common communications installation requirements as follows:

1. Pathways for Communications Systems

a. Conduits and Backboxes

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING

A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.

A. Division 26 Section “Common Work Results for Electrical” for electrical systems coordination.

B. Division 26 Section “Grounding and Bonding for Electrical Systems” for electrical systems coordination.

C. Division 26 Section “Hangers and Supports for Electrical Systems” for electrical systems coordination.

D. Division 26 Section “Raceways and Boxes for Electrical Systems” for electrical systems coordination.

1.3 CODES, REFERENCES, AND STANDARDS

A. Follow all applicable codes, references, and standards listed in Division 26 Section “General Electrical Requirements”.

B. The references to the following standards and guidelines represent the most current and up-to-date revisions or printing as of the issue of this document including all sections, parts and their addenda. The Contractor is responsible for following the correct revision or printing (UON).

1. TIA-569 – “Telecommunications Pathways and Spaces”

2. BICSI Telecommunications Distribution Methods Manual (TDMM)

1.4 QUALITY ASSURANCE

A. All cable supports shall be manufactured by a company which produces cable supports. No field made apparatus will be accepted without prior written approval.

1.5 SUBMITTALS

A. General: Submit the following in accordance with Division 01 and Division 26 Section “General Electrical Requirements”:

1. Shop Drawings for:

a. Submit for review scaled layout drawings showing the routing of all pathways and firestop locations (with quantity and NRTL system number identified), Each pathway shall be identified by type and size on the drawings.

b. Unless otherwise required by these specifications, it is permissible to show different pathways systems (conduit, cable tray, auxiliary supports, etc.) on the same shop drawing.

2. Record Documents:

a. Resubmittal of approved product submittals, with installation and O&M manuals.

b. Floor plans shall show the routing of all pathways and firestop locations (with quantity and NRTL system number identified) as actually installed. Each pathway shall be identified by type and size on the drawings.

c. Letter stating that the Telecommunications Grounding and Bonding System has been installed in accordance with the referenced standards and contract documents, including testing requirements.

1.6 DEFINITIONS

A.

B. IMC – Intermediate Metal Conduit

C. Point of Entrance (Building Entrance) – The point within a building where the Outside Plant (OSP) communications cabling emerges from an external wall, a concrete floor slab, or IMC/RMC. If Communications Point of Entrance isn't identified on the drawings, assume the Main Communications Room (MDF) also acts as the Point of Entrance.

D. RCDD – Registered Communications Distribution Designer as certified by BICSI

E. RMC – Rigid Metal Conduit

1.7 COORDINATION

A. Coordinate arrangement, mounting, and support of communications equipment with Telecommunications equipment furnished by Owner and Telecommunications service providers.

B. Coordinate arrangement, mounting, and support of communications equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

2. To allow right of way for piping, ducts, and other systems installed at required slopes and/or elevations.

3. So connecting raceways, cables, and wireways will be clear of obstructions and of the working and access space of other equipment.

C. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

D. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed.

E. Coordinate testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PARTS AND MATERIALS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

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.

B. Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference.

2.2 PATHWAYS FOR COMMUNICATIONS SYSTEMS

A. Raceways and Boxes for Communications Systems

1. General Requirements

a. Refer to Division 26, "Raceways and Boxes for Electrical Systems" for Available Manufacturers and other specific product, material and installation requirements.

b. Outlet boxes located in plenum accessible ceiling space shall be listed for installation in a plenum.

c. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified in the following paragraphs. Manufacturers and model numbers listed are used only to represent the characteristics required and are not intended to restrict the use of other Available Manufacturers models that meet the specified criteria.

2. Back boxes for Telecommunications Systems (Telephone, Data, and Multi-Service Outlets) installed in stud walls:
    a. Requirements:
        1) Minimum size of 4-11/16 inches (119.1 mm) width by 4-11/16 inches (119.1 mm) height by 2-1/8 inches (54 mm) depth
        2) with a single-gang raised cover/extension ring a minimum of 3/8” deep. Depth shall match that of wall gypsum board(s)
    b. Manufacturer shall be:
        1) Appleton 4SJD-1 series with single gang extension ring
        2) RACO 258/259 series with single gang extension ring
        3) Randl T-55017 with single gang extension ring
3. Back boxes for Telecommunications Systems (Telephone, Data, and Multi-Service Outlets) installed in masonry construction:
    a. Requirements:
        1) Minimum size shall be single gang, a minimum of 3-1/2 inches deep.
    b. Manufacturer shall be:
        1) Single gang
            a) RACO 695/8695 or equivalent
            b) Appleton MI-250 series or MI-350 series.
            c) RACO 690 series or 695 series.
            d) Steel City GW series.

PART 3 - EXECUTION

3.1 PATHWAYS FOR COMMUNICATIONS SYSTEMS

A. General
1. Unless otherwise noted, pathway routing shown on the Drawings is illustrative only and meant to indicate the general configuration of the work. Install pathways so that adequate clearances and offsets between pathways and other trades are provided. Coordinate all pathways with other trades prior to installation.
2. Permanently mark or tag each raceway at intervals of not more than 75 feet (22.86 m), and each junction box and pull box. Permanently mark or tag each raceway that is stubbed into the ceiling space from an outlet box. Identifying them as “TELECOM” or “AV” as appropriate.
3. Coordinate the following with cable-installing contractor.
    a. All supports shall be specifically designed to support the required cable weight and volume. Field manufactured supports will not be accepted.
    b. All pathways shall include empty space for a minimum of 25% growth beyond initial installation of cabling.
    c. Provide all communications pathways:
        1) So that cables are allowed to be pulled in accordance with referenced standards and guidelines.
        2) So that cables are allowed to be pulled without damage to conductors, shield, armor, or jacket.
        3) So that cables are not forced or allowed to exceed minimum allowed bend radius by manufacturer or referenced standards and guidelines
        4) So that the maximum allowable pulling tension is not exceeded
        5) To meet the requirements of the structure and the requirements of all other Work on the Project.

6) 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 Architect.

7) Parallel or perpendicular to building lines or column lines.

8) When concealed, with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

d. Follow manufacturer's recommendations for allowable fill capacity. Do not exceed load ratings specified by manufacturer.

4. Conduits which enter telecommunications rooms shall extend 1 inch (25.4 mm) to 3 inches (76.2 mm) AFF.
5. Flexible conduits may only be used where specifically allowed by these contract documents.
   a. Flexible conduit sections shall be less than 20 feet (6.1 m) in length and shall be increased by (1) trade size
6. No continuous section of a conduit may exceed 100 feet (30.5 m) without a pullbox.
7. Conduit runs shall not exceed a total of 150-feet (45.7 m).
8. No more than (2) 90° bends, or equivalent will be allowed between pullboxes.
   a. Each and any offset shall be considered a 90° bend.
   b. A pullbox is required wherever a reverse bend is installed.
9. The minimum bend radius for conduits is
   a. (6) times the inside diameter for 2 inches (50.8 mm) conduits or less.
   b. (10) times the inside diameter for conduits greater than 2 inches (50.8 mm).
10. Install a pull cord in each pathway (empty or not) for installation of new wires or cables. Use polypropylene or monofilament plastic line with not less than 200 lb (90.7 kg) tensile strength. Leave at least 12 inches (304.8 mm) of slack at each end of pull cord.
11. Provide appropriately sized sleeves where cables are required to pass through non-rated full-height partitions. Rated partitions shall be provided with appropriately rated firestop systems. Where allowed, sleeves shall extend a minimum of 3 inches (76.2 mm) beyond the partition surface on both sides, and shall be rigidly supported to support the weight of cables. Sleeves shall be sized so that no more than 50% of the cross-sectional area is utilized by the cabling to be installed. The minimum inside diameter of each sleeve shall be nominal 2 inches (50.8 mm).
12. No outlet boxes shall be located back-to-back in a wall cavity.
    a. Where possible offset to next stud cavity, but no less than a 6 inches (152.4 mm) separation.
13. Outlet boxes shall be within 3 feet (0.9 m) of nearest electrical outlet.
14. Provide appropriate plaster/mud ring as indicated on the drawings.
15. Provide conduit as indicated on the Drawings or required by this Specification. Minimum communications conduit size shall be 1 inch (25.4 mm). Provide a polypropylene or monofilament plastic line with not less than 200-lb (90.7 kg) tensile strength in each empty conduit. Permanently mark or tag each conduit or pull box, identifying it as Communications, at intervals of not more than 75 feet (22.9 m). Each conduit that is stubbed into the ceiling space from an outlet box shall be permanently marked or tagged.

END OF SECTION 260510

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:

1. Conductors, cables, and cords rated 600V and less.
2. Connectors and terminations rated 600V and less.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.

B. Division 26 Section “Common Work Results for Electrical” for sleeves and seals for electrical penetrations.

C. Division 26 Section “Equipment Wiring Systems” for electrical connections to equipment specified under other Sections, Divisions, or furnished by the Owner.

1.3 ABBREVIATIONS AND DEFINITIONS

A. The following abbreviations apply to this and other Sections of these specifications:

1. MC: Metal Clad

1.4 NBR: ACRYLONITRILE-BUTADIENE RUBBER

A. 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. 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.

1.5 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. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."

C. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to AHJ.

D. Electrical Components, Devices, and Accessories:

1.6 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.

1. Marked for intended use.

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

B. Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference.

2.2 CONDUCTORS AND CABLES

A. General

1. Available Manufacturer[s]:

a. AFC Cable Systems, Inc.

b. Alan Wire

c. Cerrowire

d. Colonial Wire & Cable

e. Encore Wire Corporation

f. General Cable

g. Northern Cables Inc.

h. Okonite Company

i. Southwire Company

2. Conductor Material: Annealed (soft) copper complying with ICEA S-95-658/NEMA WC70 and UL Standards 44 or 83, as applicable; stranded conductor, solid conductor for No. 10 AWG and smaller; concentric, compressed stranded for No. 8 AWG and larger and [stranded for all flexible cords, cables, and control wiring or as noted otherwise below.

3. Conductor Insulation Types: Type THHN/THWN-2 complying with ICEA S-95-658/NEMA WC70 or as noted otherwise below.

4. Sizes of conductors and cables indicated or specified are American Wire Gage (Brown and Sharpe).

5. 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.

6. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

B. Metal Clad Cable, Type MC (for non-patient care areas only. Do not use for life safety or critical systems.)

1. MC Cable (with insulated green grounding conductor, no bonding conductor):

a. Manufacturers:

1) AFC Cable Systems, Inc (MC Lite)

2) Encore Wire Corporation (MC)

3) Kaf-Tech

4) Southwire Company (Amorlite)

b. 600V, UL Standard 83, UL Standard 1569 for Type MC, UL Standard 1685, Federal Specification A-A59544, IEEE 1202 Vertical Cable Tray Flame Test and the NEC. Type MC Cable shall be listed for use in UL 1, 2, and 3 Hour Through-Penetration Firestop Systems.

c. Armor Assembly: Aluminum interlocked armor (aluminum color).

d. Phase Conductors: Solid soft-drawn copper, THHN-insulated single conductors, color code: ICEA Method 1.

e. Grounding Conductor: Solid soft-drawn copper, THHN/THWN-2 green insulated grounding conductor sized per NEC Table 250.122.

f. Marking: Cable markings shall comply with the requirements on NEC ART. 310.11.

2. MC Cable (with 0-10V dimming control wiring):

a. Manufacturers:

1) AFC Cable Systems, Inc (MC- PCS)
2) Encore Wire Corporation (MC- LED)
3) Southwire Company (MC – PCS Duo)

b. 600V, UL Standard 83, UL Standard 1569 for Type MC, UL Standard 1685, Federal Specification A-A59544, IEEE 1202 Vertical Cable Tray Flame Test and the NEC. Type MC Cable shall be listed for use in UL 1, 2, and 3 Hour Through-Penetration Firestop Systems.

c. Armor Assembly: Aluminum interlocked armor (aluminum color).

d. Phase Conductors: Solid soft-drawn copper, THHN-insulated single conductors, color code: ICEA Method 1.

e. Grounding Conductor: Solid soft-drawn copper, THHN/THWN-2 green insulated grounding conductor sized per NEC Table 250.122.

f. Control Conductors: color coded class2/class3 twisted jacketed pairs

g. Marking: Cable markings shall comply with the requirements of NEC Art 310 .11(1).

3. MC Cable Fittings:

a. Manufacturer & Model:

1) Arlington (4010 AST snap-in type): (SG38 saddle type)
2) Crouse-Hinds (QLK Quick-Lok Series, Saddle type); ACB Series; set-screw, saddle type)
3) O-Z Gedney (AMC-50 speed-lok, saddle type)
4) Thomas & Betts (XC-730 Series cable-lok, saddle type); 3110 Series Tite-Bite)

b. 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.

c. Fittings shall be insulated type not requiring the use of anti-short bushings.

d. Romex style, clamp type fittings are not acceptable.

C. Single Conductors

1. 600V, THHN/THWN-2insulated conductors, color-coded as follows:

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	N/A

**Except as provided in NFPA 70.]

2. Conductors shall not be smaller than No. 12 AWG, except that wiring for signal and pilot control circuits and pre-manufactured whips for light fixtures may be No. 14 AWG.

D. Flexible Cords

1. 300V, multi-conductor (2, 3, or 4 as indicated on the Drawings), oil-resistant black jacket, hard-usage; Type SJE,SJ, or SJT for indoor dry locations; SJEW,SJW, or SJTW for damp, wet, and outdoor locations; or as required by the manufacturer of the equipment to which the cords are connected].

E. Control Wiring

1. Unless otherwise noted, all control wiring will be the responsibility of the Section or Division in which the control system is specified.

F. Connectors

1. Available Manufacturers:
   a. AMP; Tyco
   b. FCI-Burndy
   c. Gould
   d. Ideal Industries, Inc.
   e. Ilsco
   f. NSi Industries, Inc.
   g. O-Z/Gedney
   h. Panduit
   i. Thomas and Betts
   j. 3-M Electrical Products Division
2. Compression connectors for conductors No. 8 AWG and larger: Long-barreled, UL 486-listed, bare copper, 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.
   a. Termination fittings: 1 hole pad and inspection port.
3. Mechanical connections for conductors No. 8 AWG and larger: UL-listed, bare copper and/or tinned aluminum, 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.
   a. Termination fittings: 1 hole pad and inspection port.
4. Connectors for solid conductors No. 10 AWG and smaller: Insulated winged wire nuts. Color-coded for size, except use green only for grounding connections.
5. 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.
6. 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.

PART 3 - EXECUTION

3.1 CONDUCTORS AND CABLES

A. General:

1. Unless otherwise indicated on the Drawings on 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 8 inches of conductor at outlets for fixture or device connections.
2. 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.
3. Use pulling means, including fish tape, cable, rope, and basket weave conductor/cable grips that will not damage conductors/cables or raceway.
4. 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.

5. 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).
6. Where parallel conductors are shown, install each set of conductors in separate raceways of essentially the same length.
7. Seal around cables penetrating fire-rated elements according to Part 2 of this Section.
8. Identify and color-code conductors and cables according to Division 26 Section “Identification for Electrical Systems".
9. Wiring at Outlets: Install conductors at each outlet with at least 6 inches of slack.
10. Common or Shared Neutrals are not allowed unless shown on the plans or specifically noted to be allowed.
11. Multi-wire branch circuits (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 example
12. 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.
    c. Isolated Ground (IG) Circuits:
        1) Do not use multi-conductor or MC cables.
        2) Do not share neutrals between separate circuits.
        3) Do not share the isolated grounding conductor with more than one device (i.e., each device on an IG circuit shall have its own dedicated IG conductor back to the branch panelboard IG bus).
        4) The equipment grounding conductor may be shared between IG circuits sharing a common raceway.
13. For branch circuits fed from GFCI circuit breakers, limit the one-way conductor length to 100 feet between the panelboard and the most remote receptacle or load on the GFCI circuit.
14. 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.
15. 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) Service entrance: Type THWN, THHN/THWN-2, or XHHW.

2) Feeders and branch circuits: Type THWN, THHN/THWN-2, or XHHW.

3) 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 Art 330 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 the NEC.

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. In locations not permitted by the NEC.

b. When specifically not allowed by the local AHJ and/or Owner/Landlord.

c. Homeruns to panelboards. Note: where metal clad cable is utilized for receptacle, lighting, and/or miscellaneous load branch circuiting, the originating point of the homerun shall be at the first (most upstream) load in the circuit or at a junction box located in the accessible ceiling space immediately above the first (most upstream) load. Reference definitions in this section for definition on “Homerun”.

d. Where exposed to view.

e. Where subject to physical damage.

f. Corrosive or Hazardous locations.

g. Wet locations.

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 specified, and permitted by local codes, only cable for communication or fire alarm systems and low voltage control wiring may be installed without raceways.

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 and UL 486B.

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 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.
5. Connect conductors No. 6 AWG and larger to panelboards and apparatus by means of approved mechanical lugs or compression connectors.
6. Do not use terminals on wiring devices to feed through to the next device.

END OF SECTION 260519

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

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.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.

b. Cooper B-Line, Inc.; a division of Cooper Industries.

c. ERICO International Corporation.

d. GS Metals Corp.

e. Thomas & Betts Corporation.

f. Unistrut; Tyco International, Ltd.

g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least 1 surface.

1. [Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.

b. Cooper B-Line, Inc.; a division of Cooper Industries.

c. Fabco Plastics Wholesale Limited.

d. Seasafe, Inc.

2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.

3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.

4. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

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. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Hilti Inc.

2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

3) MKT Fastening, LLC.

4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.

7. Hanger Rods: Threaded steel.

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. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. 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 single-bolt conduit clamps.

D. 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. Raceway Support Methods: In addition to methods described in NECA 1, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. 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).

D. 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 Existing Concrete: Expansion anchor fasteners.
5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
6. To Light Steel: Sheet metal screws.
7. 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 by means that meet seismic-restraint strength and anchorage requirements].

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS D1.1/D1.1M.

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. Touchup: Comply with requirements in Division 09 painting Sections 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.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL REQUREMENTS

1.1 SUMMARY

A. This Section includes:

1. Raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.

B. Division 26 Section “Common Work Results for Electrical” for limited scope general construction materials and methods.

C. Division 26 Section “Equipment Wiring Systems” for electrical connections to equipment specified under other Sections, Divisions, or furnished by the Owner.

D. Division 26 Section “Hangers and Supports for Electrical Systems”.

E. Division 26 Section “Identification for Electrical Systems”.

F. Division 26 Section "Wiring Devices" for devices installed in boxes, power poles, and multi-outlet assemblies.

1.3 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. IMC: Intermediate Metal Conduit
5. LFMC: Liquidtight Flexible Metal Conduit
6. LFNC: Liquidtight Flexible Nonmetallic Conduit
7. RAC: Rigid Aluminum Conduit
8. RMC: Rigid Metal Conduit
9. RNC: Rigid Nonmetallic Conduit

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. 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 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

B. Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference.

2.2 CONDUITS, SURFACE MOUNTED RACEWAYS AND ACCESSORIES

A. Metal Conduit And Tubing

1. Available Manufacturers:
    a. AFC Cable Systems, Inc.
    b. Alflex Corporation, a Southwire Company
    c. Anamet Electrical, Inc.; Anaconda Metal Hose.
    d. Electri-Flex Co.
    e. Indalex
    f. Manhattan/CDT/Cole-Flex
    g. O-Z/Gedney; Unit of General Signal (Fittings)
    h. Republic Raceway
    i. Tyco International; Allied Tube & Conduit Div.
    j. Western Tube and Conduit Corporation
    k. Wheatland Tube Co.
2. RMC:
    a. GRS: Hot-dip galvanized: ANSI C80.1, UL 6.
    b. RAC: ANSI C80.5, UL6A.
3. IMC: ANSI C80.6, UL 1242.
4. EMT and Fittings: ANSI C80.3, UL 797.
    a. Fittings: Set-screw or compression type.
5. FMC: Aluminum or Zinc-coated steel: UL 1.
6. LFMC: Flexible steel raceway with PVC jacket: UL 360.
    a. Fittings: NEMA FB 1; compatible with raceway and tubing materials.

B. Nonmetallic Raceway

1. Available Manufacturers:
    a. AFC Cable Systems, Inc. (Tubing)
    b. American International.
    c. Anamet Electrical, Inc.; Anaconda Metal Hose.
    d. Arnco Corp.
    e. Cantex Inc.
    f. Certainteed Corp.; Pipe & Plastics Group.
    g. Condux International.
    h. ElecSYS, Inc.
    i. Electri-Flex Co.
    j. Lamson & Sessions; Carlon Electrical Products.
    k. Manhattan/CDT/Cole-Flex.
    l. Prime Conduit (formerly Carlon)
    m. RACO; Division of Hubbell, Inc.
    n. Spiralduct, Inc./AFC Cable Systems, Inc.
    o. Superflex Ltd.
    p. Thomas & Betts Corporation.
2. RNC: Schedule 40 and 80 PVC: NEMA TC 2, UL 651.
    a. Fittings: match to raceway type and material: NEMA TC 3, NEMA TC 6, UL 651, as applicable.

b. Fittings: match to tubing type and material: NEMA TC 3, NEMA TC 6, UL 651, as applicable.

3. LFNC: UL 1660.

a. Fittings: match to tubing type and material: NEMA TC 3, NEMA TC 6, UL 651, as applicable.

C. Surface Metal Raceways

1. Available Manufacturers:

a. Wiremold/Legrand.

b. Mono-Systems, Inc.

c. Panduit Corp

2. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.

3. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

D. Surface Nonmetallic Raceways

1. Available Manufacturers:

a. Butler Manufacturing Co.; Walker Division.

b. Enduro Composite Systems.

c. Hubbell, Inc.; Wiring Device Division.

d. Lamson & Sessions; Carlon Electrical Products.

e. Panduit Corp.

f. Mono-Systems, Inc.

g. Wiremold/Legrand

2. Two-piece construction, manufactured of rigid PVC compound with matte texture and manufacturer's standard color.

3. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.3 BOXES, ENCLOSURES AND CABINETS

A. General

1. Available Manufacturers:

a. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.

b. Emerson/General Signal; Appleton Electric Company.

c. Erickson Electrical Equipment Co.

d. Hoffman.

e. Hubbell, Inc.

f. Killark Electric Manufacturing Co.

g. O-Z/Gedney; Unit of General Signal.

h. RACO; Division of Hubbell, Inc.

i. Robroy Industries, Inc.; Enclosure Division.

j. Scott Fetzer Co.; Adalet-PLM Division.

k. Spring City Electrical Manufacturing Co.

l. Thomas & Betts Corporation.

m. Walker Systems, Inc.; Wiremold Company (The).

n. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary

B. Outlet Boxes

1. Sheet Metal Outlet and Device Boxes: NEMA OS 1; UL514A.

2. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.
3. Nonmetallic Outlet and Device Boxes: NEMA OS 2
4. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified in the following paragraphs. Manufacturers and model numbers listed are used only to represent the characteristics required and are not intended to restrict the use of other Available Manufacturers listed above and models that meet the specified criteria.
   a. Boxes for exposed work: deep drawn type with raised covers:
      1) Appleton 4S 1/2-DR; 8300 series cover.
      2) RACO 190 series; 800 series cover.
      3) Steel City 52150 series; RS series cover.
   b. Concealed and exposed boxes for lighting:
      1) Appleton 40-3/4.
      2) RACO 160 series.
      3) Steel City 54170 series.
   c. Boxes imbedded in concrete for lighting:
      1) Appleton OCR
      2) RACO 270 or 280 series.
      3) Steel City 54500 series.
   d. Boxes for flush switches, receptacles, or other general devices:
      1) Appleton 4SVB series; 8400 series cover.
      2) RACO 198 series; 770 series cover.
      3) Steel City CWV series; 52-C-00 series cover.
   e. Boxes for flush switches, receptacles, or other general devices installed in masonry construction:
      1) Appleton MI-250 series or MI-350 series.
      2) RACO 690 series or 960 series.
      3) Steel City GW series.
   f. Boxes for telephone, data, telecommunications and audio-video outlets, refer to Division 26 Section “Common Work Results for Communications”.
   g. Exposed weatherproof boxes for general devices: cast aluminum with mounting lugs and neoprene gasket:
      1) Appleton FDB series.
      2) RACO 5300 series.
      3) Steel City T100L or LT100L series.
   h. Exposed weatherproof boxes for general devices: cast aluminum with neoprene gasket:
      1) Appleton FS series.
      2) RACO 5300 series.
      3) Steel City T100 or LT100 series.

C. Junction and Pull Boxes
   1. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
   2. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

D. Cabinets and Enclosures
   1. General:

a. Compliance: NEMA 250; UL 50 and 508A, as applicable.

b. NEMA Type 1: Code-gauge phosphatized steel with continuously welded seams; manufacturer's standard ANSI 61 gray polyester powder finish inside and out; non-gasketed removable hinged front cover, with flush latch and concealed hinge; collar studs.

c. NEMA Type 3R: Code-gauge galvanized steel with drip shield top, seam-free front, side, and back; manufacturer's standard ANSI 61 gray polyester powder finish inside and out; non-gasketed continuous-hinged door, with stainless steel pin; captive, plated steel cover screws; hasp and staple for padlocking; collar studs.

d. Removable painted steel interior panel mounted on standoffs; metal barriers to separate wiring of different systems and voltages.

e. Provide clamps, grids, slotted wireways, or similar devices to which or by which wiring may be secured. Provide DIN-rail mounted terminal strips for terminating all incoming and outgoing control wiring, and power terminal blocks for incoming/outgoing power wiring.

f. Provide metal barriers to separate compartments containing control wiring operating at less than 50 volts from power and higher-voltage control wiring.

2.4 FACTORY FINISHES

A. Finish: For metal wireway and surface raceway, enclosure, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.

B. 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 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).

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 on all conduit terminations and bond to the enclosure, equipment grounding conductor, and electrical system ground.

6. Install raceways concealed in walls or above suspended ceilings in finished areas. When approved by the Architect, raceways may be installed concealed in elevated floor slabs. Do not install raceways horizontally within slabs on grade.

7. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

8. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

9. 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.

10. 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 Architect.
    d. Parallel or perpendicular to building lines or column lines.
    e. When concealed, with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
11. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches of concrete cover.
    a. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
    b. Space raceways laterally to prevent voids in concrete.
    c. Run conduit larger than 1-inch trade size parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
    d. Change from RNC to coated GRS or IMC before rising above the floor.
12. Where masonry 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.
13. 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.
14. 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 raceway to structural steel with slotted support system attached with beam clamps. Attach raceway to slotted channel with approved raceway clamps.
    d. Attach groups of raceway 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 raceway 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.

15. 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.
16. Protect all electrical Work against damage during construction. Repair all Work damaged or moved out of line after rough-in, to meet the Architect'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.
17. Align and install raceway terminations true and plumb.
18. Complete raceway installation before starting conductor installation.
19. 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.
20. Install approved expansion/deflection fittings where raceways pass through or over building expansion joints.
21. Route raceway through roof openings for piping and ductwork or through roof seals approved by the Architect, the roofing contractor, or both. Obtain approval for all roof penetrations and seal types from the Architect, Owner, roofing contractor, or all three as required to maintain new or existing roofing warranties.

B. RMC
1. Use GRS or IMC in the following areas:
   a. Where indicated.
   b. Exterior applications where above grade and exposed.
   c. Below grade when concrete-encased, plastic-coated, or provided with a corrosion resistant approved mastic coating.
   d. 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.

C. EMT
1. Use EMT in the following areas:
   a. Where indicated.
   b. Interior concealed locations for:
      1) Branch and feeder circuits.
      2) Low-voltage control, security, and fire alarm circuits
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.
2. Do not use FMC or LFMC:
   a. For branch circuits, homeruns or feeders.
   b. In lengths exceeding 6 feet.

3. Use FMC only in dry locations; use LFMC in damp, wet, corrosive, and outdoor locations, and food service and kitchen areas.

E. RNC

1. Solvent-weld RNC fittings and raceway couplings per the manufacturer's instructions and make all connections watertight. Use solvent of the same manufacturer as the raceway.
2. Where installed exposed outdoors or other areas subject to temperature variations, install expansion fittings per Article 352.44 of NFPA 70, to accommodate thermal expansion in straight runs.
3. Use RNC in the following locations:
   a. Only where specifically indicated, and then only as specified below.
4. Do not use RNC:
   a. Exposed indoors
   b. In occupied spaces.
   c. In return air plenums.
   d. Where subject to physical damage.
   e. Where not permitted by codes.

F. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. RMC and IMC: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings and installation tools approved by the manufacturer for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits. Replace all fittings and conduits that have any portion of the coating scraped off to bare metal, at no additional cost to the Owner.
3. Join raceways with fittings designed and approved for that purpose and make joints tight.
4. Use insulating bushings to protect conductors at raceway terminations:
   a. 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.
   b. 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.

G. Telephone and Signal/Data System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

H. Wireways

1. Use flat head screws, clips and straps to fasten wireways to surfaces. Mount plumb and level.
2. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
3. Close ends of wireway and unused raceway openings.

I. Surface Raceways

1. Use flat head screws, clips and straps to fasten surface raceways to surfaces. Mount plumb and level.
2. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
3. Close ends of surface raceway.

3.2 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. Outlet Boxes
1. Install all electrical devices, such as plug receptacles, lamp receptacles, light switches, and light fixtures in or on outlet boxes.
2. 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 Architect. Locate outlets generally from column centers and finish wall lines or to centers or joints of wall or ceiling panels.
3. 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.
4. Install extension and plaster rings as required by NFPA 70.
5. 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.
6. Do not exceed allowable fill per NFPA 70.
7. Where multiple devices are shown grouped together, gang mount with a common cover plate.

C. 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.
4. Boxes for exterior use shall be:
   a. PVC with a UV-stabilized PVC cover sealed and gasketed watertight.
   b. Cast aluminum with a cast aluminum cover sealed and gasketed watertight.
   c. Cast iron with cast iron cover sealed and gasketed watertight in vehicular traffic areas. Provide box and cover UL listed for use in vehicular traffic areas.
   d. Install buried boxes so that box covers are flush with grade, unless indicated otherwise.

3.3 CABINETS AND ENCLOSURES

A. Unless otherwise indicated on the Drawings, provide NEMA 1 construction for indoor, dry locations; NEMA 12 for indoor, damp and dusty locations; NEMA 3R for outdoor locations.

B. Install flush mounted in the wall in finished spaces, with the top 78 inches above finished floor. The front shall be approximately 3/4-inch larger than the box all around.

C. Install surface mounted in unfinished spaces, with the top 78 inches above finished floor. The front shall be the same height and width as the box.

D. Electrically ground all metallic cabinets and enclosures. Where wiring to cabinet or enclosure includes a grounding conductor, provide a grounding lug in the interior of the cabinet or enclosure. Cabinets and enclosures specified in this Section are intended to house miscellaneous electrical components assembled in a custom arrangement, such as contactors and relays.

E. All components that are specified or indicated for assembly in cabinets and enclosures shall each be individually UL listed and labeled. Arrange wiring so that it can be readily identified. Support wiring no less than every 3 inches. Install gauges, meters, pilot lights and controls on the face of the door.

F. Do not provide cabinets and enclosures smaller than the sizes indicated. Where sizes and types are not indicated, provide cabinets and enclosures of the size, type and classes appropriate for the use and location per the guidelines of the NEC. Provide all items complete with covers and accessories required for the intended use.

END OF SECTION 260533

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This Section includes the following:

1. Nameplates
2. Labels for raceways and metal-clad cable.
3. Labels for junction boxes and pull boxes.
4. Labels for wiring devices and lighting control devices.
5. Markers for conductors, and control cables.
6. Tags.
7. Warning labels and signs.
8. Instruction signs.
9. Miscellaneous identification products.
10. 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. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

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 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.

B. Comply with 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 related sections for additional identification requirements.

2.2 NAMEPLATES

A. Engraved, Laminated Acrylic or Melamine Label, adhesive backed. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where 2 lines of text are required, use labels 2 inches (50 mm) high. For elevated components, increase sizes of labels and letters to those appropriate for viewing from the floor.

1. Normal systems - white letters on a black background.

2. Emergency systems - white letters on a red background

2.3 LABELS FOR RACEWAYS AND METAL-CLAD CABLE

A. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

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.

C. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.4 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.

2.5 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.

B. Engraved, Laminated Acrylic or Melamine Label: adhesive backed. Minimum letter height shall be 3/16 inch (4.76 mm).

1. Normal systems - white letters on a black background.

2. Emergency systems - white letters on a red background

C. Engraved cover plates: Provide with white letters. White or ivory cover plates shall have black letters.

D. Permanent Ink: Permanent, waterproof, black ink marker, hand printed legibly.

2.6 MARKERS FOR CONDUCTOR AND CONTROL CABLES

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

C. Self-laminating Computer Printable Labels: Clear over-laminate to protect legend for permanent, clean identification. Self-laminating Polyester material with white print-on area.

D. Aluminum Wraparound Marker Labels: Cut from 0.014-inch- (0.35-mm-) thick aluminum sheet, with stamped, embossed, or scribed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.

E. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking nylon tie fastener.

2.7 TAGS

A. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.8 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145. Attachment method shall be acceptable to the manufacturers of the equipment to which the nameplates are being applied and shall not compromise any NRTL listing or labeling criteria.

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 10 by 14 inches (250 by 360 mm).

E. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning (208 Volts): "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."
3. Workspace Clearance Warning (480 Volts): "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 48 INCHES (915 MM)."

2.9 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes. Unless indicated otherwise, provide with minimum 3/8-inch- (10-mm-) high letters.

1. Punched or drilled for mechanical fasteners.
2. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
3. Normal systems: Engraved legend with white letters on black face.
4. Essential Systems: Engraved legend with white letters on red face.

2.10 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.

2.11 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. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

C. 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.

C. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

D. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

E. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

F. Equipment Nameplates and Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual

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 dimming wall switches.
2. Line-voltage wall switch occupancy sensors.
3. Line-voltage dimming wall switch occupancy sensors.
4. Line-voltage occupancy sensors.
5. Stand-Alone Low-voltage occupancy sensors.
6. Stand-Alone Low-voltage power packs.
7. Stand-Alone Low-voltage switches.
8. Time switches.
9. Lighting contactors.
10. Conductors and Cables for Lighting Control Devices.

1.2 DEFINITIONS

A. Closed loop: Photosensor control algorithm designed for influence by both daylight and electric light in a space or area.

B. DPDT: Double pole, double throw.

C. DPST: Double pole, single throw.

D. LED: Light-emitting diode.

E. Open loop: Photosensor control algorithm designed for influence by daylight entering in a space or area.

F. PIR: Passive infrared.

G. SPST: Single pole, single throw.

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. Shop Drawings:

1. Occupancy sensors and photoelectric switches

a. Show installation details.

b. Lighting plan showing location, mounting height, orientation and coverage area of each sensor and coordination with other trades.

c. Interconnection diagrams showing field-installed wiring.

d. Include diagrams for power, signal, and control wiring.

e. For any manufacturer submitted other than that listed as the Basis of Design, provide the following information for Engineer review:

1) Factory-generated occupancy sensor and photoelectric switch layouts on project lighting plans with sensor location, orientation and product type clearly marked on plans. Sensor placement shall be coordinated with project reflected ceiling plan

layout, ceiling heights, lights, diffusers, and any other ceiling devices and equipment.

2) List of any deviations to this specification or Basis of Design products.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1. Occupancy sensors:

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.

B. Occupancy sensors and photoelectric switches

1. Products supplied shall be from a single manufacturer that has been continuously involved in the manufacturing of occupancy sensors for a minimum of 5 years.

2. Products shall be manufactured by an ISO 9001 certified manufacturing facility.

3. Manufacturer shall test all equipment prior to shipment.

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 LINE-VOLTAGE DIMMING WALL 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. Dimmer shall be suitable for dimmed load type of connected light fixture. Load types shall be as indicated on Drawings and confirmed per load type for connected luminaire as indicated in Light Fixture Schedule and approved light fixture and dimmer shop drawings.

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 as directed by the Architect.
10. Sensor:
    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.
        1) PIR Type: Detect occupancy by sensing a combination of infrared heat and movement.
        2) Ultrasonic Type: Detect occupancy by sensing a change in pattern of reflected ultrasonic energy.
        3) Dual-Technology Type: Detect occupancy by using a combination of PIR and ultrasonic detection methods. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
11. Indicators:
    a. LED indicator for visual detection of motion
    b. audible and/or visual alerts for pending shut-off
12. 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.
13. 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
14. Buttons/Relays: Provide control relay and push button quantities as indicated by model listed in Lighting Control Device Schedule.
15. 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 LINE-VOLTAGE DIMMING 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. Comply with all requirements listed under Line-Voltage Dimming Wall Switches in this specification and,

2. Comply with all requirements listed under Line-Voltage Wall Switch Occupancy Sensors in this specification.

2.4 LINE-VOLTAGE 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: Wall- or ceiling-mounted, solid-state indoor occupancy sensors. Integral relay unit for line voltage sensors.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. UL Listed for dry locations and complies with local codes.

3. Operation: Refer to drawings for Sequence of Operations or other operational instructions. If none appear on drawings, the follow shall apply. Upon occupancy of space, loads shall turn on. If occupancy is not detected with in the time delay period, loads shall de-energize. Time delay for de-engergizing loads shall be adjustable over a minimum range of 1 to 15 minutes with a maximum of 30 minutes.

4. Switch Rating: As indicated in Lighting Control Device Schedule.

5. Detection Coverage: As indicated in Lighting Control Device Schedule on Drawings.

6. Mounting: Suitable for mounting in any position on a standard outlet box.

7. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

8. Indicator: LED, to show when motion is detected during testing and normal operation of the sensor.

9. Bypass Switch: Override the “on” function in case of sensor failure, concealed on unit to prevent tampering.

10. Finish: Sensor finish shall be as directed by the Architect.

11. Operating temperatures: Unless indicated otherwise for specific models, 32 degree F through 104 degree F, and relative humidity of 0%-95%.

12. Field selectable time delay and sensitivity settings or the capability for self-adjusting technologies to optimize time delay and sensitivity settings to respond to occupancy usage patterns. Occupancy usage patterns shall be saved in a non-volatile memory that retains settings in the event of a power outage.

13. Device shall include isolated relay with NO and NC contacts to interface with BMS, HVAC and or other building monitoring systems as indicated on the Drawings

14. Device and related relays shall be compatible with the specific load types controlled.

15. Sensor:

a. Coverage pattern: As indicated in Lighting Control Device Schedule, and shall have been confirmed with Nema WD7 Guide and Robotic test method.

b. Detection types: Provide type or types indicated in Lighting Control Device Schedule.

1) PIR Type: Detect occupancy by sensing a combination of infrared heat and movement.

a) 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.

b) Sensor shall utilize pulse count processing and digital signature analysis to respond only to those signals caused by human motion.

c) Sensor shall provide high immunity to false triggering from RFI and EMI.

d) 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) Ultrasonic Type: Detect occupancy by sensing a change in pattern of reflected ultrasonic energy.

a) Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.

b) Detection Frequency (Small Area – 500 sq ft and less): Ultrasonic operating frequency shall be crystal controlled at 40 kHZ within +/- 0.005% tolerance to assure reliable performance and eliminate sensor cross-talk.

c) Detection Frequency (Medium and Large Areas – greater than 500 sq ft): Ultrasonic operating frequency shall be crystal controlled at 32 kHz within +/- 0.005% tolerance, to assure reliable performance and eliminate sensor cross-talk.

d) Sensors shall be capable of automatically adapting to airflow conditions or filtering frequency spectrum related to air movement.

3) Dual-Technology Type: Detect occupancy by using a combination of PIR and ultrasonic detection methods. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.

a) Sensitivity Adjustment: Separate for each sensing technology.

b) Different LED indicator colors for each sensing technology

c) PIR sensor component shall comply with all requirements listed under PIR Type under General Requirements for Sensors under Line-Voltage Occupancy Sensors.

d) Ultrasonic sensor component shall comply with all requirements listed under Ultrasonic Type under General Requirements for Sensors under Line-Voltage Occupancy Sensors.

C. High-Bay Model:

1. Detection type: PIR type

a. PIR sensor component shall comply with all requirements listed under PIR Type under General Requirements for Sensors under Stand-Alone Line-Voltage Occupancy Sensors.

2. Detection Coverage: Selectable by interchangeable PIR lenses, suitable for mounting heights from 12 to 50 feet.

D. Extreme Temperature Model:

1. Detection type: PIR type

a. PIR sensor component shall comply with all requirements listed under PIR Type under General Requirements for Sensors under Stand-Alone Line-Voltage Occupancy Sensors.

2. Operating Ambient Conditions: Temperatures from minus 40 to plus 125 degree F.

2.5 STAND-ALONE LOW-VOLTAGE OCCUPANCY/VACANCY 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: Wall- or ceiling-mounted, solid-state indoor occupancy sensor unit, for use with a separate stand-alone low-voltage power pack containing a line-voltage relay.

1. Occupancy sensors 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.
   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 a separate, associated switch shall energize loads. If occupancy is not detected within the time delay period, loads shall be de-energized.
5. Switch Rating: As indicated in Lighting Control Device Schedule.
6. Detection Coverage: As indicated in Lighting Control Device Schedule on Drawings.
7. Mounting: Suitable for mounting in any position on a standard outlet box.
8. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
9. Indicator: LED, to show when motion is detected during testing and normal operation of the sensor.
10. Bypass Switch: Override the “on” function in case of sensor failure, concealed on unit to prevent tampering.
11. Finish: Sensor finish shall be as directed by the Architect.
12. Operating temperatures of 32 degree F through 104 degree F, and relative humidity of 0%-95%.
13. Field selectable time delay and sensitivity settings or the capability for self-adjusting technologies to optimize time delay and sensitivity settings to respond to occupancy usage patterns. Occupancy usage patterns shall be saved in a non-volatile memory that retains settings in the event of a power outage.
14. Sensors:
    a. Sensor shall be compatible with lighting control system.
    b. Sensors shall be capable of being combined with additional sensors to achieve adequate coverage.
    c. Sensor coverage pattern: AS indicated on Lighting Control Device Schedule, and shall have been confirmed with Nema WD7 Guide and Robotic test method.
    d. Detection types: Provide type or types indicated in Lighting Control Device Schedule.
       1) PIR Type: Detect occupancy by sensing a combination of infrared heat and movement.
          a) 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.
          b) Sensor shall utilize pulse count processing and digital signature analysis to respond only to those signals caused by human motion.
          c) Sensor shall provide high immunity to false triggering from RFI and EMI.
          d) 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) Ultrasonic Type: Detect occupancy by sensing a change in pattern of reflected ultrasonic energy.

a) Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.

b) Detection Frequency (Small Area – 500 sq ft and less): Ultrasonic operating frequency shall be crystal controlled at 40 kHZ within +/- 0.005% tolerance to assure reliable performance and eliminate sensor cross-talk.

c) Detection Frequency (Medium and Large Areas – greater than 500 sq ft): Ultrasonic operating frequency shall be crystal controlled at 32 kHz within +/- 0.005% tolerance, to assure reliable performance and eliminate sensor cross-talk.

d) Sensors shall be capable of automatically adapting to airflow conditions or filtering frequency spectrum related to air movement.

3) Dual-Technology Type: Detect occupancy by using a combination of PIR and ultrasonic detection methods. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.

a) Sensitivity Adjustment: Separate for each sensing technology.

b) Different LED indicator colors for each sensing technology

c) PIR sensor component shall comply with all requirements listed under PIR Type under General Requirements for Sensors under Stand-Alone Line-Voltage Occupancy Sensors.

d) Ultrasonic sensor component shall comply with all requirements listed under Ultrasonic Type under General Requirements for Sensors under Stand-Alone Line-Voltage Occupancy Sensors.

C. High-Bay Model:

1. Detection type: PIR type

a. PIR sensor component shall comply with all requirements listed under PIR Type under General Requirements for Sensors under Stand-Alone Line-Voltage Occupancy Sensors.

D. Extreme Temperature Model:

1. Detection type: PIR type

a. PIR sensor component shall comply with all requirements listed under PIR Type under General Requirements for Sensors under Stand-Alone Line-Voltage Occupancy Sensors.

2. Operating Ambient Conditions: Temperatures from minus 40 to plus 125 degree F.

2.6 STAND-ALONE LOW-VOLTAGE POWER PACKS

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 power packs: Box mounted, solid-state indoor power pack/relay unit, for use with a separate stand-alone low-voltage sensor and switches.

1. Power packs 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. Unit shall include isolated relay with NO and NC contacts to interface with BMS, HVAC and or other building monitoring systems as indicated on the Drawings
5. Relay shall be compatible with the specific lighting types controlled.
6. Operations: Refer to drawings for Sequence of Operations or other operational instructions. Unit operates in conjunction with other system components. Refer to operations requirements of associated devices.
7. Switch Rating: As indicated in Lighting Control Device Schedule.

   Mounting: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
8. Operating temperatures of 32 degree F through 104 degree F, and relative humidity of 0%-95%.

2.7 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 as directed by the Architect.
   8. Operating temperatures of 32 degree F through 104 degree F, and relative humidity of 0%-95%.

2.8 TIME SWITCHES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   1. Area Lighting Research, Inc.; Tyco Electronics.
   2. Intermatic, Inc.
   3. Leviton Mfg. Company Inc.
   4. Lithonia Lighting; Acuity Lighting Group, Inc.
   5. Paragon Electric Co.; Invensys Climate Controls.
   6. Square D; Schneider Electric.
   7. TORK; NSI Industries.
   8. Wattstopper; a Legrand Company.

D. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.

1. Contact Configuration: SPST.
2. Contact Rating: 30-A inductive or resistive, 240-V ac, 20-A ballast load, 120/240-V ac.
3. Program: 2 channels; each channel shall be individually programmable with 40 on-off operations per week and an annual holiday schedule that overrides the weekly operation on holidays.
4. Circuitry: Allow connection of a photoelectric switch relay as substitute for on-off function of a program.
5. Astronomic Time: All channels.
6. Battery Backup: For schedules and time clock.

2.9 LIGHTING CONTACTORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. ASCO Power Technologies, LP; a division of Emerson Electric Co.
2. Eaton Electrical Inc.; Cutler-Hammer Products.
3. GE Industrial Systems; Total Lighting Control.
4. Hubbell Lighting.
5. Lithonia Lighting; Acuity Lighting Group, Inc.
6. Square D; Schneider Electric.
7. TORK; NSI Industries.

D. Description: Electrically operated and mechanically held, combination type with non-fused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including LED tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

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. LINE VOLTAGE WALL SWITCHES

1. Install dimming wall switches to achieve full rating specified on Lighting Control Device Schedule taking into account de-rating for ganging as instructed by the manufacturer.
2. Provide a separate grounded (neutral) conductor for each circuit controlled by a line voltage switch.
   a. Do not share neutral conductor on load side of dimmers.
   b. If neutral termination is not required for the device, cap conductor and tag as "Neutral for future use".

C. 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. Occupancy sensors with ultrasonic or dual-technology sensing technologies shall be located not closer than 4 feet from the nearest edge of air supply devices or similar obstructions that would adversely affect the sensor performance.
5. Adjust time delay setting of occupancy sensors to de-energize loads after space has been unoccupied for period of time indicated on the Drawings.
6. Install outdoor photoelectric switches with clear view of the northern sky unless noted otherwise on the Drawings.
7. Adjust settings of photoelectric switches to turn on lighting at illumination level indicated on the Drawings.
8. Install devices and auxiliary equipment in compliance with manufacturer’s instructions and recommendations.
9. Install relay units where concealed from view and where accessible.
10. 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.
11. Install switchbox mounted occupancy sensors at same elevation as other lighting control switches.

D. TIME SWITCHES

1. Install time switches in locations as indicated on the Drawings.
2. Program time switches with current time and date information in accordance with manufacturer’s instructions.
3. Program timeclock settings as per Sequence of Operations on the Drawings. Confirm final timeclock settings with Owner prior to programming.

E. LIGHTING CONTACTORS

1. Install lighting contactors in locations as indicated on the Drawings.
2. Provide NEMA 1 enclosures for lighting contactors in interior dry locations, NEMA 3R enclosures for lighting contactors in exterior or wet locations.
3. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

F. WIRING

1. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be [1/2 inch (13 mm)][<insert size>].
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. Power and control wiring: Identify using marker tapes.

1. Identify controlled circuits in lighting contactors.

2. Identify circuits or luminaries controlled by photoelectric switches and occupancy sensors at each sensor.

C. Components: Label each component with self-laminating computer printed labels, using a unique designation matching control drawing.

D. 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.

B. Photoelectric switch 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 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."

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 for additional information.

END OF SECTION 260923

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Receptacles: Single, duplex, USB/duplex, USB-only, twist-lock, ground-fault circuit interrupters (GFCI), surge protective device (SPD), isolated ground (IG).
2. AC Wall Switches: Single- and double-pole, three- and four-way, maintained and momentary, pilot light and lighted toggle, and dimmer
3. Device Wall Plates.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.

B. Division 26 Section "Common Work Results for Electrical Systems" for cords, caps, outlet boxes, floor service outlets, and poke-through assemblies used to support wiring devices.

C. Division 26 Section “Identification for Electrical Systems” for device and circuit labels.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. IG: Isolated Ground

C. PIR: Passive Infrared.

D. RFI: Radio Frequency Interference

E. SPD: Surge Protective Device

F. USB: Universal Serial Bus

1.4 SUBMITTALS

A. General: Submit the following in accordance with Section 013300, Division 01 and Division 26 Section “General Electrical Requirements”.

B. Product data for the following products:

1. Provide manufacturer’s catalog information specifically marked to indicate which devices are being furnished, and showing dimensions, colors, and configurations for all devices, including, but not limited to: Receptacles, AC wall switches, emergency shunt relays, cover plates, power poles, and multi-outlet assemblies.

C. Operations and Maintenance Data:

1. Provide operating instructions for each type of dimmer.

D. Warranty: Special warranties specified in this Section.

1.5 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.

1.6 COORDINATION

A. Receptacles for Equipment Furnished by Owner or Under Other Divisions or Contracts: Match plug configurations.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Wall Plates: One for every 10 of each type (i.e., style, size, and finish) installed, but no fewer than two of each type.

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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Receptacles and Switches:

a. Cooper Wiring Devices.

b. Hubbell Incorporated; Wiring Device-Kellems.

c. Leviton Mfg. Company Inc.

d. Pass & Seymour/Legrand; Wiring Devices Div.

C. In other Part 2 articles below, where lists of manufacturers and device catalog numbers are included, the following additional requirements apply to product selection:

1. Additional Manufacturers: 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 “Available Manufacturers” above.

2.3 FINISHES

A. Color:

1. Wiring devices connected to normal power systems: Match existing devices, unless otherwise indicated or required by NFPA 70. Cover plates: The same as the wiring device..

2. Isolated-Ground receptacles: Orange, with an orange triangle on its face. Cover plates: The same as the wiring device and engraved with “ISOLATED GROUND” at the top with [white filler in the engraving.

B. Manufacturer's model numbers listed are to establish the quality of the wiring devices. Coordinate the proper suffixes in order to provide the correct color as specified above.

2.4 CONVENIENCE RECEPTACLES:

A. The catalog numbers listed below are generally for 20A rated devices. Where 15A rated devices are indicated on the Drawings or required for circuit rating limitations, provide receptacles equivalent to those specified for 20A, but rated for 15A.

B. Duplex convenience receptacles: Commercial Specification grade, NEMA 5-20R, 125V, 20A, grounding type, UL listed and labeled, smooth nylon face, side and back wired, self-grounding.

Manufacturer	Duplex
Cooper	CR20

Hubbell	BR20
Leviton	CR20
Pass & Seymour	CR20

C. Duplex tamper resistant convenience receptacles: Commercial Specification grade, NEMA 5-20R, 125V, 20A, grounding type, UL listed and labeled, smooth nylon face, side and back wired, self-grounding.

Manufacturer	Duplex
Cooper	TRCR20
Hubbell	BR20TR
Leviton	TBR20
Pass & Seymour	TR20

Edit the following paragraphs as required for GFCI receptacles for the project. Retain only the table with

2.5 SWITCHES

A. The catalog numbers listed below are generally for 20A rated devices. Where 15A rated devices are indicated on the Drawings or required for circuit rating limitations, provide switches equivalent to those specified for 20A, but rated for 15A.

B. Switches: Commercial Specification grade, rated for 120/277V, 20A, back and side wired, and UL listed and labeled.

Manufacturer	1 Pole	2 Pole	3 Way	4 Way
Cooper	CSB120	CSB220	CSB320	CSB420
Hubbell	DS120	DS220	DS230	DS330
Leviton	CSB1-20	CSB2-20	CSB3-20	CSB4-20
Pass & Seymour	CS20AC1	--	CS20AC3	--

C. Pilot Light switches: 20A, single pole switch with red neon lighted handle. Toggle shall be illuminated when the switch is in the "ON" position.

Manufacturer	1 Pole	2 Pole	3 Way
Cooper	AH2221PL	AH222PL	AH2223PL
Hubbell	HBL1221PL	HPL1222PL	HBL1223PL
Leviton (120V)	1221-PLX	1222-PLX	1223-PLX
Leviton (277V)	1221-7PLX (277V)	1222-7PLX	1223-7PLX
Pass & Seymour	PS20AC1-XSL	PS20AC2-XSL	PS20AC3-XSL

D. Lighted Handle switches: 20A, single pole switch with clear neon lighted handle. Toggle shall be illuminated when the switch is in the "OFF" position.

Manufacturer	1 Pole	3 Way
Cooper	AH1221LT	AH3221LT
Hubbell	HBL1221IL	HBL1223IL
Leviton (120V)	1221-LHX (120V)	--
Leviton (277V)	1221-7LX (277V)	--
Pass & Seymour (120V)	PS20AC1-XPL	PS20AC3-XPL
Pass & Seymour (277V)	PS20AC1-XPL7	PS20AC3-XPL7

E. Switches for use with mechanically-held, electrically-operated lighting contactors: Single pole, double throw, momentary, center off switch, rated for 120/277V, and UL listed and labeled.

Manufacturer	1 Pole
Cooper	1995
Hubbell	HBL1557
Leviton	1257-I
Pass & Seymour	1251

2.6 WALL BOX DIMMERS

A. Wall box dimmers: Specification grade toggle type wall box dimmers, UL listed and labeled, with Radio Frequency Interference (RFI) filters to avoid interference with electronic equipment, and a minimum wattage as indicated on the Drawings.

Manufacturer	[Specification Grade] [Toggle-type]	[Specification grade] [Toggle-type]	[Premium grade] [Slider-type
Lutron	Diva Series	Nova Series	Maestro Series
Leviton	Renoir Series	Monet Series	Mural Series

B. Dimmer shall be suitable for dimmed load type of connected light fixture, including [incandescent],[magnetic low voltage][electronic low voltage][fluorescent 2-wire][fluorescent 3-wire]and [fluorescent 4-wire]. Load types shall be as indicated on Drawings and confirmed per load type for connected luminaire as indicated in Light Fixture Schedule and approved light fixture and dimmer shop drawings.

2.7 COVER PLATES

A. 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: Smooth plastic, minimum 0.10-inch thick. Refer to “Finishes” above for color.
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 Architect.

B. Do not use multi-conductor circuits, with a shared neutral, for any GFCI receptacle circuit. Provide a separate neutral conductor with all GFCI receptacle circuits.

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.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

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 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.

B. 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.

C. Connect wiring device grounding terminal to branch circuit equipment grounding conductor and bond to metal outlet box. Exception: Do not bond grounding terminals of isolated ground receptacles to the outlet box.

D. Install devices shown on wood trim, cases or other fixtures symmetrically and, where necessary, set with the long dimensions of the plate horizontal, or ganged in tandem.

E. Unless dimensioned otherwise, install wiring devices a minimum of 24 inches from the closest edge of any sink.

F. Install switches with OFF position down.

G. Install wall dimmers to achieve full rating specified and indicated after de-rating for ganging as instructed by manufacturer.

H. Where dimmer switches are shown adjacent to standard switches, install both in separate back boxes with adequate space between so that neither cover plate requires cutting. Dimmers shall not require de-rating. Do not remove fins.

I. Provide a separate grounded conductor (neutral) for each circuit controlled by a dimmer. Do not share neutral conductor on load side of dimmers.

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.

b. Above counters:

1) Mount vertically.

2) Mount vertically.

c. Mechanical and electrical equipment rooms and janitors closets: mount horizontally.

d. Concrete Block Walls: Dimensions above may be adjusted slightly, as required to compensate for variable joint dimensions, such that bottom or top of boxes, as applicable, are at block joints.

2. Switches:

a. Above counters: Same as for receptacles.

b. Concrete Block Walls: Dimension may be adjusted slightly, as required to compensate for variable joint dimensions, such that bottom of boxes are at block joints.

c. Walls with wainscoting: 6 inches minimum above wainscoting, but not exceeding 48 inches above finished floor.

3.6 IDENTIFICATION

A. Label all devices fed down stream of GFCI protected receptacles as “GFCI PROTECTED”.

B. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles and Switches: Identify panelboard and circuit number from which served, using:

a. Hot, stamped or engraved machine printing with black filled lettering on face of plate.

b. Durable wire markers or tags inside outlet boxes.

c. Permanent-ink marker, hand-printed legibly, inside outlet boxes.

d. Adhesive film label, but with letter/number height of 1/4 inch, on face of plate.

e. Adhesive Film Label with Clear Protective Overlay, but with letter/number height of 1/4 inch, on face of plate, for exterior and damp/wet locations.

3.7 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.

B. Operate each wall switch with circuit energized and verify proper operation.

C. Verify that each receptacle device is energized. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.

D. Test all wiring devices for electrical continuity and proper polarity of connections.

E. Test each GFCI receptacle device for proper operation.

F. Correct wiring devices incorrectly installed.

G. 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 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Molded-case circuit breakers (MCCBs).
5. Enclosures.

1.2 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.3 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).

B. Manufacturer's field service report.

C. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.4 QUALITY ASSURANCE

A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

B. 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.

C. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

1.6 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   3. Siemens Energy & Automation, Inc.
   4. Square D; a brand of Schneider Electric.
C. Type HD, Heavy Duty, Single Throw, 240 V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
D. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   3. Lugs: Mechanical type, suitable for number, size, and conductor material.
   4. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
B. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   3. Siemens Energy & Automation, Inc.
   4. Square D; a brand of Schneider Electric.
C. Type HD, Heavy Duty, Single Throw, 240 V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
D. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   3. Siemens Energy & Automation, Inc.
   4. Square D; a brand of Schneider Electric.
B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.

F. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

2.4 MOLDED-CASE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

2.5 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with 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. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.

b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.

c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816

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. Emergency lighting units.
3. Exit signs.
4. Light fixture supports.
5. Emergency Lighting Mini-Inverter.
6. Coordination.
7. Quality assurances.
8. Specific requirements.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.

B. Division 26 Section “Common Work Results for Electrical” for raceways, conductors, cables, and cords.

C. Division 26 Section "Exterior Lighting” for exterior light fixtures, except those normally mounted on exterior surfaces of buildings.

D. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

E. Division 26 Section "Wiring Devices" for manual wall-box dimmers.

1.3 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, or both, will be accepted.
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. Emergency ballast cut sheet: Descriptive cut sheets providing physical description of emergency ballasts for use in normal light fixtures, including, but not limited to, complete battery information, lumens, and method for testing per NFPA 101.

C. Control Wiring

D. Coordination Drawings: Refer to architectural reflected ceiling plans or details for exact location of light fixtures; engineering documents shall not be referenced for exact fixture positions. Contractor shall check and verify dimensions and details on drawings before proceeding with the work. If any question arises about the true meaning of drawings, refer the matter to the Architect, whose decision is final. In no case proceed with work with any uncertainty. Architectural documents shall show and coordinate with assistance from installers of items involved:

1. Light fixtures.

2. Suspended ceiling components.

3. Structural members to which suspension systems for light fixtures will be attached.

4. Other items in finished ceiling including the following:

5. Air outlets and inlets.

6. Smoke and fire detectors.

7. Occupancy sensors.

8. Access panels.

9. Perimeter moldings.

E. Samples for Verification: For products designated for sample submission in Light Fixture Schedule, or at the request of Owner or Architect. Each sample shall include lamps, LEDs, ballasts and/or drivers. Sample shall be exact light fixture intended to be supplied for the project and equipped with 120-277V universal voltage and 120V cord and plug. Provide with pendant or wall support system if appropriate.

F. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.

G. Operation and Maintenance Data: For lighting equipment and fixtures to include in operation and maintenance manuals.

H. Warranties: Special warranties specified in this Section.

1.4 DEFINITIONS

A. CCT: Correlated color temperature

B. CRI: Color-rendering index.

C. CU: Coefficient of utilization.

D. EISA: Energy Independence and Security Act of 2007.

E. L70: minimum 70% maintained initial-rated lumens at average rated life for LEDs

F. LED: Light Emitting Diode

G. 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.

H. LED Module: Light source that contains LEDs, and may include additional components such as lenses, reflectors, or refractors, however do not include drivers.

I. LER: Light fixture (Luminaire) efficiency rating.

J. Light Fixture: Complete light fixture, including ballast housing if provided.

K. 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. 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.

D. 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.

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.

D. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Lighting Unit Batteries: 1 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining coverage years.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. In Light Fixture Schedule where titles below are column or row headings that introduce lists, 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 one of the other manufacturers specified that meets or exceeds performance characteristics of the named product.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified. No substitutions shall be allowed as per Section 1.4.

3. 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.

2.2 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. 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. LED type, wattage, beam angle (if applicable) for LED luminaires. Indicate maximum allowed wattage.

c. CCT and CRI for all luminaires.

2.3 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.

2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

a. Battery: Sealed, maintenance-free, nickel-cadmium type.

b. Charger: Fully automatic, solid-state type with sealed transfer relay.

c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.4 EMERGENCY LIGHTING UNITS

A. Description: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.
8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.5 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.

2.6 EMERGENCY LIGHTING MINI-INVERTER

A. Manufacturer

1. Basis-of-Design Product: [Insert manufacturer name from below] is the Basis-of-Design manufacturer. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other equivalent manufacturers specified below:
   a. Iota Engineering #IIS Series
   b. Cooper Lighting Surelites #CMFT Series
   c. Highlites #PFT Series

B. Description – Self-contained uninterruptible or fast-transfer inverter designed for normal and emergency operation of connected lighting loads. Unit shall be capable of operating HID, incandescent, fluorescent, induction and LED fixtures with no break or interruption of illumination. UL 924 listed and meets NFPA 101, NEC and local codes.

1. Battery: Sealed, maintenance-free lead-calcium or lead-acid type. 68 deg F to 86 deg F optimum operating temperature.
2. Charger and Electronics: Fully automatic, thermal compensating variable rate battery charger. AC lockout feature, low battery voltage disconnect; DC overload, short circuit and brownout protection. 32 deg F to 104 deg F electronics operating temperature.
3. Operation: Inverter shall allow connected emergency lighting fixtures to be normally on. Upon loss of normal utility power, the emergency lighting fixtures will be delivered emergency power for their full lumen output rating with no break (<2 ms) in illumination for a minimum of 90 minutes.
4. 120V, single phase input and output voltages. Input voltage shall match output voltage, and +/- 3% voltage regulation, 60 Hz.
5. Maximum remote mounting distance of 1000’-0”.
6. Housing: Designed for surface mounting installation to floor or wall. 16 gauge steel housing with scratch-resistant powder coat paint finish..
7. Testing: Integral testing means by either manual test switch or self-testing, self-diagnostic with manual testing capabilities.
8. Onboard LED indicating lights for inverter status indication.
9. Manufacturer’s warranty or minimum 2 year warranty on electronics and battery and seven-year prorata warranty on battery, whichever is greater.
10. Overload and short circuit protection on input and output of inverter. Circuit breakers or fusing on output side.

C. Where wattage of inverter is different from Basis-of-Design manufacturer’s selected wattage, provide quantity of inverters as required to meet design intent. If additional inverters are required, confirm additional equipment will fit within available space constraints.

D. Where physical size of inverter is different from Basis-of-Design manufacturer, confirm equipment will fit within available space constraints.

2.7 LAMPS GENERAL

A. Unless specific manufacturers and lamp types are called for in the Light Fixture Schedule, all lamps provided for this project shall be by the same manufacturer. Lamps shall be manufactured by:

1. Eiko
2. General Electric
3. Osram/Sylvania
4. Philips
5. Soraa
6. Venture

B. All lamps shall be new and shall be delivered to the project in manufacturer's original sealed package.

C. Substitutions of specific lamp manufacturer as addressed in Fixture Schedule shall not be allowed. Costs associated with re-lamping due to non-compliance with specification, for both labor and material costs, shall be the sole responsibility of the contractor. For those fixtures with lamp included in fixture, contractor shall coordinate with manufacturer to ensure only approved lamp(s) is (are) installed. Lamp manufacturers indicated on Fixture Schedule are for reference. Where required, contractor shall coordinate with Owner regarding national purchasing agreement of specific lamp manufacturers. Purchasing of lamps, whether through competitive bidding of listed manufacturers or proprietary supply, shall be at the discretion of the Owner.

2.8 AUXILIARY DEVICES FOR LOW VOLTAGE AND LED FIXTURES

A. Provide remote power supplies, drivers and/or transformers for light fixtures as required for a complete and operational system. Where equipment is not indicated as plenum rated, provide an additional enclosure for the device(s) suitable for the installed environment.

2.9 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 gage.

D. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.10 TRANSFORMERS FOR LOW VOLTAGE FIXTURES

A. Provide transformers to low voltage lamps which are suitable for the electrical characteristics of the supply circuits to which they are to be connected. For remote electronic or magnetic transformers, contractor shall remote transformers so as to reduce voltage drop. For 25 amp low-voltage linear systems, contractor shall not daisy-chain 25A loaded runs together. Contractor shall provide home-run from end of run to remote transformer.

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. 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.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When

construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Support for Light Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.

1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from light fixture corners.
2. Support Clips: Fasten to light fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

D. Suspended Light Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end. Provide suitable connectors or collars to connect adjoining units to appear as a continuous unit.
4. Decorative pendant mounted light fixtures
   a. Provide cord and/or stem lengths to match elevations above finished floor as indicated on architectural elevations. If architectural elevations do not indicate suspension heights, coordinate with Architect to determine final suspension heights. Regardless, contractor shall not field cut pendants or order rigid stems without elevation approval from Architect. Pendant suspensions on electrical documents are for reference only.
      1) Cord-mounted: Manufacturers shall supply luminaires with flexible, field cutting cords. Contractor shall field cut cords as required.
      2) Field-cuttable, rigid-stem mounted: Manufacturers shall supply luminaires with field cutting rigid stems. Contractor shall field cut stems as required.
      3) Factory-cut rigid stem mounted: Contractor shall provide rigid stem dimensions to the manufacturer as required.
   b. Junction boxes used to feed light fixtures shall be covered by manufacturer supplied canopy plates.

E. Installation within non-standard ceilings, including, but not limited to, wood and metal ceilings.

1. For recessed downlight light fixtures, specification is based on standard throats to accommodate ceiling thicknesses of ¾” or less. If non-standard ceiling (such as wood, thickened gypboard ceilings and metal plank type) require throats greater than ¾”, modifications to manufacturer’s standard ¾” throat shall be determined by Architect and Contractor prior to shop drawing submission.
2. For light fixtures recessed into metal ceilings, rigidly support light fixture to ensure that trim fits flush with ceiling plane.

F. Manufacturer shall supply contractor with a complete list of component elements to comply with design intent for either 20-amp (flexible low voltage track systems or line voltage track) or 50-amp bus bar track systems. Contractor shall install track systems based on design requirements outlined herein or Light Fixture Schedule.

G. Connect wiring according to Section "260519 - Low-Voltage Electrical Power Conductors and Cables."

H. 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.

I. Wall Mounted Light fixtures

1. Unless otherwise noted, conceal all raceways and back boxes for wall mounted light fixtures. Coordinate all wall-mounted light fixtures with interior elevations. Where specific elevations

or dimensions are not indicated, verify the correct location with Architect prior to installation. Contractor shall supply structure to support weight of fixture.

J. 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.

K. Auxiliary Devices for low voltage and LED Fixtures

1. Install device within maximum remote distances and with wiring sized per manufacturer's recommendations.
2. In public areas or other areas where remote device visibility is undesireable, install device where concealed from view, well ventilated and accessible. Provide access panels as required.
3. Provide label on device indicating fixture type and location/room served along with panelboard circuit number.
4. Properly support remote lighting devices, including transformers, power supplies, and drivers, per Code and manufacturer's recommendations.

3.3 MULTI-LEVEL SWITCHING

A. For multi-level (step-dimming) drivers or ballasts, provide number of switch conductors required to the device for operation of all light levels intended.

B. The lighting design for this project has included multi-level (inboard/outboard) switching. Where indicated, 3-lamp light fixtures shall have the center lamp switched from the switch nearest the door and the outer 2 lamps switched from the other switch.

C. Where indicated, 4-lamp light fixtures shall have the outer 2 lamps switched from one switch and the center 2 lamps shall be switched from the other switch.

D. A similar multi-level lighting arrangement shall be provided where 4- and 3-way switches are shown. Where only one switch is shown at the alternate location it shall control the center lamp. Light fixtures indicated to have multi-level switching shall be furnished with the proper number of ballasts.

3.4 DIMMING

A. For dimmable light fixtures, provide both control and power wiring between light fixture and control device and between light fixtures. Quantity of low voltage and line voltage wiring and wire type shall be per manufacturer's recommendations. At a minimum, provide the following based on control type at either 120V or 277V, unless recommended otherwise by the manufacturer:

1. 0-10V – two low voltage conductors and two line voltage conductors plus ground
2. 2-Wire dimming – two line voltage conductors plus ground
3. 3-Wire dimming – three line voltage conductors (1 for control and two for power) plus ground
4. DALI – two low voltage conductors and two line voltage conductors plus ground
5. Proprietary digitally addressable – as required per the manufacturer
6. DMX – two line voltage conductors plus ground and DMX cabling

B. Coordinate light fixture and control device dimming types for compatibility.

3.5 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.

D. Wall-Mounted Light fixtures

1. Coordinate all wall-mounted light fixtures with the architectural features of the building. Where specific elevations or dimensions are not indicated, verify the correct location with the Architect prior to beginning any work.

3.6 ADJUSTING

A. Contractor shall adjust all light fixture sockets to match the lamp specified and aim all adjustable light fixtures as directed by the Architect.

B. Where required, focusing shall be done during hours of darkness. Upon notification by contractor that all fixtures are correct as per shop drawings and functioning, that specified lamps have been verified, lighting designer or Architect shall coordinate with contractor as to a mutually agreed upon time to complete focusing. Failure of contractor to notify Architect during substantial completion will result in failure to comply with specifications.

3.7 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.

3.8 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

3.9 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to [two] visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

1. Adjust aimable luminaires in the presence of Architect.

END OF SECTION 265100

SECTION 265600 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following lighting equipment:

1. Exterior LED light fixtures with LED modules and drivers.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.

B. Division 26 Section “Common Work Results for Electrical” for raceways, conductors, cables, and cords.

C. Division 26 Section “Grounding and Bonding for Electrical Systems”

D. Division 26 Section “Raceway and Boxes for Electrical Systems”

E. Division 26 Section “Indentification for Electrical Systems”

F. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

G. Division 26 Section "Wiring Devices" for devices installed in poles.

H. Division 26 Section “Enclosed Switches and Circuit Breakers”

I. Division 26 Section “Interior Lighting” for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 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, will be accepted.

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.

B. Prepare portfolios from manufacturer's standard specification sheets, and include the number indicated on the Light Fixture Schedule to identify each light fixture. Do not combine more than one light fixture type on a single sheet.

1. Fixture or other materials shall not be shipped, stored, or installed into the work without approval of shop drawings.

2. Modifications to fixtures shall be in accordance with Architect’s comments.

C. Product Data: For each light fixture, pole, and support component, arranged in order of lighting unit 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, effective projected area, 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 luminaires specified with 80 CRI or greater.

3. Light fixture mounting details, including, but not limited to, non-standard outlet boxes.

4. Construction of light fixture housing and door (if applicable).
5. 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.
   a. For dimming LED, also include dimming type technology and dimming range/limits.
6. 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.
7. Details of attaching light fixtures and accessories.
8. Details of installation and construction.
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.
10. Materials, dimensions, and finishes of poles.
11. Means of attaching light fixtures to supports, and indication that attachment is suitable for components involved.

D. Operation and Maintenance Data: For light fixtures to include in operation and maintenance manuals.

E. Warranty: Special warranties specified in this Section.

1.4 DEFINITIONS

A. CCT: Correlated color temperature

B. CRI: Color-rendering index.

C. CU: Coefficient of utilization.

D. Delegated-Design Submittals: Documents, including, but not limited to, drawings, calculations, and material and product specifications prepared as a responsibility of Contractor to obtain acceptance by Owner and authorities having jurisdiction.

E. EISA: Energy Independence and Security Act of 2007.

F. HID: High-intensity discharge.

G. LED: Light Emitting Diode

H. 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.

I. LED Module: Light source that contains LEDs, and may include additional components such as lenses, reflectors, or refractors, however do not include drivers.

J. LER: Light fixture efficacy rating.

K. Light fixture: Complete light fixture, including ballast housing if provided.

L. LLD: Lamp Lumen Depreciation.

M. LLF: Light Loss Factor.

N. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.5 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.

1.6 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 1.12.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.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. In Light Fixture Schedule (on the drawings) where titles below are column or row headings that introduce lists, 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 one of the other manufacturers specified that meets or exceeds performance characteristics of the named product.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
3. 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.

2.2 LIGHT FIXTURES, GENERAL REQUIREMENTS

A. Light fixtures shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Comply with IES RP-8 for parameters of lateral light distribution patterns indicated for light fixtures.

C. Comply with IES BUG ratings where indicated on the Light Fixture Schedule.

D. Metal Parts: Free of burrs and sharp corners and edges.

E. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

F. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed light fixtures.

G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

H. Exposed Hardware Material: Stainless steel for latches, fasteners, and hinges.

I. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

J. Light Shields: Metal baffles or louvers, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

K. 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.

L. Gaskets for Lenses and Refractors: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in light fixture doors.

M. Light Fixture Finish: Manufacturer's standard paint applied to factory-assembled and -tested light fixture before shipping..

N. 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. “USES ONLY” and include specific lamp or LED type.

b. LED type, wattage, beam angle (if applicable) for LED luminaires. Include maximum allowed wattage.

c. For LED luminaires, includes CCT and CRI.

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. Driver shall operate with maximum sustained variations of +/- 10% input voltage and frequency with no damage to driver.

6. Driver output shall be regulated to +/- 5% published load range.

7. LED Current Crest Factor: 1.5 or less.

8. LED drivers shall not over-drive LEDs at a current or voltage above LED rated values in order to increase LED lumen output.

9. Meets EN610000 for input harmonics.

10. ROHS Compliant.

11. Suitable for use in outdoor light fixtures.

12. Dimming Drivers

a. 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:

1) Luminaires: 100 to 10 percent of rated lumens.

2) LED Lamps: 100 to 20 percent of rated lumens.

b. 0-10V dimming drivers: Compliant with IEC 60929 standard for 4-wire dimming.

c. Compatibility: Certified by the manufacturer for use with specific dimming control system and LED indicated.

d. 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. Comply with ANSI C78.377 for white light LED color range. Unless noted otherwise in the Light Fixture Schedule, LED color quality characteristics shall be 70 CRI minimum and 4000K CCT. All LEDs used for same fixture type throughout the project to originate from same production bin.

B. LED binning specification tolerance to be within 3 MacAdam ellipses of rated values for color as indicated in the Light Fixture Schedule.

C. Unless indicated otherwise in the Light Fixture Schedule, minimum 70% of maintained initial-rated lumens at the average rated life as follows:

1. LED lamps: 20,000 hours
2. Other LED luminaires: 50,0000 hours

D. ROHS compliant

E. Manufacturer of LED chips will be evaluated based on the manufacturer's product literate and data. At a minimum, LED fixtures or lamps will incorporate Bridgelux, Nichia, Cree, Xicato or Osram 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 desireable.

2.5 AUXILIARY DEVICES FOR LOW VOLTAGE AND LED FIXTURES

A. Provide remote power supplies, drivers and/or transformers for light fixtures as required for a complete and operational system.

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 LIGHT FIXTURE INSTALLATION

A. Install lamps in each light fixture.

B. Fasten light fixture to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

3.3 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Adjust all light fixture sockets to match the lamp specified and aim all adjustable light fixtures as directed by the Architect.

C. Upon completion of the installation of light fixtures, and after building circuits have been energized, apply electrical energy 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. 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.

E. At the time of Substantial Completion, aim all adjustable fixtures, such as flood and spot lights, per the Architect's direction. Provide all necessary equipment to support this effort, such as scaffolds and lifts, as required.

F. At the time of Final Acceptance of this Project by the Owner, all lamps shall be in working order and all light fixtures shall be fully lamped.

G. Illumination Observations: Verify normal operation of lighting units after installing light fixtures and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

END OF SECTION