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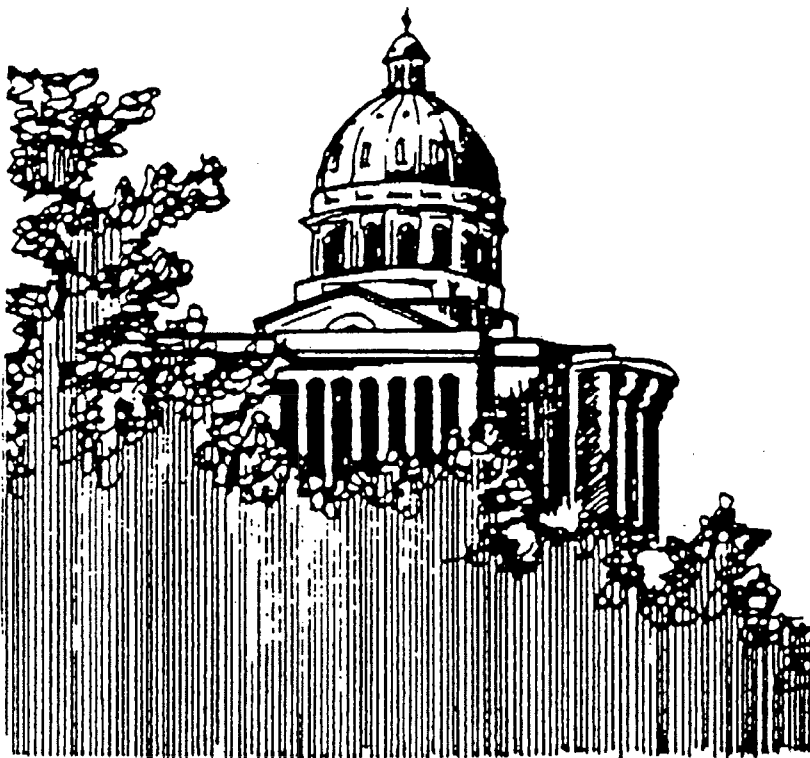
PROJECT MANUAL

Various Facility Renovations Missouri Veterans Home Mount Vernon, Missouri

DESIGNED BY: MALONE FINKLE ECKHARDT &
COLLINS, INC.
7780 W 119TH STREET
OVERLAND PARK, KS 66213

DATE ISSUED: 9/9/2016

PROJECT NO.: U1609-01



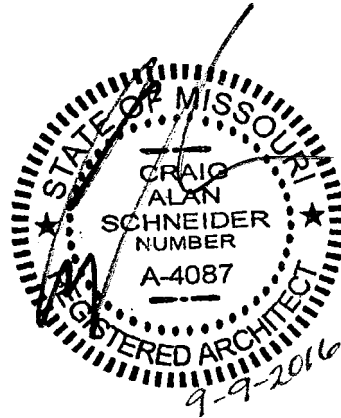
FOR: State of Missouri
Office of Administration
Division of Facilities Management,
Design and Construction

SECTION 000107 - PROFESSIONAL SEALS AND CERTIFICATIONS

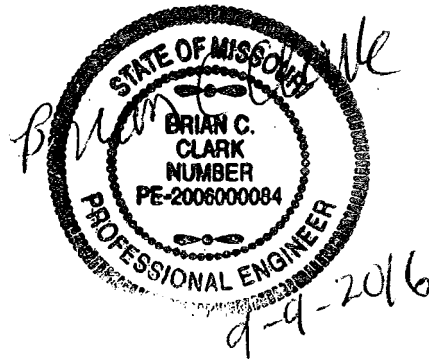
Project Number: # U1609-01

The following Design Professionals have signed and sealed the original plans and specification for this project, which are on file with the Division of Design and Construction:

Craig A. Schneider, AIA (Architects)
Esterly Schneider & Associates, Inc., AIA



Brian C. Clark, PE (MEP)
Malone, Finkle, Eckhardt & Collins, Inc.



Kevin A. Boyer, PE (Fire Protection Engineer)
Poole Fire Protection, Inc.



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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 01 Specification Sections apply to this Section.

1.2 SUMMARY

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

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 LIST OF DRAWINGS

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

<u>TITLE</u>	<u>SHEET #</u>	<u>DATE</u>	<u>CADD #</u>
1. Title Sheet	G-001	9-9-16	G-001.dwg
2. Overall Phasing Plan	G-100	9-9-16	G-100.dwg
3. Existing Fire Protection Plan	G-101	9-9-16	G-101.dwg
4. Overall Demolition Plan for Reflected Ceilings	A-100	9-9-16	A-100.dwg
5. Area A Kitchen Plan	A-400	9-9-16	A-400.dwg
6. Area A to E Reflected Ceiling Plan	A-700	9-9-16	A-700.dwg
7. Area A Reflected Ceiling	A-701	9-9-16	A-701.dwg
8. Area A Reflected Ceiling	A-702	9-9-16	A-702.dwg
9. Area A Reflected Ceiling	A-703	9-9-16	A-703.dwg
10. Area A to B Reflected Ceiling	A-704	9-9-16	A-704.dwg
11. Sprinkler System Plan-Wing Left Typical	FX-100	9-9-16	FX-100.dwg
12. Sprinkler System Plan-Wing Right Typical	FX-101	9-9-16	FX-101.dwg
13. Sprinkler System Plan-A.2	FX-102	9-9-16	FX-102.dwg
14. Sprinkler System Plan-A.3	FX-103	9-9-16	FX-103.dwg
15. Sprinkler System Plan-A.4	FX-104	9-9-16	FX-104.dwg
16. Sprinkler System Plan-A.5	FX-105	9-9-16	FX-105.dwg
17. Sprinkler Details	FX-501	9-9-16	FX-501.dwg

18. MEP Symbols List	ME-001	9-9-16	ME-001.dwg
19. Area A Mech. Room Mech. Plan	M-101	9-9-16	M-101.dwg
20. Area A Mech. Room Mech. Plan	M-102	9-9-16	M-102.dwg
21. Area A Mech. Room Mech. Plan	M-103	9-9-16	M-103.dwg
22. Area A Mech. Room Mech. Plan	M-104	9-9-16	M-104.dwg
23. Area A Mech. Room Mech. Plan	M-105	9-9-16	M-105.dwg
24. Area B Partial Mech. Plan	M-106	9-9-16	M-106.dwg
25. Area C Partial Mech. Plan	M-107	9-9-16	M-107.dwg
26. Area D Partial Mech. Plan	M-108	9-9-16	M-108.dwg
27. Area E Partial Mech. Plan	M-109	9-9-16	M-109.dwg
28. Building Automation System Plan	M-110	9-9-16	M-110.dwg
29. Mechanical Details and Schedules	M-501	9-9-16	M-501.dwg
30. Mechanical Details	M-502	9-9-16	M-502.dwg
31. Mechanical Schedules	M-601	9-9-16	M-601.dwg
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35. Controls Diagrams	M-605	9-9-16	M-605.dwg
36. Controls Diagrams	M-606	9-9-16	M-606.dwg
37. Area A Mech. Room Power Plan	E-101	9-9-16	E-101.dwg
38. Area A Mech. Room Power Plan	E-102	9-9-16	E-102.dwg
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40. Area B Partial Power Plan	E-104	9-9-16	E-104.dwg
41. Area C Partial Power Plan	E-105	9-9-16	E-105.dwg
42. Area D Partial Power Plan	E-106	9-9-16	E-106.dwg
43. Area E Partial Power Plan	E-107	9-9-16	E-107.dwg
44. Building Lighting Plan	E-201	9-9-16	E-201.dwg
45. Partial Lighting Plans	E-202	9-9-16	E-202.dwg

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. Various Facility Renovations
Missouri Veterans Home
Mount Vernon, Missouri
Project No.: U1609-01

3.0 BIDS WILL BE RECEIVED:

- A. Until: 1:30 PM, Thursday, October 27, 2016
- B. Place: Office of the Director, Division of Facilities Management, Design and Construction, Room 730, Truman State Office Building, 301 West High, PO Box 809, Jefferson City, Missouri 65102

4.0 DESCRIPTION:

- A. Scope: The project includes various facility renovations including upgrade to kitchen serving line and equipment, acoustical ceiling work, fire sprinkler system upgrades, plumbing, HVAC and electrical modifications.
- B. Estimate: \$1,600,970.00 to \$1,956,740.00
- 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.**

5.0 PRE-BID MEETING:

- A. Place/Time: 10:00 AM; Wednesday, October 12, 2016; Missouri Veterans Home, 1600 S Hickory, Mt. Vernon MO 65712.
- B. Access to State of Missouri property requires presentation of a photo ID by all persons

6.0 HOW TO GET PLANS & SPECIFICATIONS:

- A. Request: 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 1C, Columbia, Missouri 65203. Phone 573-446-7768, Fax 573-355-5433.
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.
- B. Refunds: Return plans and specifications in unmarked condition within 15 working days of bid opening to American Document Solutions, 1400 Forum Blvd., Suite 1C, Columbia, Missouri 65203. Phone 573-446-7768, Fax 573-355-5433. Deposits for plans not returned within 15 working days shall be forfeited.

Information for upcoming bids is available on the Division's web site -- <http://oa.mo.gov/facilities>
Plans, specifications and bidders lists are available on-line for bidders reference on American Document Solutions web site - <http://planroom.adsmo.net/>

7.0 POINT OF CONTACT:

- A. Designer: Malone Finkle Eckhardt & Collins, Inc., Brian Clark, phone # 913-322-1400, fax # 913-825-6697
- B. Project Manager: Paul Vassos, phone # 573-751-9203, 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.

Bid results are available after 3:00 PM the day of the bid opening by calling: (573) 751-5868.

SECTION 002113 – INSTRUCTIONS TO BIDDERS

1.0 - SPECIAL NOTICE TO BIDDERS

- A. These specifications have bound hereto a complete set of bidding forms. They are for the bidder's convenience only and are not to be detached from the specifications or filled out and executed. One set of unbound bid forms and labels will be furnished to each bidder and may be executed and submitted in a sealed envelope.
- B. Access to State of Missouri property requires presentation of a photo ID by all persons.

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 - <http://oa.mo.gov/facilities/project-management>.

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 will 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

(NOTE: See Article 7.D below for submittal restrictions.)

- 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 twelve (12) 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. Bids from an individual shall be signed as noted on the Bid Form.
- B. Bids 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. Bids 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.

7.0 - RECEIVING BID SUBMITTALS

- A. Bid submittals are to be presented in sealed envelopes which shall be plainly marked with project title, bid date and bid time and delivered to the place specified in the Invitation for Bids. Bidders shall be responsible for actual delivery of bid submittals during business hours, and it shall not be sufficient to show that a submittal was dispatched in time to be received before scheduled closing time for receipt.
- B. Bidders are cautioned to allow ample time for transmittal of submittals by mail or otherwise. If a submittal is mailed, bidder should secure correct information relative to the probable time of arrival and distribution of mail at the place where it is to be received, and make due allowance for possible delays.

- C. Bidder's attention is directed to the fact that no submittal will be accepted or considered if delivered after the specified time for receipt.
- D. 1. No telephonic, electronic mail, facsimile (FAX), or similar transmissions will be accepted or allowed for **BID SUBMITTALS**.
2. Electronic MBE/WBE/SDVE forms may be accessed at <http://oa.mo.gov/facilities/vendor-links/contractor-forms/>.
3. 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.
- E. Submittals received prior to the time of opening will be securely kept, unopened. The division representative whose duty is to receive submittals will decide when the specified time for opening has arrived, and no submittal received thereafter will be considered. No responsibility will attach to any division representative for the early opening of a submittal not properly submitted.
- F. Submittals will be received as shown in and required by the Bid Form. Submittals will be completed so as to include insertion of all amounts for alternate bids, unit prices and cost accounting data, etc. Failure to complete all required information may be cause for rejection of bid.
- G. 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.
- H. Bidders prices shall include all city, state and federal sales, excise and similar taxes which may be lawfully assessed in connection with his performance of work and purchase of materials to be incorporated in the work. **THIS PROJECT IS NOT TAX EXEMPT.**
- I. The completed forms shall be without interlineations, alterations or erasures. If contractor desires, he may request additional copies of forms.
- J. The Owner reserves the right to waive informalities in bid submittals and to reject any or all bids.

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. Modifications or corrections of any bid information previously submitted may only be made by letter or telegram. Modifications or corrections must be clearly marked with bid date, project name and number and received by the Owner prior to the scheduled closing time for receipt of bids in accordance with the following provisions:
 - 1. To maintain bid confidentiality and insure assignment to the proper bid, any such written request must be contained in a sealed envelope which is plainly marked "Modification of bid on (project title, project number and bid date)." Name and address of bidder should be on sealed envelope.
 - 2. No requests for modifications or correction of previously submitted bids will be accepted by telephone, facsimile (FAX) transmission or electronic mail.

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 at – <http://oa.mo.gov/facilities/vendor-links/contractor-forms> .

Information regarding a Memorandum of Understanding which is one form of appropriate documentation located at <https://www.uscis.gov/e-verify/> . Submittal of this form and appropriate documentation is required before the award of any contract. In addition the contractor shall be responsible for compliance of these requirements by all subcontractors and suppliers at any tier associated with this contract.

10.0 – SERVICE-DISABLED VETERAN'S

- A. For the purposes of these instructions, the terms “service-disabled veteran” and “service-disabled veteran business” have the same meanings as set forth in section 34.074, RSMo.
- B. The State of Missouri has a goal of awarding three percent of all construction projects to service-disabled veterans. Furthermore, service-disabled veteran businesses doing business as Missouri firms, corporations, or individuals, or which maintain Missouri offices or places 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 any service-disabled veteran business’s bid amount(s) by three percent of the lowest bid amount(s). 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.
- C. Any bidder who is qualified as a Missouri service-disabled veteran pursuant to Section 34.074, RSMo, must complete and submit with the bid the MISSOURI SERVICE DISABLED VETERAN BUSINESS form and provide the specified documentation in accordance with the instructions provided therein. This form can be obtained at: <http://oa.mo.gov/facilities/vendor-links/contractor-forms> .

11.0 - 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.

12.0 - 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.**

13.0 - 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.

SECTION 002213—SUPPLEMENTARY INSTRUCTIONS TO BIDDERS – MBE/WBE/SDVE INSTRUCTIONS

1.0 DEFINITIONS

1. **"MBE"**: Minority Business Enterprise.
2. **"MINORITY"**:
 - a. "Black Americans," which includes persons having origins in any of the black racial groups of Africa;
 - b. "Hispanic Americans," which includes persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish culture or origin regardless of race;
 - c. "Native Americans," which includes persons who are American Indians, Eskimos, Aleuts, or Native Hawaiians;
 - d. "Asian-Pacific Americans," which includes persons whose origins are from Japan, China, Taiwan, Korea, Vietnam, Laos, Cambodia, the Philippines, Samoa, Guam, the U.S. Trust Territories of the Pacific, or the Northern Marianas; or
 - e. "Asian-Indian Americans," which includes persons whose origins are from India, Pakistan or Bangladesh.
3. **"MINORITY BUSINESS ENTERPRISE"**: A business concern which is at least fifty-one percent (51%) owned by one (1) or more minority as defined in 2. "MINORITY" above or in the case of any publicly-owned business, fifty-one percent (51%) of the stock of which is owned by one (1) or more minority as defined in 2. "MINORITY" above AND whose management and daily business operations are controlled by one (1) or more minority as defined herein.
4. **"WBE"**: Women Business Enterprise.
5. **"WOMEN BUSINESS ENTERPRISE"**: A business concern which is at least fifty-one percent (51%) owned by one (1) or more women or in the case of any publicly-owned business at least fifty-one percent (51%) of the stock of which is owned by one (1) or more women AND whose management and daily business operations are controlled by one (1) or more women.
6. **"SDVE"**: A Service-Disabled Veterans Enterprise.
7. **"SERVICE-DISABLED VETERAN"**: Any individual who is service disabled as certified by the appropriate federal agency responsible for the administration of veterans' affairs.
8. **"SERVICE-DISABLED VETERANS ENTERPRISE"**: A service disabled veteran business as defined by Section 34.074, RSMo, meaning a business concern which is at least fifty-one percent (51%) owned by one (1) or more service-disabled veterans or in the case of any publicly-owned business at least fifty-one percent (51%) of the stock of which is owned by one (1) or more service-disabled veterans AND whose management and daily business operations are controlled by one (1) or more service disabled veterans.

2.0 MBE/WBE/SDVE PROGRAM REQUIREMENTS

- A. For bids where MBE, WBE and or SDVE goals are greater than zero percent (0%) as noted in the "Invitation for Bid," the following provisions shall apply
 1. MBE/WBE/SDVE Percentage Goals:
 - a. The bidder shall have as a goal subcontracting not less than the percentages stated on the Bid Form for MBE, WBE and SDVE firms.
 2. Computation of MBE/WBE/SDVE Percent Goal Participation:
 - a. The total dollar value of the work granted to the MBE, WBE or SDVE by the successful bidder shall be counted towards the applicable goal of the entire contract.
 - b. A bidder may count toward the MBE/WBE/SDVE goals only expenditures to certified MBE's, WBE's, or SDVE's that perform a commercially useful function in the work of a contract. A MBE, WBE, or SDVE is considered to perform a commercially useful function when it is responsible for executing a distinct element of the work contract and carrying out its responsibilities by actually performing, managing and supervising the work or providing supplies or manufactured materials. A bidder who is a MBE, WBE or SDVE may count 100% of the contract towards the MBE, WBE or

SDVE goal. (NOTE: MBE firms who bid as general contractors are expected to obtain WBE and SDVE participation; WBE firms who bid as general contractors are expected to obtain MBE and SDVE participation; and SDVE firms who bid as general contractors are expected to obtain MBE and WBE participation to meet the project's separate goals.)

- c. Bidder may count toward its MBE/WBE/SDVE goals expenditures for materials and supplies obtained from certified MBE, WBE, or SDVE suppliers and manufacturers, provided that the MBE, WBE, or SDVE assumes the actual and contractual responsibility for the provision of the materials and supplies.
 - d. A bidder may count towards the MBE/WBE/SDVE goals that portion of the total dollar value of the work granted to a second or subsequent tier subcontractor or a supplier to any subcontractor at any tier, provided that the MBE, WBE, or SDVE properly assumes responsibility for the work as outlined in 2.A.2.b and 2.A.2.c above.
 - e. A bidder may count towards the MBE/WBE/SDVE goals that portion of the total dollar value 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.
3. Certification by bidder of MBE/WBE/SDVE Subcontractors:
- a. The bidder shall submit with his bid 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 on the contract work.
 - b. The bidder may determine the status of certification of a proposed MBE or WBE subcontractor or supplier by referring to the Office of Equal Opportunity (OEO) MBE/WBE directory (<https://apps1.mo.gov/o eo/>); and the eligibility of a SDVE subcontractor or supplier by referring to the Division of Purchasing and Materials Management 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/>). Additional information, clarifications, etc., regarding the listings in the Directory may be obtained by calling the Division at (573) 751-3339 and asking to speak to the Contract Specialist of record as shown in Section 007300, Supplementary Conditions.
 - c. If the proposed subcontractor is certified as a MBE/WBE firm by any other State of Missouri agency or any Missouri city or county government agency, the bidder shall so note and provide particulars. Other known State of Missouri entities providing certification are:

Mountain Plains Minority Supplier Development Council	816-221-4200
Human Relations Department, KCMO	816-274-1432
Lambert International Airport	314-551-5000
Metro (formerly Bi-State Development Agency)	314-982-1457
St. Louis Development Corporation	314-622-3400 Ext. 362
St. Louis Minority Business Council	314-241-1073
SBA 8/St. Louis, MO	314-539-6600
Missouri Department of Transportation	573-751-2859
National Women Business Owners Corp.	561-848-5066

(Missouri firms only)

4. Waiver of MBE/WBE/SDVE Participation:
- a. The bidder is required to make a good faith effort to locate and contract with MBE's, WBE's and SDVE's. If a bidder has made a good faith effort to secure the required MBE's, WBE's and SDVE's and has failed, he may submit with his bid the information requested in "MBE/WBE/SDVE Good

Faith Effort (GFE) Determination.” The Director will review the bidder’s actions as set forth in the bidder’s Application for Waiver, the ability or success of other bidders to obtain MBE, WBE, or SDVE participation in their bids, and any other factors deemed relevant by the Director, to determine if a good faith effort has been made to meet the applicable percentage goals. If the bidder is judged not to have made 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 SDVE participation will be determined to be responsive to the MBE/WBE/SDVE participation goals of the contract regardless of the percent of MBE/WBE/SDVE participation, provided the bid is otherwise acceptable.

- b. In reaching a determination of good faith, the Director may evaluate, but is not limited to, the following factors:
 1. How subcontractors were contacted initially, the specific project information provided and the documentation to support that contact;
 2. How project plans and specifications were provided to MBE/WBE/SDVE subcontractors;
 3. The names, addresses, phone numbers, and dates of contact for MBE/WBE/SDVE firms contacted for specific categories of work;
 4. Attempts to follow-up with MBE, WBE or SDVE subcontractors prior to bid to negotiate price, scope of work, or make other adjustments or clarifications;
 5. Amount of bids received from any of these subcontractors;
 6. Bid accepted from one of these subcontractors or reasons for rejecting bids;
 7. The MBE, WBE, or SDVE suppliers contacted, date of contact, material or equipment, amounts of quotes;
 8. The ability or success of other bidders to obtain the MBE/WBE/SDVE participation in their bids.
- c. If MBE/WBE/SDVE goals have been identified on Section 004113-BID FORM, ALL bidders are required to submit all appropriate MBE/WBE/SDVE documentation before the stated time and date set forth in the “Invitation for Bid”. Failure to provide this information by the specified date and time will be grounds for rejecting the bid.

MBE/WBE/SDVE forms may be accessed at <http://oa.mo.gov/fmndc/dc/contractorforms.htm>. 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.”
- d. The Director reserves the right to provide bidders the opportunity to correct or amplify the documented information received concerning MBE/WBE/SDVE goals. The additional information will be transmitted to Facilities Management Design and Construction within two (2) working days of a phone or facsimile or email request from the Director’s representative.

3.0 CONTRACTOR REQUIREMENTS

For contracts where there are MBE/WBE/SDVE participation goals as noted in the “Invitation for Bid,” the following provisions shall apply:

- A. The Contractor is bound to subcontracting or obtaining materials in amounts not less than the dollar amount indicated in the awarded contract to MBE/WBE/SDVE (s) unless that amount is revised in writing by the Owner’s representative.
- B. If the Contractor fails to meet or maintain the participation requirements contained in the Contractor’s bid, he must satisfactorily explain to the Director or his Designee why the requirement cannot be achieved and why meeting the requirement was beyond the Contractor’s control.
- C. If the Director finds the Contractor’s explanation unsatisfactory, the Director may take any appropriate action including, but not limited to:

1. Declaring the Contractor ineligible to participate in any Facilities Management, Design and Construction contracts for a period not to exceed twelve (12) months; and
 2. Directing that the Contractor be declared non-responsive to the "Invitation for Bid," or in breach of this contract.
- D. If a MBE, WBE, or SDVE is replaced during the course of this contract, the Contractor shall replace it with a similar MBE, WBE, or SDVE OR make a good faith effort to replace it with another MBE, WBE, or SDVE. All substitutions shall be approved by the Owners Representative.
- E. The Contractor shall provide the Owner with regular reports on its progress in meeting its MBE/WBE/SDVE obligations. As a minimum, the dollar-value of work completed by each MBE, WBE, or SDVE subcontractor during the preceding month and as a cumulative total shall be reported with each monthly application for payment. A final report shall include the total dollar-value of work completed by each MBE, WBE, and SDVE subcontractor during the total 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:

<http://www.directory.oeo.oa.mo.gov/>

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:

<http://oa.mo.gov/sites/default/files/sdvelisting.pdf>

<https://www.vip.vetbiz.gov/>

NOTE: ALL PAGES OF THIS BID FORM (004113) MUST BE COMPLETED AND SUBMITTED OR THE BID MAY BE REJECTED FOR BEING NON-RESPONSIVE.

STATE OF MISSOURI

Bid Time: 1:30 PM

Bid Date: _____

SECTION 004113 - BID FORM

1.0 BID:

A. From:

(Bidder's Name)

herein after called the "**Bidder**".

B. To:

Director, Division of Facilities Management, Design and Construction
Room 730, Harry S Truman State Office Building
301 West High Street
Jefferson City, Missouri 65102

herein after called the "**Owner**."

C. For:

Various Facility Renovations
Missouri Veterans Home
Mount Vernon, Missouri

D. Project Number:

U1609-01

hereinafter called the "**Work**."

E. Documents:

The undersigned, having examined and being familiar with the local conditions affecting the work and with the complete set of contract documents, including the Drawings, the Invitation For Bid, Instructions To Bidders, Statement of Bidders Qualifications, General Conditions, Supplement to General Conditions, and the technical specifications, including: addenda number _____ through _____ hereby proposes to perform the Work for the following:

F. Bid Amount:

_____ Dollars (\$ _____)

G. Allowances:

The Base Bid above must include an allowance of bad weather days only. See Section 012100 for details.

H. Alternates: Alternate No. 1: In accordance with the requirements of the drawings and specifications, remove two existing boilers (Boiler #1 and Boiler #2) and provide and install 2 new boilers (Boiler #1 and Boiler #2) in their place. Boilers shall be provided with a boiler controller in accordance with the boiler specifications capable of controlling multiple boilers. This work shall include all revisions to heating water piping, electrical, gas piping, etc. and connection to the DDC Building Automation System. **No additional work days will be added should the Owner accept this Alternate.**

\$ _____ Dollars (\$ _____).

2.0 MBE/WBE/SDVE PERCENTAGE OF PARTICIPATION PROJECT GOALS:

This project's specific goals are: **MBE 10.00%** **WBE 10.00%**, and **SDVE 3.00%**. NOTE: Only MBE/WBE firms certified by a State of Missouri public entity, and SDVE(s) meeting the requirements of Section 34.074, RSMo, and 1 CSR 30-5.010, as of the date of bid opening, can be used to satisfy the MBE/WBE/SDVE participation goals for this project.

3.0 BID BOND

A. Accompanying the bid is: ___ 5% Bid Bond or ___ Cashier's Check/Bank Draft for 5% of base bid.

Payable without condition to the Division of Facilities Management, Design and Construction, State of Missouri, as per Article 5 of "Instructions To Bidders".

NOTE: ALL PAGES OF THIS BID FORM (004113) MUST BE COMPLETED AND SUBMITTED OR THE BID MAY BE REJECTED FOR BEING NON-RESPONSIVE.

4.0 CONTRACT COMPLETION TIME AND LIQUIDATED DAMAGES

- A. The Bidder agrees to complete the work within 142 working days from the date the Notice of Intent to Award is issued as modified by additional days added by the Owner's acceptance of alternates, if applicable. This includes 12 working days for document mailing and processing. The Bidder further agrees to pay to, or allow the State as liquidated damages the sum of \$1,000 for each working day thereafter that the entire work is not substantially complete.

5.0 ATTACHMENTS TO BID:

- A. 004322 Unit Prices
- B. 004336 Proposed Subcontractors
- C. 004541 Affidavit of Work Authorization
- D. 004337 MBE/WBE/SDVE Compliance Form
- E. 004338 MBE/WBE/SDVE Joint Venture Form
- F. 004339 MBE/WBE/SDVE Waiver Form
- G. 004340 SDVE Business Form

6.0 BIDDER'S CERTIFICATIONS:

- A. The Bidder agrees to pay not less than the hourly rate of wages as determined by the Department of Labor and Industrial Relations, State of Missouri, in accordance with Sections 290.210 to 290.340, RSMo.
- B. The Bidder hereby certifies that this bid is genuine and is not made in the interest of or on behalf of any undisclosed person, firm, or corporation, and is not submitted in conformity with any agreement or rules of any group, association or corporation;

That he/she has not directly or indirectly induced or solicited any other bidder to put in a false or sham proposal;

That he/she has not solicited or induced any person, firm or corporation to refrain from submitting a bid;

That he/she has not sought by collusion or otherwise to obtain for him/herself any advantage over any other bidder or over the Owner.

That he/she will not discriminate against any employee or applicant for employment because of race, creed, color or national origin in the performance of the work.

That he/she certifies that he/she has based this proposal upon an official /complete set of contract documents, either obtained from the Owner after Bidder placed himself/herself on the bidders' list or from a secondary source known to the Bidder to have provided a complete and accurate set of contract documents, provided that if Bidder received the contract documents from such a secondary source, any errors or omissions in the contract documents shall be interpreted and construed in favor of the Owner and against the Bidder. This proposal is also based upon the conditions within Article 1.2 of the General Conditions.

That he/she certifies that he/she will comply with the provisions of Sections 285.230-234, RSMo, regarding transient employers.

That he/she has enrolled and is and will continue to participate in a federal work authorization program in accordance with Sections 285.525 and 285.530, RSMo for the duration of this contract.

NOTE: ALL PAGES OF THIS BID FORM (004113) MUST BE COMPLETED AND SUBMITTED OR THE BID MAY BE REJECTED FOR BEING NON-RESPONSIVE.

7.0 CONTACT INFORMATION (mandatory for all bidders):

Sole Proprietorship/General Partnership LLC Limited Partnership Corporation Joint Venture

Business Name: _____

Address: _____

Telephone: _____ Fax Number: _____

Federal ID Number: _____ or Social Security Number: _____

Missouri Business Charter Number: _____ (or provide the proper certificate from the Secretary of State)

Contact Name: _____ Contact email: _____

8.0 SIGNATURES:

FOR SOLE PROPRIETORSHIPS/GENERAL PARTNERSHIPS ONLY:

_____ Name each general partner: _____
Sole Proprietor's Name (printed) _____

Today's Date: _____

I, _____, being the sole proprietor/general partner of (name of business) _____ (and if the name of said business is other than my legal name, having filed a Registration of Fictitious Name with the Missouri Secretary of State in order to allow me to use such name in connection with my business, as provided by Section 417.200, RSMo, et seq.), do hereby submit this bid and agree to be bound unto the State of Missouri as herein provided (if a general partnership, all partners must sign below).

Signature: _____ Signature: _____

Signature: _____ Signature: _____

FOR LIMITED LIABILITY COMPANIES ONLY:

_____ today's date _____ State(s) of organization: _____
Manager's (or Managing Member's) Name (printed)

I, _____, being the Manager (or Managing Member) of (full legal name of limited liability company from Articles of Organization) _____, and being duly authorized to act as herein provided on behalf of said limited liability company, do hereby submit this bid on behalf of said limited liability company and agree that said limited liability company shall be bound unto the State of Missouri as herein provided.

Signature: _____

FOR LIMITED PARTNERSHIPS/LIMITED LIABILITY PARTNERSHIPS/LIMITED LIABILITY LIMITED PARTNERSHIPS ONLY:

_____ today's date: _____ State(s) of organization: _____
General/Managing Partner's Name (printed)

I, _____, being the General Partner/Managing Partner of (full legal name of limited partnership/limited liability partnership/limited liability limited partnership from partnership agreement or Certificate of Limited Partnership) _____, and being duly authorized to act as herein provided on behalf of said limited partnership/limited liability partnership/limited liability limited partnership, do hereby submit this bid on behalf of said limited partnership/limited liability partnership/limited liability limited partnership and agree that said limited partnership/limited liability partnership/limited liability limited partnership shall be bound unto the State of Missouri as herein provided.

Signature: _____

FOR CORPORATIONS ONLY:

_____ President's Name (printed) _____ Secretary's Name (printed) _____ Today's date
State(s) of incorporation: _____

I, _____, being the (officer or title) _____ of (full legal name of corporation, from Articles of Incorporation) _____, and being duly authorized by the Board of Directors of said corporation to act as herein provided on behalf of said corporation, do hereby submit this bid on behalf of said corporation and agree that said corporation shall be bound unto the State of Missouri as herein provided.

Signature: _____ President Attested by: _____ Corporate Secretary

The President should sign as the bidder. If the signator is other than the corporate president, the bidder must provide satisfactory evidence that the signator has the legal authority to bind the corporation.

FOR ASSOCIATIONS/JOINT VENTURES: If multiple business entities/individuals are bidding collectively as an association or joint venture, each business entity/individual bidding as part of the association or joint venture shall sign this bid in the above sections relevant to the form that such business entity or individual does business, and the bidder shall duplicate the necessary number of signature pages so that all members of the association or joint venture shall sign this bid. If a name is adopted for use by the association or joint venture, the association or joint venture shall file a Registration of Fictitious Name with the Missouri Secretary of State in order to use such name in connection with the association or joint venture, as provided by Section 417.200, RSMo, *et seq.*

SECTION 004322 - UNIT PRICES

PROJECT NUMBER U1609-01

1.0 Description

- A. 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 during construction the total contract price shall be decreased as appropriate or increased by contract change in accordance with General Conditions Article 4.1.

2.0 Unit Prices:

A. Unit Price:

Unit Price 1 – 24” x 48” x 3/4” Acoustical Ceiling Tile

Description: Remove and replace one 24” x 48” x 3/4” acoustical Ceiling Tile and replace with new 24” x 48” x 3/4” Celotex Cashmere Designer Series acoustical tile CDS-224 (Refer to Specifications -Type I).

Unit of Measurement: One acoustical tile.

\$ _____ per acoustical tile

SECTION 004336 – PROPOSED SUBCONTRACTORS

Project Number U1609-01

1.0 CONTRACTOR/SUBCONTRACTOR/MATERIAL SUPPLIER LIST:

A. Identify the subcontractor(s) who will perform the categories of work listed below. If you plan to use your own employees to do the work, list yourself. Failure to list your firm, or a subcontractor for each category of work listed under “Description of Work” shall be cause for rejection of the bid. **If any category of work is left vacant, the bid shall be rejected.** If more than one firm performs work in one category, you must designate the portion of work to be performed by each contractor/subcontractor. If your choice(s) of subcontractor will change if certain alternates are accepted, indicate in the different columns which subcontractor you will use for the base bid and each accepted alternate. After bid opening, no substitutes of listed firms will be allowed except as indicated in SECTION 007200 - GENERAL CONDITIONS, Article 3.7 - SUBCONTRACTS.

B. The Bidder hereby certifies that the following Contractor, subcontractors, suppliers and /or manufacturers will be used in the performance of the work:

DESCRIPTION OF WORK	SPECIFICATION DIVISION OR SECTION(S)	NAME OF FIRM FOR BASE BID WORK
Electrical	26	
Mechanical	23	
Plumbing	22	
Fire Suppression	21	
Kitchen Equipment	114000	

SECTION 004337 - MBE/WBE/SDVE COMPLIANCE EVALUATION FORM

Project Name: _____ Project No.: U1609-01

This form is to be completed by bidders and submitted to the State of Missouri, Division of Facilities Management, Design and Construction with the bid submittal. Submit one form per MBE/WBE/SDVE firm involved with the project. This includes any MBE/WBE/SDVE general contractor, joint venture, subcontractor or supplier, regardless of how many tier levels of sub-contracts.

A condition for remaining in competition for award is the satisfactory completion of this form for each minority/woman/service disabled veteran-owned firm that will perform a commercially useful function on the contract. The undersigned submits the following data with respect to the following firm's assurance to meet the Office of Administration's goal for MBE/WBE/SDVE participation.

1. Name of General Contractor: _____

2. MBE/WBE/SDVE Firm: _____

(Name)

(Address)

(City, State, Zip Code)

(Phone Number)

(Fax Number)

Type of Business: _____ Type of Firm: MBE WBE SDVE

Officer Name & Title: _____

3. Describe the subcontract actual work to be performed (List BASE BID work and any ALTERNATE work separately):

BASE BID: _____

ALTERNATE (S): (identify separately)

4. Indicate the dollar (\$) amount of contract to be subcontracted to the MBE/WBE/SDVE Firm:

BASE BID: \$ _____

ALTERNATE (S): (identify separately)
\$ _____
\$ _____
\$ _____

5. Is the proposed subcontractor listed in the Minority/Women Business Enterprise Directory maintained by the Office of Equal Opportunity (OEO) or the Division of Purchasing and Materials Management SDVE directory? YES NO

6. Is the proposed subcontractor certified as a MBE/WBE firm by another State of Missouri public entity? YES NO
If yes, please provide the name and address of such entity below. Also provide a copy of the subcontractor's certificate or certification letter from such entity for verification.

Name & address of Missouri: certifying public entity:

Name of General Contractor Signee (Print) _____

Signature: _____

Title: _____

Date: _____

SECTION 004338 - MBE/WBE/SDVE ELIGIBILITY DETERMINATION FORM FOR JOINT VENTURES

Project Name: _____ Project No.: U1609-01

If bidder is a joint venture, this form shall be completed and submitted with the bid submittal to the Missouri State Division of Facilities Management, Design and Construction.

1. Joint Venture Firm: _____
(Name)

(Address) (City, State, Zip Code)

(Phone Number) (Fax Number)

2. In order to be counted toward project MBE/WBE/SDVE goals, the MBE/WBE/SDVE partner(s) must be currently certified by a State of Missouri public entity or have proof of SDVE eligibility. Identify the firms which comprise the joint venture and include a copy of the certification of each MBE/WBE/SDVE firm included in the joint venture.

(a) Describe the role of each MBE, WBE, or SDVE firm in the joint venture:

(b) Briefly describe the experience and business qualifications of each non-MBE/WBE/SDVE co-venturer:

3. What is the claimed percentage of MBE/WBE/SDVE ownership in the joint venture?

4. Ownership of joint venture. **Attach a copy of the joint venture agreement.** (The following need not be filled in if described in the joint venture agreement)

(a) Description of profit and loss sharing:

(b) Description of capital contributions, including equipment:

(c) Description of other applicable ownership interests:

6. Control of, and participation in, this contract. Identify by name, race, sex, and "firm" those individuals (and their titles) who are responsible for day-to-day management and policy decision making including, but not limited to, those with prime responsibility for:

- Financial Decisions Management Decisions Estimating Marketing Sales
- Hiring (of management) Firing (of management) Purchase of major items or supplies

Name	Race	Sex	Firm & Title	Responsibility	Management Decisions

NOTE: If after filing this information and before the completion of the joint venture's work on the contract covered by this regulation, there is any significant change in the information submitted, the joint venture must inform the Commissioner, either directly or if the joint venture is a subcontractor through the prime contractor.

AFFIDAVIT

"The undersigned swear that the foregoing statements are correct and include all material and information necessary to identify and explain the terms and operation of our joint venture and the intended participation by each joint venturer in the undertaking. Further, the undersigned covenant and agree to provide the Commissioner, Office of Administration, current, complete and accurate information regarding actual joint venture work and the payment therefore and any proposed changes in any of the joint venture arrangements and to permit the audit and examination of the books, records, and files of the joint venture, or those of each joint venturer relevant to the joint venture, by authorized representatives of the Commissioner of the Office of Administration. Any material misrepresentation will be grounds for terminating any contract which may be awarded and for initiating action under Federal or State laws concerning false statements."

Name of Firm: _____
 Signature: _____
 Name: _____
 Title: _____
 Date: _____

Name of Firm: _____
 Signature: _____
 Name: _____
 Title: _____
 Date: _____

Date: _____

State of: _____

County of: _____

On this _____ day of _____, 20____, before me appeared
(name) _____ to me personally known, who, being duly sworn, did execute the foregoing
affidavit, and did state that he or she was properly authorized by (name of firm) _____
to execute the affidavit and did so as his or her own free act and deed.

Notary Public: _____ (seal)

My commission expires: _____

Date: _____

State of: _____

County of: _____

On this _____ day of _____, 20____, before me appeared
(name) _____ to me personally known, who, being duly sworn, did execute the foregoing
affidavit, and did state that he or she was properly authorized by (name of firm) _____
to execute the affidavit and did so as his or her own free act and deed.

Notary Public: _____ (seal)

My commission expires: _____

Bidders must request a GFE determination for EACH category goal not achieved:

REQUEST FOR WBE GOAL WAIVER
 REQUEST FOR SDVE GOAL WAIVER

PROJECT NO. U1609-01 PROJECT TITLE

SUBMITTED BY Prime Bidder

Please complete the following information. Scores will be based on the comparison of effort made by the bidders on this project and the completeness of the information. Maximum points possible is indicated in parenthesis () for each type of information requested. Bidders not attaining the project MBE/WBE/SDVE goals must secure necessary credit in each category through a combination of participation and/or effort in order to be considered responsive to the project goals.

INSTRUCTIONS FOR PART A and B - Prime Bidder has the option of completing all lines (1-6) of Part A or all lines (7-12) of Part B or a combination of A and B with a maximum of six (6) lines total for A and B such as (1, 2, 3, 6, 7 & 8) or (1, 2, 6, 7, 8 & 11). Credit values possible for each line are equal.

Part A Developing Relationships: Provide the information requested in this section for up to six (6) MBE/WBE/SDVE firms that the owner, partner or principle officer of the Prime Bidder has had personal contact within the last sixty days for the purpose of developing a working relationship.

	a. Name of Firm: MBE (5) or WBE (5) or SDVE (5); and Principle of Firm (5) That Prime Bidder Met With	b. Telephone Number (2)	c. Date of Meeting (2)	d. Years in Business (4)	e. Number of Employees (4)	f. Number of Licensed Tradesmen (3)	g. Bonding Limit(5)	h. Limit of General Liability Insurance (3)	i. Typical Project Size (2)
1.	MBE WBE SDVE								
2.	MBE WBE SDVE								
3.	MBE WBE SDVE								
4.	MBE WBE SDVE								
5.	MBE WBE SDVE								
6.	MBE WBE SDVE								

Part B Sustained Relationships: Provide the names of up to three MBE/WBE/SDVE firms that the Prime Bidder has contracted with in the past 12 months and list the projects and subcontract values.

	a. Name of Firm: MBE (5) WBE (5) SDVE (5)	1 st Project			2 nd Project			3 rd Project		
		b. Name of Project (5)	c. Subcontract Value (5)	d. Name of Project (5)	e. Subcontract Value (5)	f. Name of Project (5)	g. Subcontract Value (5)			
7.	MBE WBE SDVE									
8.	MBE WBE SDVE									
9.	MBE WBE SDVE									
10.	MBE WBE SDVE									
11.	MBE WBE SDVE									
12.	MBE WBE SDVE									

Part C. How did prime Bidder provide access to full sets of plans and specifications and specific sections for this project to subcontractors and suppliers?

Check boxes for all methods used.

1. Directed to local plan room at _____ (3)
2. Made available at Prime Bidder's Office (3)
3. Directed to website at _____ (5)
4. Faxed specific sections to subcontractors and/or suppliers (attach copy) (3)
5. Mailed or emailed specific sections to subcontractors and/or suppliers (attach copy) (3)
6. Hand carried directly to subcontractors and/or suppliers (5)

Part D. How were subcontractors and suppliers (specifically for this project) initially contacted and informed of Prime Bidder's interest in receiving a proposal from them?

Explain and attach copies of emails, telephone logs, fax transmittals and logs, scopes of work for specific categories of work. Please cross-reference documentation for Parts E, F, G & H. (20)

INSTRUCTIONS FOR PARTS E, F, G, & H - Provide the Information Requested for MBE/WBE/SDVE Firms for each of the "Categories of Work" and "Supplier" that you solicited participation.

Part E. Category or Categories of Work: _____ Specification(s) Division(s): _____ Section(s): _____

	Name of Firm & Person Contacted	M B E (5)			W B E (5)			S D V E (5)			a. Date of Initial Contact (5 pts for 3 weeks prior to bid date; 3 pts for 2 weeks prior; and 1 pt for 1 week prior.)	b. Follow-up date and assistance given to sub-contractor prior to bid. Attach documentation. (10)	c. Amount of Bid Received (15)	d. Bid Accepted (5)	e. If Applicable, Reason for Rejection of Bid Failure to provide information (-5)
		B	E	(5)	W	B	E	(5)	S	D					
1.															
2.															
3.															
4.															
5.															
6.															

Name(s) of Selected Firm(s) for This Category or Categories _____ Bid(s) Accepted \$ _____

Part F. Category or Categories of Work: _____ Specification(s) Division(s): _____ Section(s): _____

	Name of Firm & Person Contacted	M B E (5)			W B E (5)			S D V E (5)			a. Date of Initial Contact (5 pts for 3 weeks prior to bid date; 3 pts for 2 weeks prior; and 1 pt for 1 week prior.)	b. Follow-up date and assistance given to sub-contractor prior to bid. Attach documentation. (10)	c. Amount of Bid Received (15)	d. Bid Accepted (5)	e. If Applicable, Reason for Rejection of Bid Failure to provide information (-5)
		B	E	(5)	W	B	E	(5)	S	D					
1.															
2.															
3.															
4.															
5.															
6.															

Name(s) of Selected Firm(s) for This Category or Categories _____ Bid(s) Accepted \$ _____

Part G. Category or Categories of Work: _____

Specifications Division(s): _____

Section(s): _____

1. 2. 3. 4. 5. 6.	Name of Firm & Person Contacted	M B E (5) √	W B E (5) √	S D V E (5) √	Telephone No.	a. Date of Initial Contact (5 pts for 3 weeks prior to bid date; 3 pts for 2 weeks prior; and 1 pt for 1 week prior.)	b. Follow-up date and assistance given to sub-contractor prior to bid. Attach documentation. (10)	c. Amount of Bid Received (15)	d. Bid Accepted (5)	e. If Applicable, Reason for Rejection of Bid Failure to provide information (-5)

Name(s) of Selected Firm(s) for This Category or Categories _____

Bid(s) Accepted \$ _____

Part H. Suppliers:

1. 2. 3. 4. 5. 6.	Name of Firm, Person, and type of Supplier Contacted	M B E (5) √	W B E (5) √	S D V E (5) √	Telephone No.	a. Date of Initial Contact (5 pts for 3 weeks prior to bid date; 3 pts for 2 weeks prior; and 1 pt for 1 week prior.)	b. Material or Equipment Quoted (5)	c. Amount of Quote Received (10)	d. Quote Accepted (5)	e. If Applicable, Reason for Rejection of Bid Failure to provide information (-5)

Name(s) of Selected Firm(s) for This Category or Categories _____

Bid(s) Accepted \$ _____

NAME INFORMATION WILL BE VERIFIED AS NECESSARY, INVALID INFORMATION WILL RECEIVE NO SCORE.

**INSTRUCTIONS FOR COMPLETING
FORM NO. 004339 – MBE/WBE/SDVE
GOOD FAITH EFFORT (GFE) DETERMINATION**

General Information

1. This form is to be used by bidders if they were not able to meet any or all of the stated MBE, WBE, or SDVE goal(s) for the project.
2. This form is to be part of the Bid Submittal as explained in the "Instructions to Bidders."
3. This form is designed for submittal of information to determine whether the bidder made a Good Faith Effort to obtain the MBE/WBE/SDVE goals established for the project.
4. If a bidder achieves a participation goal, the bidder will be awarded full credit for that category. This score plus the GOOD FAITH EFFORT credit for the other categories not achieved for participation will determine if the bid is responsive to attaining the MBE, WBE and SDVE goals.
5. This form shall be completed by the Prime Bidder.

Completing Form No. 004339

- Step 1 Indicate by checking the box if the waiver is requested for the MBE, WBE or SDVE Goal(s).
- Step 2 Provide the Project Number, Project Title and Company Name of Prime Bidder where indicated.
- Step 3 Review the entire form well in advance of bid submittal to be familiar with the required information.
- Step 4 Complete all of Part A, all of Part B, or a combination of Part A & Part B, such that a maximum of lines are completed. Only 6 of lines 1 through 12 in Parts A & B will be considered. For lines 1 through 6, provide the name of the MBE, WBE or SDVE firm, name of the principal owner of the firm met with, their phone number, the date of the meeting and the other specific information requested related to that firm. For lines 7 through 12, provide the name of MBE/WBE/SDVE firm contracted with, the names of the projects they were used on, and the dollar values of their subcontracts.
- Step 5 Complete Part C by checking the boxes for all methods that were used, being sure to provide for: 1. The plan room address; and 3. website address. Attach copies as requested.
- Step 6 Complete Part D. Explain in this section how MBE/WBE/SDVE subcontractors were initially contacted and provide the contact name, date and time of contact, whether by phone, email, or fax, and provide a copy of the scope of work they were asked to bid.

Instructions for Completing
Form No. 004339 — MBE/WBE/SDVE
Page Two

- Step 7** Complete Parts E, F, and G. Indicate the category of work, specification division and section(s), for which MBE/WBE/SDVE participation is sought. Provide: the name of the MBE/WBE/SDVE firm; person contacted; telephone number; date of initial contact; and attach documentation to verify that a follow-up contact was made, such as date of follow-up and an explanation of what was discussed. Indicate on the form the amount of their bid, whether or not it was accepted, reason for rejection (if applicable) and name of selected firm and their bid amount.
- Step 8** Complete Part H. Indicate the firm names of the contacted suppliers and person contacted, phone number, date of contact, type of material or equipment quoted amount of quote received, whether or not it was accepted, reason for rejection (if applicable), name of selected firm and their quote amount.

Notes

1. Information must be placed on the form where requested and attached documentation must indicate the PART, line and column on the form that it relates to, such as, "PART F -- Line 2 -- Column B."
2. Information will be verified by calling the firms listed, as necessary. Information that cannot be verified will not be considered in determining whether a good faith effort was made.
3. Bidders are encouraged to provide information neatly organized and to provide a summary cover letter.

MISSOURI SERVICE-DISABLED VETERAN BUSINESS FORM

Pursuant to Section 34.074, RSMo, the Office of Administration, Division of Facilities Management, Design and Construction has a goal of awarding three (3) percent of all contracts for the performance of any job or service to service-disabled veteran businesses (see below for definitions included in Section 34.074, RSMo) either 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 or whenever competing bids, in their entirety, are comparable.

Definitions (as provided by Section 34.074, RSMo):

Service-Disabled Veteran is defined as any individual who is disabled as certified by the appropriate federal agency responsible for the administration of veterans' affairs.

Service-Disabled Veteran Business is defined as a business concern:

- a. not less than fifty-one (51) percent of which is owned by one or more service-disabled veterans or, in the case of any publicly owned business, not less than fifty-one (51) percent of the stock of which is owned by one or more service-disabled veterans; and
- b. the management and daily business operations of which are controlled by one or more service-disabled veterans.

If a bidder meets the definitions of a service-disabled veteran and a service-disabled veteran business as defined in Section 34.074, RSMo and is either doing business as a Missouri firm, corporation, or individual; or maintains a Missouri office or place of business, the bidder **must** provide the following (**unless they are registered with Division of Purchasing and Materials Management <http://content.oa.mo.gov/purchasing-materials-management/>**) with the bid in order to receive the Missouri service-disabled veteran business preference over a non-Missouri service-disabled veteran business when the quality of performance promised is equal or better and the price quoted is the same or less or whenever competing bids, in their entirety, are comparable:

- a. a copy of a letter from the Department of Veterans Affairs (VA), or a copy of the bidder's discharge paper (DD Form 214, Certificate of Release or Discharge from Active Duty); and
- b. a completed copy of this form.

(NOTE: For ease of evaluation, please attach copy of the above-referenced letter from the VA or a copy of the bidder's discharge paper to this Form.)

By signing below, I certify that I meet the definitions of a service-disabled veteran and a service-disabled veteran business as defined in Section 34.074, RSMo, and that I am either doing business as a Missouri firm, corporation, or individual; or maintain Missouri offices or places of business at the location(s) listed below.

Service-Disabled Veteran's Name
(Please Print)

Service-Disabled Veteran Business Name

Service-Disabled Veteran's Signature

Missouri Address of Service-Disabled Veteran
Business

SECTION 004541 - AFFIDAVIT OF WORK AUTHORIZATION

STATE OF _____)
)
COUNTY OF _____)

On this _____ day of _____, 20_____, before me appeared _____, personally known to me or proved to me on the basis of satisfactory evidence to be a person whose name is subscribed to this affidavit, who being by me duly sworn, deposed as follows:

My name is _____, and I am of sound mind, capable of making this affidavit, and personally certify the facts herein stated, as required by Section 285.530, RSMo, to enter into any contract agreement with the state to perform any job, task, employment, labor, personal services, or any other activity for which compensation is provided, expected, or due, including but not limited to all activities conducted by business entities:

I am the _____ of _____, and I am duly authorized, directed, and/or empowered to act officially and properly on behalf of this business entity.
title business name

I hereby affirm and warrant that the aforementioned business entity is enrolled in a federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, and the aforementioned business entity shall participate in said program with respect to all employees working in connection with the contracted services related to _____ with the Office of Administration, Division of Facilities Management, Design and Construction (FMDC). ^{Project Number} I have attached documentation to this affidavit to evidence enrollment/participation by the aforementioned business entity in a federal work authorization program, as required by Section 285.530, RSMo.

In addition, I hereby affirm and warrant that the aforementioned business entity does not and shall not knowingly employ, in connection to work under the within state contract agreement with FMDC, an alien who does not have the legal right or authorization under federal law to work in the United States, as defined in 8 U.S.C. § 1324a(h)(3).

I am aware and recognize that, unless certain contract and affidavit conditions are satisfied pursuant to Section 285.530, RSMo, the aforementioned business entity may be held liable under Section 285.525 through 285.559, RSMo, for subcontractors that knowingly employ or continue to employ any unauthorized alien to work within the state of Missouri.

I acknowledge that I am signing this affidavit as a free act and deed of the aforementioned business entity and not under duress.

Affidavit Signature

Subscribed and sworn to before me this _____ day of _____, 20____.

Notary Public

My commission expires:



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 Public Safety, Missouri Veterans Commission.

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: **Various Facility Renovations
Missouri Veterans Home
Mount Vernon, Missouri**

Project Number: **U1609-01**

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 **XXX** working days from the transmittal date of this agreement. The contract completion date is **MONTH, DAY, YEAR**. This time includes twelve (12) 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 twelve (12) 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 \$X,XXX** 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: \$

The Owner accepts the following Alternate Bids:

Alternate One: \$

TOTAL CONTRACT AMOUNT: (\$CONTRACT AMOUNT)

UNIT PRICES: The Owner accepts the following Unit Prices: SEE ATTACHMENT A

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

ARTICLE 5. PREVAILING WAGE RATE

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 W. Hill, P.E.
 Deputy Director of Planning & Design
 Division of Facilities Management,
 Design and Construction

 Contractor's Authorized Signature

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

 Corporate Secretary



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 or officer of

NAME

a sole proprietorship partnership

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 EMBOSSEER SEAL

STATE OF

COUNTY (OR CITY OF ST. LOUIS)

USE RUBBER STAMP IN CLEAR AREA BELOW

SUBSCRIBED AND SWORN BEFORE ME, THIS

DAY OF
 NOTARY PUBLIC SIGNATURE

YEAR
 MY COMMISSION EXPIRES

NOTARY PUBLIC NAME (TYPED OR PRINTED)

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	DATE INSTALLED
LOCATION		

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 <input type="checkbox"/> 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 <input type="checkbox"/> WBE <input type="checkbox"/> SDVE <input type="checkbox"/>		\$	\$ %	- - -
MBE <input type="checkbox"/> WBE <input type="checkbox"/> SDVE <input type="checkbox"/>		\$	\$ %	- - -
MBE <input type="checkbox"/> WBE <input type="checkbox"/> SDVE <input type="checkbox"/>		\$	\$ %	- - -
MBE <input type="checkbox"/> WBE <input type="checkbox"/> SDVE <input type="checkbox"/>		\$	\$ %	- - -
MBE <input type="checkbox"/> WBE <input type="checkbox"/> SDVE <input type="checkbox"/>		\$	\$ %	- - -

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 _____

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
	NOTARY PUBLIC SIGNATURE	MY COMMISSION EXPIRES
NOTARY PUBLIC NAME (TYPED OR PRINTED)		USE RUBBER STAMP IN CLEAR AREA BELOW

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 without compensation may be made when:
1. Weather-related delays occur, subject to provisions for the inclusion of a specified number of "bad weather" days when provided for in Section 012100-Allowances, OR
 2. Labor strikes or acts of God occur, OR
 3. The work of the Contractor is delayed on account of conditions which were beyond the control of the Contractor, subcontractors or suppliers, and were not the result of their fault or negligence.
- C. No time extension or compensation will be provided for delays caused by or within the control of the Contractor, subcontractors or suppliers and for concurrent delays caused by the Owner.
- D. The Contractor shall notify the Owner promptly of any occurrence or conditions which in the Contractor's opinion results in a need for an extension of time. The notice shall be in writing and shall include all necessary supporting materials with details of any resultant costs and be

submitted in time to permit full investigation and evaluation of the Contractor's claim. The Owner shall promptly acknowledge the Contractor's notice and, after recommendation from the Owner's Representative and/or Designer, shall provide a decision to the Contractor. Failure on the part of the Contractor to provide such notice and to detail the costs shall constitute a waiver by the Contractor of any claim. Requests for extensions of time shall be for working days only.

ARTICLE 5 - CONSTRUCTION AND COMPLETION

ARTICLE 5.1 – CONSTRUCTION COMMENCEMENT

- A. Upon receipt of the "Intent to Award" letter, the Contractor must submit the following properly executed instruments to the Owner:
1. Contract;
 2. Performance/payment bond as described in Article 6.1;
 3. Certificates of Insurance, or the actual policies themselves, showing that the Contractor has obtained the insurance coverage required by Article 6.2.
 4. Written Affirmative Action Plans as required in Article 1.4.

Above referenced items must be received by the Owner within twelve (12) working days after the effective date of the contract. If not received, the Owner may treat the failure to timely submit them as a refusal by the Contractor to accept a contract for this work and may retain as liquidated damages the Contractor's bid bond, cashier's check or certified check as provided in the Instructions to Bidders. Upon receipt the Owner will issue a "Notice to Proceed" with the work to the Contractor.

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

faithfulness and energy, and shall complete the entire work on or before the completion time stated in the contract documents or pay to the Owner the damages resulting from the failure to timely complete the work as set out within Article 5.4.

ARTICLE 5.2 -- PROJECT CONSTRUCTION

- A. Each Contractor shall submit for the Owner's approval, in reproducible form, a progress schedule showing the rate of progress and the order of the work proposed to carry on various phases of the project. The schedule shall be in conformance with the requirements outlined in Section 013200 – Schedules.
- B. Contractor shall employ and supply a sufficient force of workers, material, and equipment and shall pay when due, any worker, subcontractor or supplier and otherwise prosecute the work with such diligence so as to maintain the rate of progress indicated on the progress schedule, prevent work stoppage, and insure completion of the project within the time specified.

ARTICLE 5.3 -- PROJECT COMPLETION

- A. Substantial Completion. A Project is substantially complete when construction is essentially complete and work items remaining to be completed can be done without interfering with the Owner's ability to use the Project for its intended purpose.
1. Once the Contractor has reached what they believe is Substantial Completion, the Contractor shall notify the Designer and the Construction Representative of the following:
 - a. That work is essentially complete with the exception of certain listed work items. The list shall be referred to as the "Contractor's Punch."
 - b. That all Operation and Maintenance Manuals have been assembled and submitted in accordance with Article 3.5A.
 - c. That the Work is ready for inspection by the Designer and Construction Representative. The Owner shall be entitled to a minimum of ten working days notice before the inspection shall be performed.
 2. If the work is acceptable, the Owner shall issue a Certificate of Substantial Completion, which shall set forth the responsibilities of the Owner and the Contractor for utilities, security, maintenance, damage to the work and risk of loss. The Certificate shall also

identify those remaining items of work to be performed by the Contractor. All such work items shall be complete within 30 working days of the date of the Certificate, unless the Certificate specifies a different time. If the Contractor shall be required to perform tests that must be delayed due to climatic conditions, it is understood that such tests and affected equipment will be identified on the Certificate and shall be accomplished by the Contractor at the earliest possible date. Performance of the tests may not be required before Substantial Completion can be issued. The date of the issuance of the Certificate of Substantial Completion shall determine whether or not the work was completed within the contract time and whether or not Liquidated Damages are due.

3. If the work is not acceptable, and the Owner does not issue a Certificate of Substantial Completion, the Owner shall be entitled to charge the Contractor with the Designer's and Owner's costs of re-inspection, including time and travel.
- B. Partial Occupancy. Contractor agrees that the Owner shall be permitted to occupy and use any completed or partially completed portions of the Project, when such occupancy and use is in the Owner's best interest. Owner shall notify Contractor of its desire and intention to take Partial Occupancy as soon as possible but at least ten (10) working days before the Owner intends to occupy. If the Contractor believes that the portion of the work the Owner intends to occupy is not ready for occupancy, the Contractor shall notify the Owner immediately. The Designer shall inspect the work in accordance with the procedures above. If the Contractor claims increased cost of the project or delay in completion as a result of the occupancy, he shall notify the Owner immediately but in all cases before occupancy occurs.
- C. Final Completion. The Project is finally complete when the Certificate of Substantial Completion has been issued and all work items identified therein as incomplete have been completed, and when all administrative items required by the contract have been completed. Final Completion entitles the Contractor to payment of the outstanding balance of the contract amount including all change orders and retainage. Within five (5) working days of the date of the Certificate of Substantial Completion, the Contractor shall identify the cost to complete any outstanding items of work. The Designer shall review the Contractor's estimate and either approve it or provide an independent estimate for all such items. If the Contractor fails to complete the remaining items within the time specified in

the Certificate, the Owner may terminate the contract and go to the surety for project completion in accordance with Article 7.2 or release the contract balance to the Contractor less 150% of the approved estimate to complete the outstanding items. Upon completion of the outstanding items, when a final cost has been established, any monies remaining shall be paid to the Contractor. Failure to complete items of work does not relieve the Contractor from the obligation to complete the administrative requirements of the contract, such as the provisions of Article 5.3 FAILURE TO COMPLETE ALL ITEMS OF WORK UNDER THE CONTRACT SHALL BE CONSIDERED A DEFAULT AND BE GROUNDS FOR CONTRACT TERMINATION AND DEBARMENT.

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

ARTICLE 5.4 -- PAYMENT TO CONTRACTOR

- A. Payments on account of this contract will be made monthly in proportion to the work which has been completed. Request for payment must be submitted on the Owner's forms. No other pay request will be processed. Supporting breakdowns must be in the same format as Owner's forms and must provide the same level of detail. The Designer will, within 5 working days from receipt of the contractor's request for payment either issue a Certificate for Payment to the Owner, for such amount as the Designer determines is properly due, or notify the Contractor in writing of reasons for

withholding a Certificate. The Owner shall make payment within 30 calendar days after the "Application and Certification for Payment" has been received and certified by the Designer. The following items are to be attached to the contractor's pay request:

1. Updated construction schedule
 2. Certified payrolls consisting of name, occupation and craft, number of hours worked and actual wages paid for each individual employee, of the Contractor and all subcontractors working on the project
- B. The Owner shall retain 5 percent of the amount of each such payment application, except as allowed by Article 5.4, until final completion and acceptance of all work covered by this contract.
- C. Each payment made to Contractor shall be on account of the total amount payable to Contractor and all material and work covered by paid partial payment shall thereupon become the sole property of Owner. This provision shall not be construed as relieving Contractor from sole responsibility for care and protection of materials and work upon which payments have been made or restoration of any damaged work or as a waiver of the right of Owner to require fulfillment of all terms of this contract.
- D. Materials delivered to the work site and not incorporated in the work will be allowed in the Application and Certification for Payment on the basis of one hundred (100%) percent of value, subject to the 5% retainage providing that they are suitably stored on the site or in an approved warehouse in accordance with the following requirements:
1. Material has previously been approved through submittal and acceptance of shop drawings conforming to requirements of Article 3.2 of General Conditions.
 2. Delivery is made in accordance with the time frame on the approved schedule.
 3. Materials, equipment, etc., are properly stored and protected from damage and deterioration and remain so - if not, previously approved amounts will be deleted from subsequent pay applications.
 4. The payment request is accompanied by a breakdown identifying the material equipment, etc. in sufficient detail to establish quantity and value.
- E. The Contractor shall be allowed to include in the Application and Certification for Payment, one hundred (100%) of the value, subject to retainage,

of major equipment and material stored off the site if all of the following conditions are met:

1. The request for consideration of payment for materials stored off site is made at least 15 working days prior to submittal of the Application for Payment including such material. Only materials inspected will be considered for inclusion on Application for Payment requests.
 2. Materials stored in one location off site are valued in excess of \$25,000.
 3. That a Certificate of Insurance is provided indicating adequate protection from loss, theft conversion or damage for materials stored off site. This Certificate shall show the State of Missouri as an additional insured for this loss.
 4. The materials are stored in a facility approved and inspected, by the Construction Representative.
 5. Contractor shall be responsible for, Owner costs to inspect out of state facilities, and any delays in the completion of the work caused by damage to the material or for any other failure of the Contractor to have access to this material for the execution of the work.
- F. The Owner shall determine the amount, quality and acceptability of the work and materials which are to be paid for under this contract. In the event any questions shall arise between the parties, relative to this contract or specifications, determination or decision of the Owner or the Construction Representative and the Designer shall be a condition precedent to the right of the Contractor to receive any money or payment for work under this contract affected in any manner or to any extent by such question.
- G. Payments Withheld: The Owner may withhold or nullify in whole or part any certificate to such extent as may be necessary to protect the Owner from loss on account of:
1. Defective work not remedied. When a notice of noncompliance is issued on an item or items, corrective action shall be undertaken immediately. Until corrective action is completed, no monies will be paid and no additional time will be allowed for the item or items. The cost of corrective action(s) shall be borne by the Contractor.
 2. A reasonable doubt that this contract can be completed for the unpaid balance.
 3. Failure of the Contractor to update as-built drawings monthly for review by the Construction Representative.

4. Failure of the Contractor to update the construction schedule.

When the Construction Representative is satisfied the Contractor has remedied above deficiencies, payment shall be released.

- H. Final Payment: Upon receipt of written notice from the Contractor to the Designer and Project Representative that the work is ready for final inspection and acceptance, the Designer and Project Representative, with the Contractor, shall promptly make such inspection. If the work is acceptable and the contract fully performed, the Construction Representative shall complete a final acceptance report and the Contractor will be directed to submit a final Application and Certification for Payment. If the Owner approves the same, the entire balance shall be due and payable, with the exception of deductions as provided for under Article 5.4.

1. Where the specifications provide for the performance by the Contractor of (certain tests for the purpose of balancing and checking the air conditioning and heating equipment and the Contractor shall have furnished and installed all such equipment in accordance with the specifications, but said test cannot then be made because of climatic conditions, such test shall may be considered as required under the provisions of the specifications, Section 013300 and this contract may be substantial Full payment will not be made until the tests have been made and the equipment and system is finally accepted. If the tests are not completed when scheduled, the Owner may deduct 150% of the value of the tests from the final payment.
2. The final payment shall not become due until the Contractor delivers to the Construction Representative:
 - a) A complete file of releases, on the standard form included in the contract documents as "Final Receipt of Payment and Release Form", from subcontractors and material suppliers evidencing payment in full for services, equipment and materials, as the case may require, if the Owner approves, or a consent from the Surety to final payment accepting liability for any unpaid amounts.
 - b) An Affidavit of Compliance with Prevailing Wage Law, in the form as included in this contract specifications, properly executed by each subcontractor, and the Contractor
 - c) Certified copies of all payrolls

- d) As-built drawings

3. If any claim remains unsatisfied after all payments are made, the Contractor shall refund to the Owner all monies that the latter may be compelled to pay in discharging such a claim including all costs and a reasonable attorney's fee.
4. Missouri statute requires prompt payment from the Owner to the Contractor within thirty calendar days and from the Contractor to his subcontractors within fifteen calendar days. Failure to make payments within the required time frame entitles the receiving party to charge interest at the rate of one and one half percent per month calculated from the expiration of the statutory time period until paid.
5. The value of all unused unit price allowances and/or 150% of the value of the outstanding work items, and/or liquidated damages may be deducted from the final pay request without executing a Contract Change. Any unit price items which exceed the number of units in the contract may be added by Contract Change.

ARTICLE 6 -- INSURANCE AND BONDS

ARTICLE 6.1 -- BOND

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

ARTICLE 6.2 – INSURANCE

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

B. Minimum Scope and Extent of Coverage

1. General Liability

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

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

2. Automobile Liability

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

3. Workers' Compensation and Employer's Liability

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

4. Builder's Risk or Installation Floater Insurance

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

Contractor shall maintain sufficient insurance to cover the full value of the work and materials as the work progresses, and shall furnish Owner copies of all endorsements. If Builder's Risk Reporting- Form of Endorsement is used, Contractor shall make all reports as required therein so as to keep in force an amount of insurance which will equal the replacement cost of the work, materials, equipment, supplies, temporary structures, and other property covered thereby; and if, as a

result of Contractor's failure to make any such report, the amount of insurance so recoverable shall be less than such replacement cost, Contractor's interest in the proceeds of such insurance, if any, shall be subordinated to Owner's interest to the end that Owner may receive full reimbursement for its loss.

C. Minimum Limits of Insurance

1. General Liability

Contractor

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

\$2,000,000 annual aggregate

2. Automobile Liability

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

3. Workers' Compensation and Employers Liability

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

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

D. Deductibles and Self-Insured Retentions

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

E. Other Insurance Provisions and Requirements

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

1. General Liability

The Owner, and its respective commissioners, officers, officials, agents, consultants and employees shall be endorsed as additional

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

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

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

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

2. Automobile Insurance

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

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

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

performance of services or the delivery of goods called for by the Contract.

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

3. Workers' Compensation/Employer's Liability

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

4. All Coverages

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

F. Insurer Qualifications and Acceptability

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

G. Verification of Insurance Coverage

Prior to Owner issuing a Notice to Proceed, the Contractor shall furnish the Owner with Certificate(s) of Insurance and with any applicable original endorsements evidencing the required insurance coverage. The insurance certificates and endorsements are to be signed by a person authorized by that insurer to bind coverage on its behalf. All certificates and endorsements received by the Owner are subject to review and approval by the Owner. The Owner reserves the right to require certified copies of all required policies at any time. If the scope of this contract will exceed one (1) year - or, if any of Contractor's applicable insurance coverage expires prior to completion of the work or services required under this contract - the Contractor will provide a renewal or replacement certificate before continuing work or services hereunder. If the Contractor fails to provide documentation of required insurance coverage, the Owner may issue a stop work order and no additional contract completion time and/or compensation shall be granted as a result thereof.

ARTICLE 7 – SUSPENSION OR TERMINATION OF CONTRACT

ARTICLE 7.1 - FOR SITE CONDITIONS

- 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:

Brian Clark
Malone Finckle Eckhardt & Collins, Inc.
7780 W 119th Street, Overland Park, KS 66213
Telephone: 913-322-1400, Fax: 913-825-6697
Email: bclark@mfec.com

Construction Representative:

Tina Brown
Division of Facilities Management, Design and Construction
709 Missouri Boulevard, Jefferson City, MO 65109
Telephone: (573) 298-1644, Fax: (573) 751-7277
Email: Tina.Brown@oa.mo.gov

Project Manager:

Paul Vassos
Division of Facilities Management, Design and Construction
301 West High Street, Room 730, Jefferson City, Missouri 65102
Telephone: 573-751-9203, Fax: 573-751-7277
Email: Paul.Vassos@oa.mo.gov

Contract Specialist:

Kelly Copeland
Division of Facilities Management, Design and Construction
301 West High Street, Room 730, Jefferson City, Missouri 65102
Telephone: 573-522-2283, Fax: 573-751-7277
Email: Kelly.Copeland@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.

Missouri Division of Labor Standards

WAGE AND HOUR SECTION



JEREMIAH W. (JAY) NIXON, Governor

Annual Wage Order No. 23

Section 055

LAWRENCE 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

John E. Lindsey, Director
Division of Labor Standards

This Is A True And Accurate Copy Which Was Filed With The Secretary of State: March 10, 2016

Last Date Objections May Be Filed: April 11, 2016

Prepared by Missouri Department of Labor and Industrial Relations

OCCUPATIONAL TITLE	** Date of Increase	*	Basic Hourly Rates	Over-Time Schedule	Holiday Schedule	Total Fringe Benefits
Asbestos Worker (H & F) Insulator			\$25.47	56	28	\$11.25
Boilermaker	7/16		\$35.93	57	7	\$28.33
Bricklayer and Stone Mason	6/16		\$27.73	24	74	\$16.44
Carpenter	6/16		\$24.73	61	4	\$15.65
Cement Mason			\$19.00	FED		\$5.52
Communication Technician	6/16		\$26.79	27	9	\$12.425 + 8%
Electrician (Inside Wireman)	6/16		\$26.79	27	9	\$12.425 + 8%
Electrician (Outside-Line Construction/Lineman)			\$41.52	125	65	\$5.00 + 34.5%
Lineman Operator			\$38.37	125	65	\$5.00 + 34.5%
Groundman			\$26.76	125	65	\$5.00 + 34.5%
Elevator Constructor	.7/16	a	\$44.515	26	54	\$31.531
Glazier			\$23.35	36	52	\$6.21
Ironworker			\$31.25	50	4	\$27.90
Laborer (Building):						
General	6/16		\$21.28	112	4	\$11.73
First Semi-Skilled	6/16		\$23.42	112	4	\$11.73
Second Semi-Skilled	6/16		\$21.96	112	4	\$11.73
Lather	6/16		\$24.73	61	4	\$15.65
Linoleum Layer and Cutter	6/16		\$24.63	123	78	\$15.65
Marble Mason			\$21.66	124	74	\$12.68
Marble Finisher			\$14.14	124	74	\$9.08
Millwright	6/16		\$24.73	61	4	\$15.65
Operating Engineer						
Group I	6/16		\$26.34	84	4	\$12.69
Group II			\$22.00	FED		\$6.60
Group III	6/16		\$23.89	84	4	\$12.69
Group III-A	6/16		\$24.60	84	4	\$12.69
Group IV						
Group V	6/16		\$15.80	84	4	\$12.69
Painter	6/16		\$22.00	7	14	\$12.40
Pile Driver	6/16		\$24.73	61	4	\$15.65
Pipe Fitter			\$28.95	19	1	\$14.67
Plasterer			\$23.53	64	4	\$10.55
Plumber			\$28.95	19	1	\$14.67
Roofer \ Waterproofer	6/16		\$22.75	10	2	\$10.88
Sheet Metal Worker	7/16		\$28.94	4	24	\$14.18
Sprinkler Fitter - Fire Protection	7/16		\$33.49	33	19	\$19.45
Terrazzo Worker			\$28.73	124	74	\$14.38
Terrazzo Finisher			\$18.68	124	74	\$14.38
Tile Setter			\$21.66	124	74	\$12.68
Tile Finisher			\$14.14	124	74	\$9.08
Traffic Control Service Driver			\$16.35	48	49	\$2.75
Truck Driver-Teamster						
Group I	6/16		\$28.97	31	35	\$12.45
Group II	6/16		\$29.13	31	35	\$12.45
Group III			\$19.00	FED		\$7.84
Group IV			\$21.40	FED		\$6.60

Fringe Benefit Percentage is of the Basic Hourly Rate

**Annual Incremental Increase

**Building Construction Rates for
LAWRENCE County Footnotes**

Section 055

	** Date of Increase	Basic Hourly Rates	Over-Time Schedule	Holiday Schedule	Total Fringe Benefits

* Welders receive rate prescribed for the occupational title performing operation to which welding is incidental.

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

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).

a - Vacation: Employees over 5 years - 8%; Employees under 5 years - 6%

**REPLACEMENT PAGE
LAWRENCE COUNTY
BUILDING CONSTRUCTION - OVERTIME SCHEDULE**

FED: Minimum requirement per Fair Labor Standards Act means time and one-half (1 ½) shall be paid for all work in excess of forty (40) hours per work week.

NO. 4: Means the regular working day shall consist of eight (8) hours labor on the job between six (6) a.m. and six-thirty (6:30) p.m. and the work week shall consist of five (5) consecutive eight (8) hour days beginning on Monday and ending with Friday of each week. All full time or part time labor performed during such hours shall be recognized as regular working hours and paid for at the regular hourly rate. Also, there may be a 40-hour work week which would consist of ten (10) hours each day for Monday, Tuesday, Wednesday, Thursday or Friday. The first two (2) hours performed in excess of an eight (8) hour workday, Monday through Friday, and the first ten (10) hours on Saturday, shall be paid at one and one half (1½) times the regular rate of pay. All work performed on Sundays and Holidays and in excess of ten (10) hours a day on all days shall be paid at two (2) times the regular rate of pay. A make-up day may be scheduled for work missed due to inclement weather. The make-up hours shall be paid at the regular hourly rate of pay.

NO. 7: Means work between the hours of 7:00 a.m. and 6:00 p.m. daily, Monday through Saturday, as assigned by the Employer shall be considered regular hours. Weekend work shall be paid at the rate of one and one-half (1 ½) times the regular rate of pay. Weekend begins 12:01 a.m. Saturday. Overtime is time worked over forty (40) hours per pay period, and shall be paid at the rate of one and one-half (1½) times the regular rate of pay. Sunday and Holidays will be paid at the rate of two (2) times the regular rate of pay.

NO. 10: Means the regular working day shall be scheduled to consist of at least eight (8) hours but no more than ten (10) consecutive hours, exclusive of the lunch period, unless otherwise provided. Crews shall be scheduled to commence at any time between the hours of 5:00 a.m. and 10:00 a.m. or earlier if agreed on by the majority of any one crew. Except as specifically provided for Saturdays, Sundays and holidays, all work performed by Employees anywhere in excess of forty (40) hours in one (1) work week, or in excess of ten (10) hours in one work day shall be paid at the rate of one and one-half (1½) times the regular hourly wage scale. Any work performed on a Saturday shall be paid at the rate of one and one-half (1½) times the regular hourly wage scale unless such Saturday work falls under the category of Saturday make Up Day. When this Saturday Make Up Day does occur, the Employee may work on Saturday at straight time; provided, however, if during the period worked by said Employee on Saturday, the Employee's compensable time at the straight time rate exceeds forty (40) hours, all time worked in excess of the forty (40) hours will be paid at the rate of one and one-half (1½) time the regular hourly wage scale. The provision of this Saturday Make Up Day shall not apply to any weeks in which a designated holiday is recognized. Any work performed by Employees anywhere on Sunday or holidays shall be paid at the rate of double (2) time the regular wage scale.

NO. 19: On single shift operation, eight (8) hours of work, between 8:00 a.m. and 4:30 p.m., shall constitute a day's work. Forty (40) hours of work Monday through Friday shall constitute a workweek. The starting time may be changed to begin between the hours of six (6:00) and ten (10:00) a.m. The first two (2) hours performed in excess of an eight (8) hour workday Monday through Friday, and the first ten (10) hours on Saturday, shall be paid at time and one-half (1.5) the basic straight-time rate. All work performed on Sundays and holidays, and in excess of ten (10) hours a day shall be paid at double (2) the basic straight time rate of pay. When hours worked are outside of established work hours, the pay rate shall be one and one-half (1.5) times the regular rate of pay for the first ten (10) hours, and all hours in excess of ten (10) hours shall be at the double-time rate. Shift work of either one (1) eight hour night shift, or two (2) eight (8) hour night shifts on a job which will continue for at least one (1) week, all employees shall be paid eighteen and one-half percent (18.5%) over the straight-time hourly rate on the night shifts. All hours worked in excess of eight (8) in a shift shall be paid at the applicable overtime rate of pay. The normal workweek may be changed to four (4) ten (10) hour days or four (4) ten (10) hour nights, if on shift work, with the following provisions: Monday through Thursday would be the normal workweek with Friday being used as scheduled workday in case of a day being lost due to weather, all employees working night shift, on a job that will continue at least one (1) week, shall be paid thirty percent (30%) over the regular straight-time hourly rate of pay, and any hours worked before or after established starting and quitting times being paid at double (2) time hourly rates of pay.

**REPLACEMENT PAGE
LAWRENCE COUNTY
BUILDING CONSTRUCTION - OVERTIME SCHEDULE**

NO. 24: Means eight (8) hours shall constitute a day's work on all classes of work between the hours of 6:00 a.m. and 5:30 p.m., Monday through Friday. The pay for time worked during these hours shall be at the regular wage rate. The regular workweek shall be Monday through Friday. A workweek of four (4), ten (10) hour days may be established on a per job basis. Saturday may be used for a make-up day, when working 5-8's, Friday when working 4-10's. All time worked before and after the established workday of eight (8) hours, Monday through Friday, and all time worked on Saturday shall be paid for at the rate of time and one-half (1½) except after eight (8) hours worked, then double (2) time will apply. All time worked on Sundays and the recognized holidays shall be paid at the rate of double (2) time.

NO. 26: Means that the regular working day shall consist of eight (8) hours worked between 6:00 a.m., and 5:00 p.m., five (5) days per week, Monday to Friday, inclusive. Hours of work at each jobsite shall be those established by the general contractor and worked by the majority of trades. (The above working hours may be changed by mutual agreement). Work performed on Construction Work on Saturdays, Sundays and before and after the regular working day on Monday to Friday, inclusive, shall be classified as overtime, and paid for at double (2) the rate of single time. The employer may establish hours worked on a jobsite for a four (4) ten (10) hour day work week at straight time pay for construction work; the regular working day shall consist of ten (10) hours worked consecutively, between 6:00 a.m. and 6:00 p.m., four (4) days per week, Monday to Thursday, inclusive. Any work performed on Friday, Saturday, Sunday and holidays, and before and after the regular working day on Monday to Thursday where a four (4) ten (10) hour day workweek has been established, will be paid at two times (2) the single time rate of pay. The rate of pay for all work performed on holidays shall be at two times (2) the single time rate of pay.

NO. 27: Means eight (8) hours of work between the hours of eight (8:00) a.m. and four-thirty (4:30) p.m. shall constitute a work day. Forty (40) hours within five (5) days - Monday through Friday, inclusive - shall constitute a work week. The regular starting time in the morning may be moved not more than one hour prior to 8:00 a.m.; however, in no case shall more than eight (8) hours be worked per day without the applicable overtime rate being paid. When job conditions dictate and as required by the employer, the employer shall be allowed to establish a four (4) day, ten (10) hour per day work week. This work week is defined as Monday through Thursday, with a Friday make-up day. The normal work day under a ten (10) hour four (4) day work week shall be from 8:00 a.m. to 6:30 p.m., with a one hour starting variance. The make-up day of Friday shall be instituted for specific reasons such as loss of production due to weather and Holidays. All hours worked in excess of ten (10) hours per day or forty (40) hours per week or hours worked outside the normal work week shall be paid at the applicable overtime rate. This language is not intended to change the normal five (5) day, eight (8) hours per day work week. All overtime work after a regular work day, (8) hours, Monday through Friday shall be paid at time and one-half (1½). All hours worked on Saturday shall be paid at time and one-half (1½). All other overtime on Sunday and recognized holidays shall be paid for at double (2) the straight-time rate of pay. Shift work performed between the hours of 4:30 p.m. and 1:00 a.m. (second shift) shall receive eight (8) hours pay at the regular hourly rate of pay plus 17.3% for all hours worked. Shift work performed between the hours of 12:30 a.m. and 9:00 a.m. (third shift) shall receive eight (8) hours pay at the regular hourly rate of pay plus 31.4% for all hours worked. A lunch period of thirty (30) minutes shall be allowed on each shift. All overtime work required after the completion of a regular shift shall be paid at one and one-half (1½) times the shift hourly rate.

NO. 31: Means a regular work week shall consist of not more than forty (40) hours of work and all work performed over and above ten (10) hours per day and forty (40) hours per week shall be paid at the rate of time and one-half (1½). A workday is to begin between 6:00 a.m. and 9:00 a.m. at the option of the Employer except when inclement weather or other conditions beyond the reasonable control of the Employer, in which event, the starting time may be advanced or delayed. Work performed on recognized holidays or days observed as such, shall receive time and one-half (1½).

NO. 33: Means the standard work day and week shall be eight (8) consecutive hours of work between the hours of 6:00 a.m. and 6:00 p.m., excluding the lunch period Monday through Friday, or shall conform to the practice on the job site. Four (4) days at ten (10) hours a day may be worked at straight time, Monday through Friday and need not be consecutive. All overtime, except for Sundays and holidays shall be at the rate of time and one-half (1½). Overtime worked on Sundays and holidays shall be at double (2) time.

**REPLACEMENT PAGE
LAWRENCE COUNTY
BUILDING CONSTRUCTION - OVERTIME SCHEDULE**

NO. 36: Means eight (8) hours shall constitute a work day, Monday through Friday between the hours of 6:00 a.m. and 6:00 p.m. Saturday can be used as a makeup day if time is lost due to weather. All hours in excess of the regular forty (40) hour work week or eight (8) hours per day shall be considered overtime and shall be paid for at the rate of one and one-half (1½) times the regular rate. Employees will be paid at the rate of one and one-half (1½) times their regular rate for work performed on Saturdays. Sundays and holidays worked are to be paid at double (2) the regular hourly rate. Four (4) ten-hour days, at the option of the Employer, shall be the standard work week, consisting of a consecutive ten-hour period, Monday through Thursday or Tuesday through Friday, between the hours of 6:00 a.m. and 6:00 p.m. Forty (40) hours per week shall constitute a week's work.

NO. 48: Means the regularly scheduled work week shall be five (5) consecutive days, Monday through Friday or Tuesday through Saturday. Eight (8) hours shall constitute a day's work. Starting time shall not be earlier than 7:00 a.m. nor later than 10:00 a.m. Forty (40) hours shall constitute a week's work. Overtime at the rate of time and one-half (1½) will be paid for all work in excess of forty (40) hours in any one work week. On the Monday through Friday schedule, all work performed on Saturday will be time and one-half (1½) unless time has been lost during the week, in which case Saturday will be a make up day to the extent of the lost time. On the Tuesday through Saturday schedule, all work performed on Monday will be time and one-half (1½) unless time has been lost during the week, in which case Monday will be a make-up day to the extent of the lost time. Any work performed on Sunday will be double (2) time. If employees work on any of the recognized holidays, they shall be paid time and one-half (1½) their regular rate of pay for all hours worked.

NO. 50: Means eight (8) hours constitute a normal day's work Monday through Friday. Any time worked over eight (8) hours will normally be paid at time and one-half (1½) except for exclusions stated in some following additional sentences. The Employer, at his discretion, may start the work day between 6:00 a.m. and 9:00 a.m. Any schedule chosen shall be started at the beginning of the work week (Monday) and used for at least five days. Work may be scheduled on a four (4) days a week (Monday through Thursday) at ten (10) hours a day schedule. If such a schedule is employed, then Friday may be used as a make-up day when time is lost due to inclement weather. Time and one-half (1½) shall be paid for any work in excess of eight (8) hours in any regular work day Monday through Friday unless working 4-10's, then time and one-half (1½) after ten (10) hours. All work performed on Saturday will be time and one-half (1½). Double (2) time shall be paid for all work on Sundays and recognized holidays.

NO 56: Means the regular work day shall consist of eight (8) hours between 8:00 a.m. and 4:30 p.m. An optional four day work week may be utilized with the ten (10) hour clause, days Monday through Thursday or Tuesday through Friday. Work hours shall be from 7:00 a.m. to 5:30 p.m. any work performed on Monday or Friday outside the regular scheduled four (4) days shall be at one and one half (1 ½) the regular rate of pay. Work performed outside of the regular work day, and on Saturdays shall be paid at one and one half (1 ½) the regular rate of pay. Sundays and holidays shall be paid at double (2) time the regular rate of pay.

NO. 57: Means eight (8) hours per day shall constitute a day's work and forty (40) hours per week, Monday through Friday, shall constitute a week's work. The regular starting time shall be 8:00 a.m. If a second or third shift is used, the regular starting time of the second shift shall be 4:30 p.m. and the regular starting period for the third shift shall be 12:30 a.m. These times may be adjusted by the employer. The day shift shall work a regular eight (8) hours shift as outlined above. Employees working a second shift shall receive an additional \$0.25 above the regular hourly rate and perform seven and one-half (7½) hours work for eight (8) hours pay. Third shift employees shall be paid an additional \$0.50 above the regular hourly rate and work seven (7) hours for eight (8) hours pay. When circumstances warrant, the Employer may change the regular workweek to four (4) ten-hour days at the regular time rate of pay. All time worked before and after the established workday of eight (8) hours, Monday through Friday, and all time worked on Saturday shall be paid at the rate of time and one-half (1½) except in cases where work is part of an employee's regular Friday shift. All time worked on Sunday and recognized holidays shall be paid at the double (2) time rate of pay except in cases where work is part of an employee's previous day's shift. For all overtime hours worked \$27.04 of the fringe benefits portion of the prevailing wage shall be paid at the same overtime rate at which the cash portion of the prevailing wage is to be paid. The remaining \$1.29 of the fringe benefit portion of the prevailing wage may be paid at straight time.

**REPLACEMENT PAGE
LAWRENCE COUNTY
BUILDING CONSTRUCTION - OVERTIME SCHEDULE**

NO. 61: Means except as herein provided, eight (8) hours a day, 8:00 a.m. to 4:30 p.m., shall constitute a standard work day, and forty (40) hours per week shall constitute a week's work. The regular workday starting time of 8:00 a.m. (and resulting quitting time of 4:30 p.m.) may be moved forward to 6:00 a.m. or delayed one (1) hour to 9:00 a.m. All time worked outside of the standard work day and on Saturday shall be classified as overtime and paid the rate of time and one-half (1½). All time worked on Sunday and holidays shall be classified as overtime and paid at the rate of double (2) time. The Employer has the option of working either five (5) eight-hour days or four (4) ten-hour days to constitute a normal forty (40) hour work week. When the four (4) day ten hour work week is in effect, the standard work week shall consist of forty (40) hours, Monday through Friday, which will consist of any four (4) consecutive ten-hour four days within the five (5) day period. In the event the job is down for any reason beyond the control of the Employer, then Friday and/or Saturday may, at the option of the Employer, be worked as a make-up day, straight time not to exceed ten (10) hours per day, or forty (40) hours per week. When the five (5) day eight-hour work week is in effect, forty (40) hours per week shall constitute a week's work (normal work week being Monday through Friday). In the event the job is down for any reason beyond the control of the Employer, then Saturday may, at the option of the Employer, be worked as a make-up day, at straight time not to exceed eight (8) hours for that day, or forty (40) hours per week. A make-up day is not to be used to make up time lost due to recognized holidays.

NO. 64: Means eight (8) hours shall constitute a day's work beginning at 8:00 a.m. and ending at 4:30 p.m. Forty (40) hours shall constitute a week's work, Sunday through Saturday. In the event time is lost due to weather or conditions beyond the control of the Employer, the Employer may schedule work on Saturday at straight time. All work over eight (8) hours in one day, forty (40) hours in one week, or on Saturday (except as herein provided) shall be classified as overtime and be paid at the rate of time and one-half (1½). All work on Sunday or recognized holidays shall be classified as overtime and be paid at the rate of double (2) time. When the four (4) day ten-hour work week is in effect, the standard work day shall be consecutive ten (10) hour periods. Forty (40) hours per week shall constitute a week's work Sunday through Saturday inclusive. In the event the job is down for reasons beyond the contractors control, then Friday and/or Saturday may, at the option of the Employer be worked as a make-up day, straight time not to exceed ten (10) hours per day or forty (40) hours per week.

NO. 84: The regular working starting time of 8:00 a.m. (and resulting quitting time of 4:30 p.m.) may be moved forward to 6:00 a.m. or delayed one (1) hour to 9:00 a.m. Except as provided in this Article, eight (8) hours a day shall constitute a standard work day and forty (40) hours per week shall constitute a weeks' work, which shall begin on Sunday and end on Saturday. All time worked outside of the standard work day and on Saturday shall be classified as overtime and paid at the rate of time & one-half (1½) (except as herein provided). All time worked on Sunday and recognized holidays shall be classified as overtime and paid at the rate of double (2) time. The Employer has the option of working either five (5) eight-hour days or four (4) ten-hour days to constitute a normal forty (40) hour work week. When the four (4) ten-hour work week is in effect, the standard work day shall be consecutive ten (10) hour periods, exclusive of the lunch period, beginning at 6:30 a.m. and forty (40) hours per week shall constitute a week's work, Monday through Thursday, inclusive. In the event the job is down for any reason beyond the Employer's control, then Friday and/or Saturday may, at the option of the Employer, be worked as a make-up day, straight time not to exceed ten (10) hours or forty (40) hours per week. When the five (5) eight-hour work week is in effect, forty (40) hours per week shall constitute a week's work, Monday through Friday, inclusive. In the event the job is down for any reason beyond the Employer's control, then Saturday may, at the option of the Employer, be worked as a make-up day, straight time not to exceed eight (8) hours or forty (40) hours per week.

NO. 112: Means the regular starting time of 8:00 a.m. (and resulting quitting time of 4:30 p.m.) may be moved forward to 6:00 a.m. or delayed one (1) hour to 9:00 a.m. Except as provided for, eight (8) hours a day shall constitute a standard work day, and forty (40) hours per week shall constitute a week's work, which shall begin on Sunday and end on Saturday. All time worked outside of the standard work day and on Saturday shall be classified as overtime and paid the rate of time and one-half (1½) (except as herein provided). All time worked on Sunday and recognized holidays shall be classified as overtime and paid at the rate of double (2) time. The Employer has the option of working either five (5) eight (8) hour days or four (4) ten (10) hour days to constitute a normal forty (40) hour work week. When the four (4) ten-hour work week is in effect, the standard work day shall be consecutive ten hour periods between the hours of 6:30 a.m. and 6:30 p.m. Forty (40) hours per week shall constitute a week's work, Monday through Thursday, inclusive. In the event the job is down for any reason beyond the Employer's control, then Friday and/or Saturday may, at the option of the Employer, be worked as a make-up day; straight time not to exceed eight (8) hours or forty (40) hours per week.

**REPLACEMENT PAGE
LAWRENCE COUNTY
BUILDING CONSTRUCTION - OVERTIME SCHEDULE**

NO. 123: Means except as provided, eight (8) hours a day (8:00 A.M. to 4:30 P.M.) shall constitute a standard work day, excluding the 30-minute lunch period, and forty (40) hours per week shall constitute a week's work. All time worked outside of the standard work day and on Saturday shall be classified as overtime and paid the rate of time and one-half (except as herein provided). All time worked on Sunday and herein named holidays shall be classified as overtime and paid at the rate of double time. The Employer has the option of working either five (5) eight-hour days or four (4) ten-hour days to constitute a normal forty (40) hour work week. When the four (4) day ten-hour work week is in effect, the standard work week shall consist of forty (40) hours, Monday through Friday, which will consist of any four (4) consecutive ten (10) hour days within the five day period. In the event the job is down for any reason beyond the control of the Employer, then Friday and/or Saturday may, at the option of the Employer, be worked as a make-up day, straight time not to exceed ten (10) hours or forty (40) hours per week. Starting time will be designated by the Employer. When the five (5) day eight (8) hour work week is in effect forty (40) hours per week will constitute a week's work (normal work week being Monday through Friday). In the event the job is down for any reason beyond the control of the Employer, then Saturday may, at the option of the Employer, be worked as a make-up day; at straight time not to exceed eight (8) hours or forty (40) hours per week.

NO. 124: Means eight (8) hours shall constitute a day's work on all classes of work between the hours of 6:00 a.m. and 5:30 p.m., Monday through Friday. The pay for time worked during these hours shall be at the regular wage rate. The regular workweek shall be Monday through Friday. Employment from 4:30 p.m. to 12:00 midnight, Monday through Friday, shall be paid for at one and one-half (1½) times the regular hourly rate. From 12:00 midnight until 8:00 a.m. on any day shall be paid for at twice the regular hourly rate. All time worked on Sundays and the recognized holidays shall be paid at the rate of double (2) time. It is understood that forty (40) hours shall constitute a regular workweek, (5-8's) Sunday Midnight through Friday Midnight, understanding anything over eight (8) hours is one and one-half (1½) times the hourly wage rate.

NO. 125: Eight (8) hours of work between the hours of 8:00 a.m. and 4:30 p.m. shall constitute a work day. Forty (40) hours within the five (5) days, Monday through Friday inclusive, shall constitute the work week. Starting time may be adjusted not to exceed two (2) hours. Work performed outside of the aforementioned will be paid at the applicable overtime rate. When starting time has been adjusted, all other provisions concerning the work day shall be adjusted accordingly. The overtime rate of pay shall be one and one-half (1½) times the regular rate of wages, other than on Sundays, holidays and from Midnight until 6:00 a.m., which will be paid at double (2) the straight time rate.

**LAWRENCE COUNTY
HOLIDAY SCHEDULE – BUILDING CONSTRUCTION**

NO. 1: All work done on New Year's Day, Decoration Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day shall be paid at the rate of double time. When one of the above holidays falls on Sunday, the following Monday shall be observed. When one of the above holidays falls on Saturday the preceding Friday shall be observed.

NO. 2: All work performed on New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day, Christmas Day, or the days observed as such, shall be paid at the double time rate of pay.

NO. 4: All work done on New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving and Christmas Day shall be paid at the double time rate of pay. If any of the above holidays fall on Sunday, Monday will be observed as the recognized holiday. If any of the above holidays fall on Saturday, Friday will be observed as the recognized holiday and holidays falling on Sunday will be observed on the following Monday.

NO. 7: The following days are assigned days and are recognized as holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day, and Christmas Day. If a holiday falls on a Sunday, it shall be observed on the following Monday. If a holiday falls on a Saturday, it shall be observed on the preceding Friday. No work shall be performed on Labor Day except in case of jeopardy to work under construction. This is applied to protect Labor Day. When a holiday falls during the normal workweek, Monday through Friday, it shall be counted as eight (8) hours toward the forty (40) hour week. However, no reimbursement for these eight (8) hours is to be paid to the workman unless worked. If workman are required to work the above enumerated holidays or days observed as such, or on Sunday, they shall receive double (2) the regular rate of pay for such work.

NO. 9: All work performed on New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and Christmas Day shall be paid for at the double time rate of pay. Any one of the above listed holidays falling on Sunday shall be observed on the following Monday and paid at the double time rate of pay as all observed holidays, if worked.

NO. 14: The following days are recognized Holidays: Memorial Day, Fourth of July, Thanksgiving Day, Christmas Day, and New Year's Day. No work shall be done on Labor Day. When falling on a Sunday and the following Monday is observed as part of the holiday, then that Monday shall be considered a holiday. Sunday and Holidays will be paid at the rate of two (2) times the regular rate of pay.

NO. 19: All work done on New Year's Day, Memorial Day, July 4th, Labor Day, Thanksgiving Day, and Christmas Day shall be paid at the double time rate of pay. The employee may take off Friday following Thanksgiving Day. However, the employee shall notify his or her Foreman, General Foreman or Superintendent on the Wednesday preceding Thanksgiving Day. When one of the above holidays falls on Sunday, the following Monday shall be considered a holiday and all work performed on either day shall be at the double (2) time rate. When one of the holidays falls on Saturday, the preceding Friday shall be considered a holiday and all work performed on either day shall be at the double (2) time rate.

NO. 24: All work done on Christmas Day, Thanksgiving Day, New Year's Day, Memorial Day, Independence Day, Labor Day, Veteran's Day, Presidential Election Day or days locally observed as such, and Sunday shall be recognized as holidays and paid at the double time rate of pay.

NO. 28: All work done on New Year's Day, Veteran's Day, Memorial Day, Independence Day, Thanksgiving Day and Christmas Day shall be paid at the double time rate of pay. No work shall be performed on Labor Day except when triple (3) time is paid. When a holiday falls on Sunday, the following Monday shall be observed as the holiday.

**LAWRENCE COUNTY
HOLIDAY SCHEDULE – BUILDING CONSTRUCTION**

NO. 35: The following days are recognized as holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day. If a holiday falls on a Sunday, it shall be observed on the following Monday. No work shall be performed on Labor Day except in case of jeopardy to work under construction. This rule is applied to protect Labor Day. When a holiday falls during the normal work week, Monday through Friday, it shall be counted as eight (8) hours toward the forty (40) hour week; however, no reimbursement for this eight (8) hours is to be paid the workman unless worked. An Employer working a four (4) day, ten (10) hour schedule may use Friday as a make-up day when an observed holiday occurs during the work week. Employees have the option to work that make-up day. If workmen are required to work the above enumerated holidays or days observed as such, they shall receive time and one-half (1 ½) the regular rate of pay for such work.

NO. 49: The following days shall be observed as legal holidays: New Year's Day, Decoration Day, July 4th, Labor Day, Thanksgiving Day, Christmas Day, Employee's birthday and two (2) personal days. The observance of one (1) of the personal days to be limited to the time between December 1 and March 1 of the following year. If any of these holidays fall on Sunday, the following Monday will be observed as the holiday and if any of these holidays fall on Saturday, the preceding Friday will be observed as the holiday. If employees work on any of these holidays they shall be paid time & one-half (1½) their regular rate of pay for all hours worked.

NO. 52: All work performed on Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day shall receive the double (2) time rate of pay.

NO. 54: All work performed on New Year's Day, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day, the Friday after Thanksgiving Day, and Christmas Day shall be paid at the double (2) time rate of pay. When a holiday falls on Saturday, it shall be observed on Friday. When a holiday falls on Sunday, it shall be observed on Monday.

NO. 65: Work performed on New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day, Christmas Day, or days celebrated as such, shall be paid at the double time rate of pay. If the holiday falls on Saturday, it will be observed on Friday; if the holiday falls on Sunday, it will be observed on Monday, and shall be paid for at double (2) the regular straight time rate of pay.

NO. 74: All work performed on New Year's Day, Memorial Day, Fourth of July, Labor Day, Veteran's Day, Thanksgiving Day and Christmas Day, shall be paid at double (2) time of the hourly rate of pay. In the event one of the above holiday's falls on Saturday, the holiday shall be celebrated on Saturday. If the holiday falls on Sunday, the holiday will be celebrated on Monday.

NO. 78: The following days shall be recognized as holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving and Christmas. If any of the above holidays fall on Sunday, Monday will be observed as the legal holiday. If any of the above holidays fall on Saturday, Friday will be observed as the legal holiday. All time worked on Sunday and herein named holidays shall be classified as overtime and paid at the rate of double time.

OCCUPATIONAL TITLE	* Date of Increase	Basic Hourly Rates	Over-Time Schedule	Holiday Schedule	Total Fringe Benefits
Carpenter	6/16	\$29.03	23	16	\$16.10
Electrician (Outside-Line Construction)\Lineman		\$41.52	18	24	\$5.00 + 34.5%
Lineman Operator		\$38.37	18	24	\$5.00 + 34.5%
Lineman - Tree Trimmer		\$21.64	31	30	\$5.00 + 27.5%
Groundman		\$26.76	18	24	\$5.00 + 34.5%
Groundman - Tree Trimmer		\$17.50	31	30	\$5.00 + 27.5%
Laborer					
General Laborer	6/16	\$24.32	4	18	\$12.71
Skilled Laborer	6/16	\$24.87	4	18	\$12.71
Millwright	6/16	\$29.03	23	16	\$16.10
Operating Engineer					
Group I	6/16	\$30.82	5	15	\$13.30
Group II	6/16	\$30.47	5	15	\$13.30
Group III	6/16	\$30.27	5	15	\$13.30
Group IV	6/16	\$28.22	5	15	\$13.30
Oiler-Driver	6/16	\$28.22	5	15	\$13.30
Pile Driver	6/16	\$29.03	23	16	\$16.10
Traffic Control Service Driver		\$16.35	29	28	\$2.75
Truck Driver-Teamster					
Group I	6/16	\$28.97	12	3	\$12.45
Group II	6/16	\$29.13	12	3	\$12.45
Group III	6/16	\$29.12	12	3	\$12.45
Group IV	6/16	\$29.24	12	3	\$12.45

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.

**REPLACEMENT PAGE
LAWRENCE COUNTY
OVERTIME SCHEDULE - HEAVY CONSTRUCTION**

FED: Minimum requirement per Fair Labor Standards Act means time and one-half (1 ½) shall be paid for all work in excess of forty (40) hours per work week.

NO. 4: Means a regular work week shall consist of not more than forty (40) hours of work, Monday through Saturday, and all work performed over and above ten (10) hours per day and forty (40) hours per week shall be paid at the rate of time & one-half (1½). Workers shall receive time and one-half (1½) for all work performed on Sundays and holidays. A work day is to begin between 6:00 a.m. and 9:00 a.m. at the option of the Employer except when inclement weather or other conditions beyond the reasonable control of the Employer prevent work, in which event, the starting time may be delayed, but not later than 12:00 noon. When a holiday falls during the normal work week, Monday through Friday, it shall be counted as eight (8) hours toward a forty (40) hour week; however, no reimbursement for this eight (8) hours is to be paid to the worker(s) unless worked.

NO. 5: Means a regular work week shall consist of not more that forty (40) hours work, Monday through Saturday, and all work performed over and above ten (10) hours per day and forty (40) hours per week shall be paid at the rate of time & one-half (1½). Workmen shall receive time and one-half (1½) for all work performed on Sundays and recognized holidays or days observed as such. Double (2) time shall be paid for work on Sunday or recognized holidays when and only if any other craft employees of the same employer at work on that same job site are receiving double (2) time pay for that Sunday or holiday. If a job can't work forty (40) hours, Monday through Saturday, because of inclement weather or other conditions beyond the control of the Employer, Friday and Saturday may be worked as make up days at straight time (if working 4-10's). Saturday may be worked as a make up day at straight time (if working 5-8's). Make up days shall not be utilized for days lost to holidays. A work day is to begin between 6:00 a.m. and 9:00 a.m. at the option of the Employer except when inclement weather or other conditions beyond the reasonable control of the Employer, including requirements of the owner, prevent work. In such event the starting time may be delayed but not later than 12:00 noon. Where one of the holidays falls or is observed during the work week, then all work performed over and above thirty-two (32) hours shall be paid at time & one-half (1½).

NO. 12: Means a regular work week shall consist of not more than forty (40) hours of work and all work performed over and above ten (10) hours per day and forty (40) hours per week shall be paid at the rate of time & one-half (1½). A workday is to begin between 6:00 a.m. and 9:00 a.m. at the option of the Employer except when inclement weather or other conditions beyond the reasonable control of the Employer, in which event, the starting time may be advanced or delayed. Workers shall receive time and one-half (1½) for all work performed on recognized holidays or days observed as such.

NO: 18: Eight (8) hours of work between the hours of 8:00 a.m. and 4:30 p.m. shall constitute a work day. Forty (40) hours within the five (5) days, Monday through Friday inclusive, shall constitute the work week. Starting time may be adjusted not to exceed two (2) hours. Work performed outside of the aforementioned will be paid at the applicable overtime rate. When starting time has been adjusted, all other provisions concerning the work day shall be adjusted accordingly. The overtime rate of pay shall be one and one-half (1½) times the regular rate of wages, other than on Sundays, holidays and from Midnight until 6:00 a.m., which will be paid at double (2) the straight time rate.

**REPLACEMENT PAGE
LAWRENCE COUNTY
OVERTIME SCHEDULE - HEAVY CONSTRUCTION**

NO. 23: Means the regular workweek shall start on Monday and end on Friday, except where the Employer elects to work Monday through Thursday, (10) hours per day. All work over ten (10) hours in a day or forty (40) hours in a week shall be at the overtime rate of one and one-half (1½) times the regular hourly rate. The regular workday shall be either eight (8) or ten (10) hours. If a job can't work forty (40) hours Monday through Friday because of inclement weather or other conditions beyond the control of the Employer, Friday or Saturday may be worked as a make-up day at straight time (if working 4-10's). Saturday may be worked as a make-up day at straight time (if working 5-8's). An Employer, who is working a four (4) ten (10) hour day work schedule may use Friday as a make-up day when a workday is lost due to a holiday. A workday is to begin at the option of the Employer but not later than 11:00 a.m. except when inclement weather, requirements of the owner or other conditions beyond the reasonable control of the Employer prevent work. Except as worked as a make-up day, time on Saturday shall be worked at one and one-half (1½) times the regular rate. Work performed on Sunday shall be paid at two (2) times the regular rate. Work performed on recognized holidays or days observed as such, shall also be paid at the double (2) time rate of pay. For all overtime hours worked during the week or on Saturday \$15.55 of the fringe benefits portion of the prevailing wage shall be paid at time and one-half (1½). For all overtime hours worked on Sundays or recognized holidays \$15.55 of the fringe benefits portion of the prevailing wage shall be paid double time. The remaining \$.55 of the fringe benefit portion of the prevailing wage shall be paid at straight time.

NO. 29: Means the regularly scheduled work week shall be five (5) consecutive days, Monday through Friday or Tuesday through Saturday. Eight (8) hours shall constitute a day's work. Starting time shall not be earlier than 7:00 a.m. nor later than 10:00 a.m. Forty (40) hours shall constitute a week's work. Overtime at the rate of time and one-half (1½) will be paid for all work in excess of forty (40) hours in any one work week. On the Monday through Friday schedule, all work performed on Saturday will be time and one-half (1½) unless time has been lost during the week, in which case Saturday will be a make up day to the extent of the lost time. On the Tuesday through Saturday schedule, all work performed on Monday will be time and one-half (1½) unless time has been lost during the week, in which case Monday will be a make-up day to the extent of the lost time. Any work performed on Sunday will be double (2) time. If employees work on any of the recognized holidays, they shall be paid time and one-half (1½) their regular rate of pay for all hours worked.

NO. 31: Means the overtime rate shall be time and one-half the regular rate for work over forty (40) hours per week. Sundays and Holidays shall be paid at double the straight time rate. All employees performing work on affected properties during or following emergencies shall receive the applicable rate of pay for the first sixteen (16) consecutive hours and all hours worked in excess of sixteen (16) consecutive hours shall be paid at double time until broken by an eight (8) hour rest period. Should an employee be called back to work within two hours of his normal quitting time, the previous hours worked shall count toward the above sixteen (16) hour provision.

**LAWRENCE COUNTY
HOLIDAY SCHEDULE – HEAVY CONSTRUCTION**

NO. 3: The following days are recognized as holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day. If a holiday falls on a Sunday, it shall be observed on the following Monday. No work shall be performed on Labor Day except in case of jeopardy to work under construction. This rule is applied to protect Labor Day. When a holiday falls during the normal work week, Monday through Friday, it shall be counted as eight (8) hours toward the forty (40) hour week; however, no reimbursement for this eight (8) hours is to be paid to the workmen unless worked. An Employer working a four (4) day, ten (10) hour schedule may use Friday as a make up day when an observed holiday occurs during the work week. Employees have the option to work that make up day. If workmen are required to work the above enumerated holidays, or days observed as such, they shall receive time & one-half (1½) the regular rate of pay for such work.

NO. 15: The following days are recognized as holidays: New Year's Day, Memorial Day, July Fourth, Labor Day, Thanksgiving Day and Christmas Day. If a holiday falls on Sunday, it shall be observed on the following Monday. If a holiday falls on Saturday, it shall be observed on the preceding Friday. No work shall be performed on Labor Day except in case of jeopardy to work under construction. This rule is applied to protect Labor Day. If workmen are required to work the above enumerated holidays or days observed as such, they shall receive time and one-half (1½) the regular rate of pay for such work. Where one of the holidays specified falls or is observed during the workweek, then all work performed over and above thirty-two (32) hours in that week shall be paid at the rate of time and one-half (1½). Workmen shall receive time and one-half (1 ½) for all work performed on Sundays. Double (2) time shall be paid for work on Sunday or recognized holidays when and only if any other craft employees of the same employer at work on that same job site are receiving double (2) time for that Sunday or holiday.

NO. 16: The following days are recognized as holidays: New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and Christmas Day. If a holiday falls on Sunday, it shall be observed on the following Monday. If a holiday falls on Saturday, it shall be observed on the preceding Friday. No work shall be performed on Labor Day except in case of jeopardy to work under construction. This rule is applied to protect Labor Day. When a holiday falls during the normal work week, Monday through Friday, it shall be counted as eight (8) hours toward the forty (40) hour week; however, no reimbursement for this eight (8) hours is to be paid to the worker unless worked. If workers are required to work the above recognized holidays or days observed as such, they shall receive double (2) the regular rate of pay for such work.

NO. 18: All work performed on New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day shall be paid at the time and one-half (1½) rate of pay. If a holiday falls on Sunday, it shall be observed on the following Monday. If a holiday falls on Saturday, it shall be observed on the preceding Friday. No work shall be performed on Labor Day except in case of jeopardy to work under construction. This rule is applied to protect Labor Day. When a holiday falls during the normal work week, Monday through Friday, it shall be counted as eight (8) hours toward a forty (40) hour week; however no reimbursement for this eight (8) hours is to be paid to the working person(s) unless the holiday is worked.

NO. 24: Work performed on New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day, Christmas Day, or days celebrated as such, shall be paid at the double time rate of pay. If the holiday falls on Saturday, it will be observed on Friday; if the holiday falls on Sunday, it will be observed on Monday, and shall be paid for at double (2) the regular straight time rate of pay.

NO. 28: The following days shall be observed as legal holidays: New Year's Day, Decoration Day, July 4th, Labor Day, Thanksgiving Day, Christmas Day, Employee's birthday and two (2) personal days. The observance of one (1) of the personal days to be limited to the time between December 1 and March 1 of the following year. If any of these holidays fall on Sunday, the following Monday will be observed as the holiday and if any of these holidays fall on Saturday, the preceding Friday will be observed as the holiday. If employees work on any of these holidays they shall be paid time & one-half (1½) their regular rate of pay for all hours worked.

NO. 30: All work performed on New Year's Day, Decoration Day, Fourth of July, Labor Day, Christmas Day, Thanksgiving Day and Day after Thanksgiving or days celebrated for the same.

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 01 Specification Sections apply to this Section.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Project consists of miscellaneous improvements.
 - 1. Project Location: 1600 S. Hickory St., Missouri Veterans Home, Mt. Vernon, MO
 - 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 9-9-2016 were prepared for the Project by Malone, Finkle, Eckhardt & Collins, Inc., 7780 West 119th Street, Overland Park, KS 66213
- C. The Work consists of HVAC Renovation, Fire sprinkler piping replacement, and kitchen serving line modifications.
 - 1. The Work includes various facility renovations including upgrade to Kitchen serving line and equipment, acoustical ceiling work, fire sprinkler system upgrades, plumbing, HVAC and electrical modifications.
- D. The Work will be constructed under a single prime contract.

1.3 DESIGNER’S ESTIMATE OF CONSTRUCTION COSTS

- A. The project designer has prepared this cost estimate. It is intended to provide an indication of the relative amounts of work by division and section only. The State of Missouri makes no guarantee regarding the accuracy of the values contained herein nor does the State of Missouri intend to imply that the values associated with any specification section are accurate or in any way reflect actual costs required to perform the work represented by the specifications and drawings. The contractor should not rely on this estimate in any way while preparing a bid for this project or otherwise.

DESCRIPTION – Base Bid			TOTAL
Division 1 – General Contractor Base Bid Overhead and Profit	17%		\$226,550.33
Division 9 - Finishes			\$30,169.00
Division 11 - Equipment			\$49,900.00
Division 21 – Fire Sprinkler			\$166,200.00
Division 22 - Plumbing			\$78,350.00
Division 23 - HVAC			\$957,030.00

Division 26 - Electrical			\$51,000
	Base Bid Subtotal		\$1,332,649.00
	G.C. OH&P	17% of Subtotal	\$226,550.33
	BASE BID TOTAL		\$1,559,199.33
Alternate #1 – Boilers #1 and #2 with Controller	Alt #1		\$274,248.00
Total with Alternates	GRAND TOTAL		\$1,833,447.33

1.4 WORK UNDER OTHER CONTRACTS

- A. Separate Contract: The Owner has awarded a separate contract for performance of certain construction operations at the site. Those operations are scheduled to be substantially complete before work under this Contract begins. The separate contract includes the following:
 - 1. Contract: N/A
- B. Separate Contract: The Owner has awarded a separate contract for performance of certain construction operations at the site. Those operations will be conducted simultaneously with work under this contract. That Contract includes the following:
 - 1. Contract: N/A
- C. Cooperate fully with separate contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.

1.5 FUTURE WORK

- A. Future Contract: The Owner has awarded a separate contract for additional work to be performed at the site following Substantial Completion. Completion of that work depends on successful completion of preparatory work under this Contract. The Contract for future work includes the following:
 - 1. Contract: N/A

1.6 WORK SEQUENCE

- A. The Work will be conducted in multiple phases as detailed on sheet G-100. Each of the project phases shall be substantially complete and ready for occupancy according to the approximate timeline indicated on the phasing sheet. The complete project shall have a duration of 150 working days from commencement of construction.

1.7 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 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 construction limits indicated on the project plans. 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 cause by construction operations. Take all precautions necessary to protect the building and its occupants during the construction period.

1.8 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.
- B. Partial Owner Occupancy: The Owner reserves the right to occupy and to place and install equipment in completed areas of the building prior to Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placing of equipment and partial occupancy shall not constitute acceptance of the total Work.
 1. The Designer will prepare a Certificate of Partial Occupancy for each specific portion of the Work to be occupied prior to substantial completion.
 2. Prior to partial Owner occupancy, mechanical and electrical systems shall be fully operational. Required inspections and tests shall have been successfully completed. Upon occupancy, the Owner will operate and maintain mechanical and electrical systems serving occupied portions for the building.
 3. Upon occupancy, the Owner will assume responsibility for maintenance and custodial service for occupied portions for the building.

1.9 OWNER-FURNISHED PRODUCTS

- A. The Owner will furnish kitchen equipment as called out at the end of this section. The Work includes providing support systems to receive Owner's equipment, and mechanical and electrical connections.
 1. The Owner will arrange for and delivery necessary of product.
 2. The Owner will arrange and pay for delivery of Owner-furnished items according to the contractor's Construction Schedule.
 3. The Contractor is responsible for receiving, unloading and handling Owner furnished items at the site.
 4. Following delivery, the Contractor will inspect items delivered for damage. The Contractor shall not accept damaged items and shall notify the Owner of rejection of damaged items.
 5. If Owner-furnished items are damaged, defective, or missing, the Owner will arrange for replacement.
 6. The Owner will arrange for manufacturer's field services and for the delivery of manufacturer's warranties to the appropriate Contractor.
 7. The Contractor shall designate delivery dates of Owner-furnished items in the Contractor's Construction Schedule.
 8. The Contractor shall review shop drawings, product data and samples and return them to the Designer noting discrepancies or problems anticipated in use of the project.

9. The Contractor is responsible for protecting Owner-furnished items from damage, including damage from exposure to the elements. The Contractor shall repair or replace items damaged as a result of his operations.

1.10 MISCELLANEOUS PROVISIONS

- A. Chemical Water Treatment: Coordinate with Walter Louis Fluid Technologies for all chemicals needed during start-up. The State of Missouri will provide all chemicals needed for start-up through their existing service contract with Walter Louis Fluid Technologies. Walter Louis Fluid Technologies of Quincy, Illinois (217) 223-2017. No chemicals shall be added to any system without their direction.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 SCHEDULE OF PRODUCTS ORDERED IN ADVANCE OR EXISTING RE-INSTALLED

a. Schedule:

The following is a list of kitchen equipment provided by Owner and installed by Contractor: (See also Equipment Schedule Sheet A-400.)

ITEM 2 COLD FOOD MERCHANDISER (OWNER PROVIDED/CONTRACTOR INSTALLED)

Quantity: One (1)
Manufacturer: Structural Concepts
Model: DOS3637R
SIS No.:

Impulse Drop-In Counter Case, stainless steel exterior, stainless steel interior, glass shelves, per plan and manufacturer's standard construction.

Manufacturer provides:

Above countertop case, 60-3/4" high, 28-5/8" wide, 38-1/8" long

Self-contained refrigeration below countertop, 120v/60/1ph 15.8 amps, 6 ft cord & plug NEMA #5-20P

ITEM 7 MILK DISPENSER – N.I.C. (OWNER PROVIDED/CONTRACTOR INSTALLED)

Quantity: One (1)
Manufacturer: Silver King
Model: SKMAJ3/C4
SIS No.:

Majestic Milk Dispenser Unit, stainless steel exterior, stainless steel interior, (3) dispensing valves, per plan and manufacturer's standard construction.

Manufacturer provides:

Countertop dispenser, 39-1/2" high, 17-1/8" wide, 37-1/2" long

Self-contained refrigeration, 115v/60/1ph 1.6 amps, 6 ft cord & plug NEMA #5-15P

ITEM 8 TABLE TOP TOASTER – N.I.C. (OWNER PROVIDED/CONTRACTOR INSTALLED)

Quantity: One (1)
Manufacturer: EXISTING
Model: FIELD VERIFY

SIS No.:

Electric Toaster Unit, stainless steel exterior, per plan and manufacturer's standard construction.
Manufacturer provides:
Countertop Toaster, 120v/60/1ph xx amps, 6 ft cord & plug NEMA #5-15P

- ITEM 11** ICE MAKER - EXISTING EQUIPMENT – N.I.C (OWNER PROVIDED/CONTRACTOR TO RE-INSTALL)

- ITEM 14** REFRIGERATOR - EXISTING EQUIPMENT – N.I.C (OWNER PROVIDED/CONTRACTOR RE-INSTALL)

- ITEM 15** UNDERCOUNTER FREEZER - EXISTING EQUIPMENT – N.I.C (OWNER PROVIDED/CONTRACTOR RE-INSTALL)

- ITEM 16** FRYER- EXISTING EQUIPMENT – N.I.C (OWNER PROVIDED/CONTRACTOR RE-INSTALL)

- ITEM 18** GRIDDLE - EXISTING EQUIPMENT – N.I.C. (OWNER PROVIDED/CONTRACTOR INSTALLED) MODEL AND MANUFACTURER TBD

- ITEM 19** DRAWER WARMER - EXISTING EQUIPMENT – N.I.C. (OWNER PROVIDED/CONTRACTOR INSTALLED)

- ITEM 21** ICE CREAM DISPENSER - EXISTING EQUIPMENT – N.I.C. (OWNER PROVIDED/CONTRACTOR RE-INSTALL)

- ITEM 22** FOLDING TABLE - EXISTING EQUIPMENT – N.I.C. (OWNER PROVIDED/CONTRACTOR RE-INSTALL)

- ITEM 23** TRASH CAN - EXISTING EQUIPMENT – N.I.C. (OWNER PROVIDED/CONTRACTOR RE-INSTALL)

- ITEM 24** PLATE DISPENSER - EXISTING EQUIPMENT – N.I.C. (OWNER PROVIDED/CONTRACTOR RE-INSTALL) MFG: Standex MODEL: HML2-10 S# 260581501002

- ITEM 25** SANDWICH PREP TABLE - EXISTING EQUIPMENT – N.I.C. (OWNER PROVIDED/CONTRACTOR RE-INSTALL) MFG: SUPERIOR, MODEL: 1756972



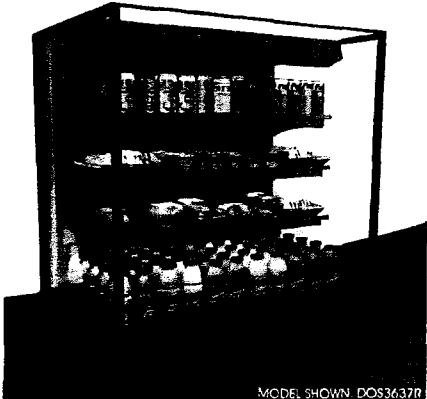
ITEM NO: ITEM 2)
 PROJECT: _____
 DATE: _____

Product Specifications

Refrigerated Self-Service Drop-In Counter Case

- DOS3637R
- DOS4837R

Lengths include end panels
 38-1/8"L x 28-5/8"D x 60-3/4"H
 50-1/8"L x 28-5/8"D x 60-3/4"H



MODEL SHOWN: DOS3637R

STANDARD FEATURES

- Breeze™ w/ EnergyWise s/c refrigeration (rear access/ventilation)
- Compressor air rear intake, rear discharge
- Glass ends
- Integrated average product temperature of 40°F or less
- NOTE: A vent in the front of the counter is recommended to help dissipate compressor heat.
- NOTE: Height of display case above counter is 36 3/4"
- One year parts & labor; 5 year compressor warranty
- Shelving removable and adjustable on 1" centers
- T-8 top light

Features	Standard	Options
EXTERIOR COLOR	<input type="checkbox"/> Black	<input type="checkbox"/> Stainless steel
INTERIOR COLOR	<input type="checkbox"/> Black	<input type="checkbox"/> Stainless steel
UPPER REAR	<input type="checkbox"/> Solid back panel	<input type="checkbox"/> Clear glass rear sliding doors with inner acrylic plenum <input type="checkbox"/> Clear glass rear swinging doors with inner acrylic plenum
SHELVING	<input type="checkbox"/> Clear glass shelves, non-lighted	<input type="checkbox"/> Clear glass shelves, lighted (T-8) <input type="checkbox"/> Clear glass shelves, lighted (LED 3500K)
ELECTRICAL CONNECT	<input type="checkbox"/> 6' straight blade power cord (self-cont.)	<input type="checkbox"/> 6' locking power cord (self-cont.) <input type="checkbox"/> Electrical leads (remote)
REFRIGERATION	<input type="checkbox"/> Breeze™ w/ EnergyWise s/c refrigeration (rear access/ventilation)	<input type="checkbox"/> Breeze™ w/ EnergyWise s/c refrigeration (front access/ventilation) <input type="checkbox"/> Note: Remote doesn't incl Conds unit. Floor drain reqd. <input type="checkbox"/> Remote w/thermostat, solenoid & TXV
MISCELLANEOUS		<input type="checkbox"/> Rear door lock <input type="checkbox"/> Second year parts & labor warranty (excludes compressor)
ACCESSORIES		<input type="checkbox"/> Night curtain, retractable, non-locking <input type="checkbox"/> Solid security cover, removable, locking



888 E. Porter Rd.
 Muskegon, MI 49441
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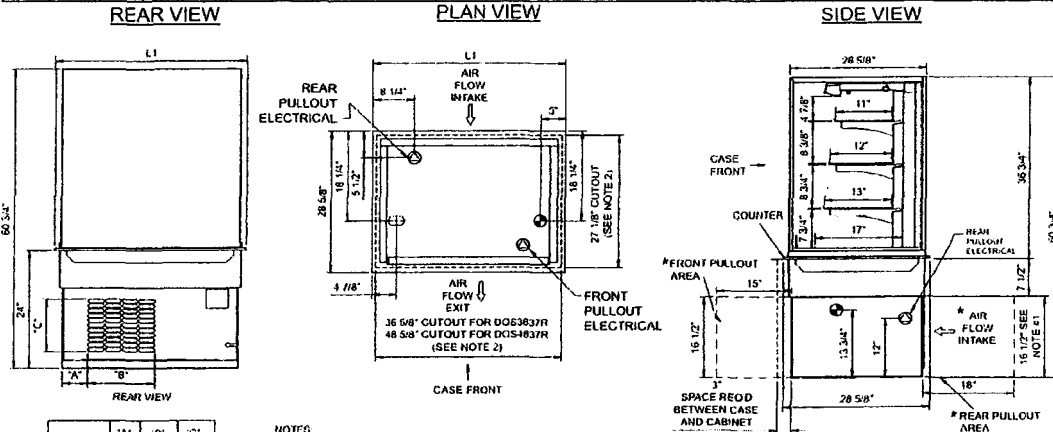
Note: Information is subject to change at any time.
 Visit www.structuralconcepts.com for the most current specs.

Revised 12/1/2015 20029510



Product Specifications

Intended Environment: Type I - Designed to operate in ambient conditions of 75°F with 55% relative humidity unless noted otherwise in system information below.	
Zone: Intended Product To Be Displayed	Integrated Prod Temp ° F
All Packaged / unpackaged refrigerated products	40



	A'	B'	C'
DOS3637R	4 1/8"	14"	10 3/4"
DOS4837R	6"	14"	10 3/4"

- NOTES
- 1 18 1/2" TALL, FULL WIDTH OF CASE, OPENING IN BACK, AND FRONT OF CABINET OR COUNTER IS REQUIRED TO PULL OUT REFRIGERATION SYSTEM
 - 2 REPRESENTS CUTOOUT SIZE IN CABINET FOR CASE TO DROP IN TO. SQUARE CORNERS ON CUTOOUTS
 - 3 BACK OF COUNTER / CABINET AND FRONT MUST BE VENTED PROPERLY FOR ADEQUATE AIRFLOW TO CONDENSER.
 - 4 EXIT VENT IN FRONT OF CABINET IS PREFERRED. IF NOT PROVIDED, AIR VENT MUST BE SURE NOT TO MIX WITH INTAKE AIR
 - *5, AIR FLOW INTAKE, EXIT DETAILS, AND ELECTRICAL ARE REVERSED WITH FRONT PULLOUT REFRIGERATION OPTION

NOTE: ALL DIMENSIONS APPROXIMATE

- ELECTRICAL JUNCTION BOX (SUPPLIED WITH 6' LEADS OR POWER CORD)
- REFRIGERATION LINE CONNECTION
- SELF-CONTAINED CASE SERVICE ACCESS AREA
- LOCATION OF DRAIN LINE FOR REMOTE REF ONLY (SUPPLIED WITH 1" OR 1 1/2" PVC TUBE)
- REMOTE FLOOR SINK & UTILITIES ACCESS AREA
- DRY CASE SERVICE ACCESS AREA

Model	L"	L1"	L2"	Model Technical Specifications											
				System	Circuit	Volts	Phs	Freq	Amps	Watts	Wires	NEMA	Plug	SST	BTUH
DOS3637R	N/A	38.13	6.00	Remote(Type I)	Circuit #1	110-120	1	60	2.02	212	2+G	Leads Multiple	20.00	3150	700
				Self-Contained	Circuit #1	110-120	1	60	16.80	1,378	2+G	5-20P or LS-20P	N/A	N/A	
DOS4837R	N/A	50.13	5.00	Remote(Type I)	Circuit #1	110-120	1	60	2.28	183	2+G	Leads Multiple	20.00	4000	800
				Self-Contained	Circuit #1	110-120	1	60	18.00	1,452	2+G	5-20P or LS-20P	N/A	N/A	

*** Does not include electric defrost on freezer models.

Regulatory Approvals:	
All Models	Accordance with AHRI Std 1200
	ETL Listed to UL 471
	ETL Listed to CAN/CSA 22.2 No. 120
	ETL Sanitation to NSF 7



- Important Notes:
- 1) ELECTRICAL NOTE: If GFCI is required, a GFCI breaker MUST be used in lieu of a GFCI receptacle
 - 2) Back side of counter must be open or vented the full length of the unit to allow proper ventilation for the refrigeration system.
 - 3) A vent in the front of the counter recommended to help dissipate compressor heat.
 - 4) Height of display case above counter is 36 3/4"



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Note: Information is subject to change at any time.
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Revised 12/1/2015 20029510

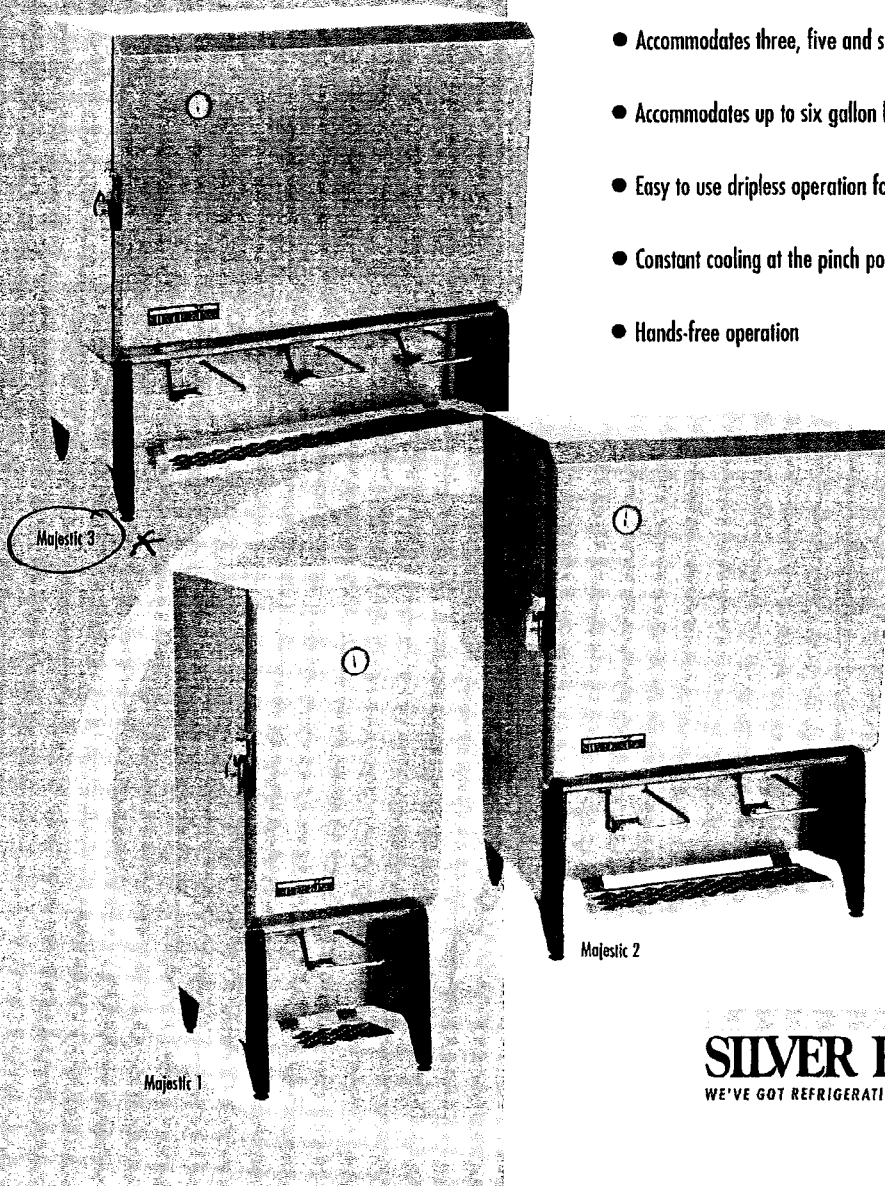
MAJESTIC SERIES MILK DISPENSERS

ITEM 7)

SUPERIOR COOLING

QUALITY DISPENSE

- Accommodates three, five and six gallon bags
- Accommodates up to six gallon bag-n-box
- Easy to use dripless operation for optimum sanitation
- Constant cooling at the pinch point
- Hands-free operation

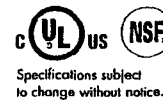


SILVER KING.
WE'VE GOT REFRIGERATION DOWN COLD.

MAJESTIC SERIES MILK DISPENSERS

MODELS
 SKMAJ1
 SKMAJ2
 SKMAJ3

- Stainless steel exterior and interior
- Temperature indicator on door front. Adjustable temperature control.
- Door: Heavy duty hinges. Easily removable door gasket for ease in cleaning.
- Dispenser valve: Spring loaded lift type valve for dripless operation and optimum sanitation.
- Electrical: Standard 115 volt, 60 Hz, single phase. Also available in 230 volt, 50Hz, single phase.
- Listings: UL (US and Canada), NSF International
- Warranty: One year parts and labor. Five year warranty on compressor.

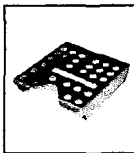


MODEL	DESCRIPTION	EXTERIOR DIMENSIONS			COMPRESSOR	AMPS	WEIGHT
		LENGTH	DEPTH	HEIGHT			
C4 SERIES: Includes 6 gallon crate(s) and platform(s)							
SKMAJ1/C4	Single valve, accommodates 3, 5 and 6 gallon	15 1/2"	17 1/8"	39 1/2"	1/10 hp	1.2	80 lbs
SKMAJ2/C4	Double valve, accommodates 3, 5 and 6 gallon	26 1/2"	17 1/8"	39 1/2"	1/10 hp	1.3	110 lbs
SKMAJ3/C4	Triple valve, accommodates 3, 5 and 6 gallon	37 1/2"	17 1/8"	39 1/2"	1/6 hp	1.6	140 lbs
C3 SERIES: With shipboard legs; includes 6 gallon crate(s) and platform(s)							
SKMAJ1/C3	Single valve, accommodates 3, 5 or 6 gallon	15 1/2"	17 1/8"	39 1/2"	1/10 hp	1.2	80 lbs
SKMAJ2/C3	Double valve, accommodates 3, 5 or 6 gallon	26 1/2"	17 1/8"	39 1/2"	1/10 hp	1.3	110 lbs
SKMAJ3/C3	Triple valve, accommodates 3, 5 or 6 gallon	37 1/2"	17 1/8"	39 1/2"	1/6 hp	1.6	140 lbs

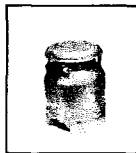
ACCESSORIES



Milk crate for
3, 5 or 6 gallon bags
Item # 35904



Platform for
bag-n-box
Item # 63959



3 gallon
dispenser can
Item # 62642

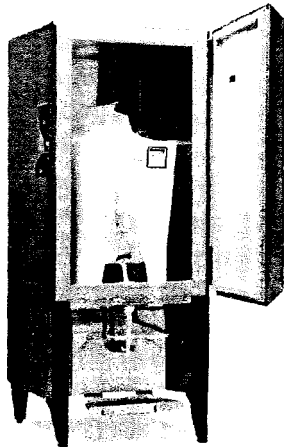


5 gallon
dispenser can
Item # 60224

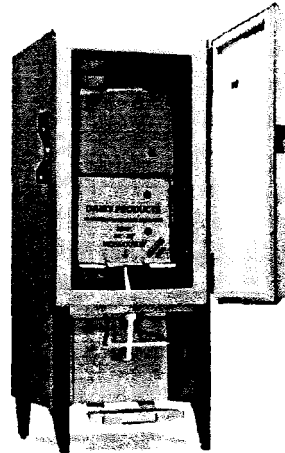
Not Pictured:
Tubes 10 1/4"
Item # 20323



SUPERIOR COOLING QUALITY DISPENSE



Application: Milk in bag (3, 5 or 6 gallon)

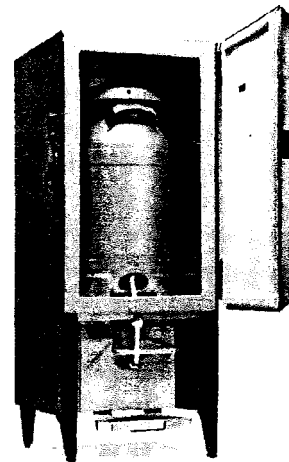


Application: Bag-n-box milk



Application: Bag-n-box milk

shipboard
legs



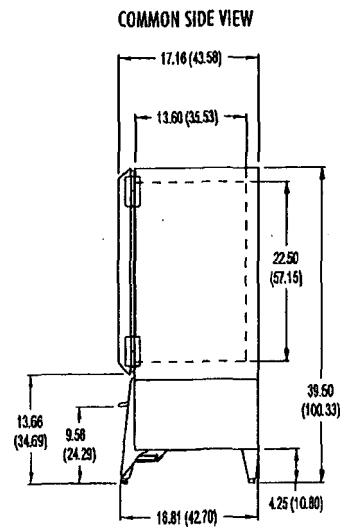
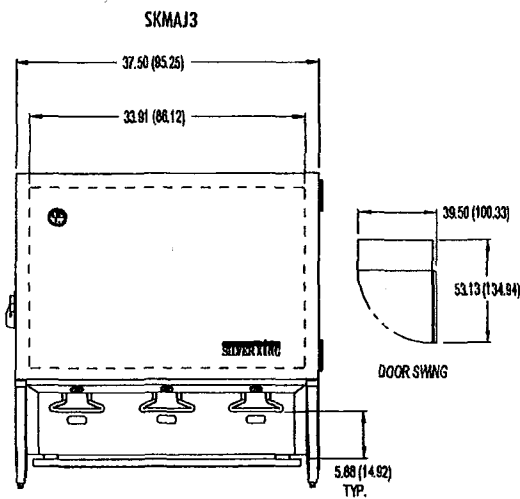
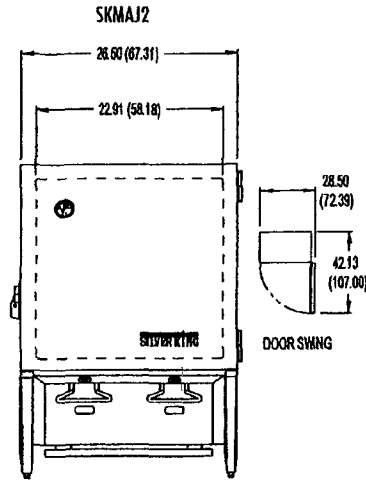
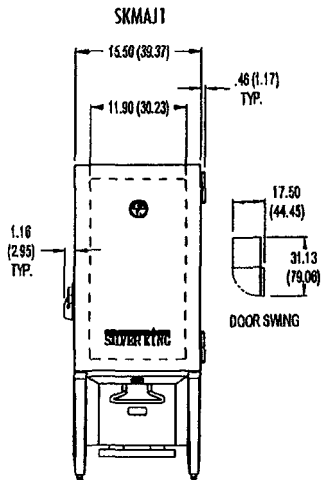
Application: 5 gallon dispenser can (sold as accessory)



www.allvarking.com

MAJESTIC SERIES MILK DISPENSERS

Dimensions in inches and centimeters
 All drawings shown with standard legs



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 Phone (763) 923-2441
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www.silverking.com

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ITEM 15)

UNDERCOUNTER REFRIGERATORS AND FREEZERS Installation, Operation and Maintenance Instructions

INSPECTION

When the equipment is received, all items should be carefully checked against the Bill of Lading to insure all crates and cartons have been received. Do not sign the freight bill clear until the freight has been properly inspected for damage. All units should be inspected for damage including concealed damage by uncrating immediately. If any damage is found, it should be reported to the carrier at once, noted on the Bill of Lading and a claim should be filed with the carrier. This equipment has been inspected and tested in the manufacturing facility and has been crated in accordance with transportation rules and guidelines. The manufacturer is not responsible for freight loss or damages.

INSTALLATION

The exterior of the cabinet and doors have been protected by a plastic covering. Peel this protective covering before installation. After removing the covering, clean the interior and exterior surfaces of the unit with soap and water and a rinse with clean water. Do not use chlorinated cleaners on the surfaces as they can cause corrosion.

If the door(s) have come out of alignment during shipping they will need to be adjusted. This can be accomplished by opening the door(s) and loosening the screws that hold both the top and bottom hinges to the cabinet. After adjusting the door so it is aligned correct, tighten the screws to securely hold the hinges and door(s) in place.

The shelves and self clips are packaged inside the unit. Install the shelf clips on the pilasters inside the unit and set the shelves on the clips. The shelves are adjustable in ½" increments. One (1) shelf can support up to 132 lbs (60 kg).

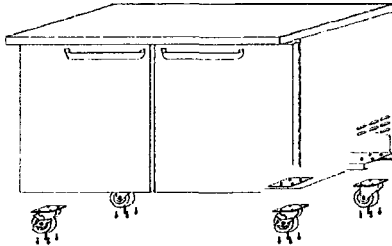
The refrigeration system located in the rear of the unit requires free air access for proper operation. Allow a minimum of seven inches between the back of the cabinet and the wall. Do not locate the unit next to heat generating equipment or in direct sunlight.

Confirm that the proposed electrical outlet has the correct voltage, frequency and current carrying capacity for the requirements of the unit. This information is noted on the data plate on the inside left wall of the unit. The unit should be isolated on a circuit.

Do not use an extension cord to get power to the unit. Improper electrical installations will void the compressor warranty. To prevent shock and fire, be sure the unit is properly grounded.

The temperature controller is located at the top, right corner inside the cabinet. Adjust the temperature to fit your needs.

Install casters per the following diagram.



Note: The casters with brakes should be installed to the front of the cabinet.

MAINTENANCE

General Cleaning

Beginning with the initial installation, the interior surfaces of the cabinet should be periodically cleaned with a solution of warm water and baking soda. This solution will remove any odors from spillage that has occurred. The exterior of the cabinet should also be cleaned frequently with a commercial stainless steel cleaner, glass cleaner or mild soap solution. Do not use chlorinated cleaners on the stainless steel surfaces.

Note: do not use stainless steel cleaners or other solvent-based chemicals on the plastic parts (door handle or trim strips) as they can cause failure. Use mild soap and warm water on plastic parts.

The door gaskets should be cleaned in place with a mild soap solution to extend their life.

The shelving can be cleaned in a sink with a mild soap solution and a soft bristled brush.

Condenser Coil Cleaning

Prior to cleaning the condenser coil disconnect the unit from power. Periodic cleaning of the condenser coil will aid the heat transfer of the refrigeration system and increase its efficiency. To accomplish this, remove the rear grill from the cabinet. The condenser coil is located behind the grill. Use a soft bristled brush to remove any dirt particles that are on the fins of the condenser coil. Use a vacuum cleaner or compressed air to remove the loosened particles. Replace the grill and reconnect the unit to power. Failure to clean the condenser coil can lead to performance loss and compressor failure.

Stocking

When loading the cabinet with contents, do not block the fans in the back. Blocking the air flow may decrease performance.

TROUBLESHOOTING

Problem	Remedy
Compressor will not start	<ul style="list-style-type: none"> • Check the power cord and make sure it is plugged in. • Check the temperature controller. If it is in the "OFF" position, turn it clockwise to set a desired temperature. If there is an on/off switch, make sure it is in the "ON" position.
Poor performance	<ul style="list-style-type: none"> • Move the unit from direct sunlight. • Move the unit away from heating devices. • Install the unit in a well ventilated place, with at least 7 inches of clearance on all sides. • Clean the condenser if heavy dust is collected. • Clear contents from blocking the air duct. • Check the temperature controller for incorrect setting. • Check the refrigerant level, it may need to be charged. • Check the door and be sure it is completely closed.
Unit noisy	<ul style="list-style-type: none"> • Install the unit on a level surface. • Maintain 7 inches of clearance from the wall. • Check for loose part or mounting. • Keep the tubing free from any contact to avoid rattle.
Condensation on cabinet exterior and/or floor	<ul style="list-style-type: none"> • Reduce humidity where the unit is installed. • Repair or replace the gasket on the door.

SPECIFICATIONS

PRODUCT		UNDERCOUNTER REFRIGERATORS/FREEZERS				
MODEL	REF	UR27	UR36	UR48	UR60	UR72
	FRZR	UF27		UF48	UF60	
Capacity		7 CuFt (198 liter)	10 CuFt (283 liter)	13 CuFt (368 liter)	16 CuFt (453 liter)	20 CuFt (566 liter)
Exterior Dimensions (including casters)	(W)	27.5"	36.4"	48.25"	60.4"	72.4"
	(D)	30.0"				
	(H)*	35.9"				
Doors		1	1	2	2	3
Shelves per Door		1	1	2	2	3
Condensing Unit Size	REF	1/5 HP	1/5 HP	1/5 HP	3/8 HP	3/8 HP
	FRZR	3/8 HP		1/2 HP	1/2 HP	
Electrical		115V / 60Hz				
NEMA Plug Configuration		NEMA 5-15P				
Total Amp Draw	REF	3.2	3.2	6.0	6.0	6.1
	FRZR	5.3		7.5	7.5	
Temperature Range	REF	+34°F to +38°F				
	FRZR	-5°F to 0°F				
Refrigerant	REF	R-134a	R-134a	R-134a	R-134a	R-134a
	FRZR	R-134a		R-404a	R-404a	
Net Weight (lbs)	REF	199	242	280	333	384
	FRZR	207		298	350	

- Above specifications are subjected to change without prior notice for quality improvement.

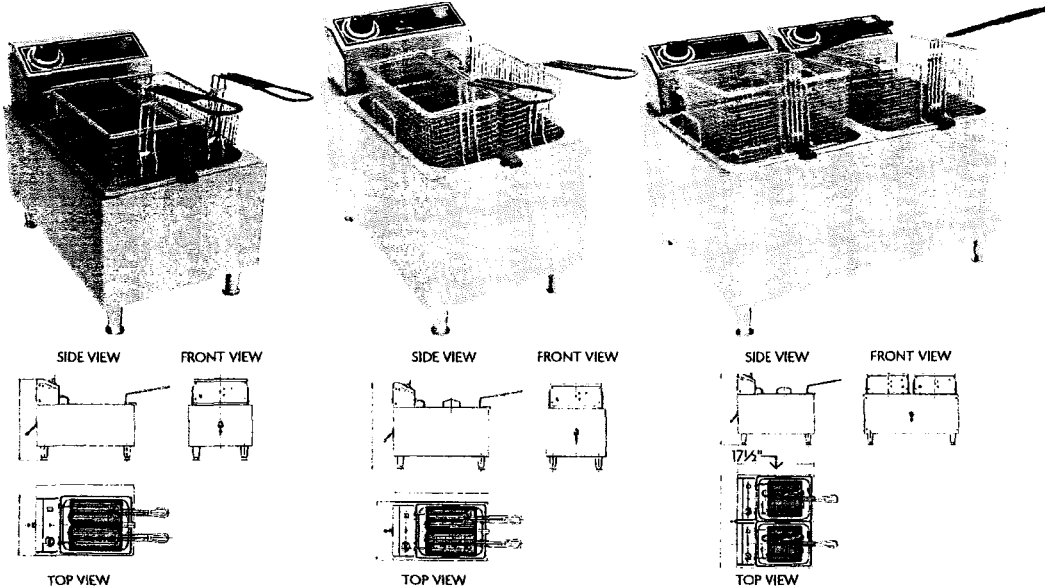
* Includes 6 inch casters. 3 inch casters are available for ADA compliant installation (33")

ITEM 16)



SUPERIOR LIGHT DUTY FRYERS

SPC: 173651 | APN: 0887604 SPC: 172772 | APN: 0885772
 * SPC: 172843 | APN: 0885996



ROUGH-IN DATA	
FRYER 173651 / 0887604	
11.2" W x 17.5" D x 14.9" H	
Fat Capacity	10 lbs.
Thermostat Controls	1
Prod./Hr. (Lbs.)*	11.5
Voltage	120V
Watts	1700
NEMA Plug	5-15P
Amps	14.2
Cord	48"
Weight	21
FRYER 172772 / 0885772	
11.2" W x 17.5" D x 16.5" H	
Fat Capacity	16 lbs.
Thermostat Controls	1
Prod./Hr. (Lbs.)*	25
Voltage	208/240V
Watts	2900-3800
NEMA Plug	6-20P
Amps	15.8
Cord	48"
Weight	23

SPECIFICATIONS

- 70°F – 375°F Thermostat
- Thermal limit control
- Stainless Steel construction
- European thermostat
- ABS control dial
- Removable electrical head and element for easy cleaning
- Adjustable feet to level fryer
- Easy to remove/clean oil pan
- 2 high quality chrome plated baskets with insulated handle
- Swing up element
- Lift out fry pot

Models Available

- SPC: 173651 APN: 0887604 10 lb. Capacity
- SPC: 172772 APN: 0885772 16 lb. Capacity
- SPC: 172843 APN: 0885996 32 lb Capacity (dual tank)

03/11





SUPERIOR LIGHT DUTY FRYERS

SPC: 173651 | APN: 0887604 SPC: 172772 | APN: 0885772
SPC: 172843 | APN: 0885996

FRYER 172843 / 0885996
21.8" W x 17.5" D x 16.5" H
Fat Capacity 32 lbs.
Thermostat Controls 2
Prod./Hr. (Lbs.)* 32
Voltage 208-240V
Watts 5800-7600
NEMA Plug 6-20P (2)
Amps 31.6
Cord 48"
Weight 37

**Production based on lbs. of potatoes per hour (frozen to finish)*

Note: 32 lb. fryer requires NEMA 6-20P outlets.

Replacement fryer baskets available, call for details

Manufactured for Next Day Gourmet®

Applications

- Designed for entry level and lighter duty cooking applications
- Produces 10 to 50 lbs of fries per hour, frozen to finish, depending on model
- 10 lb model can be plugged into standard 120 Volt 15 amp outlets
- Fries product in limited quantities like French fries, onion rings, chicken, fish fillets, etc.

Warranty (USA)

- Exclusive two-year replacement warranty

Specifications subject to change without notice.

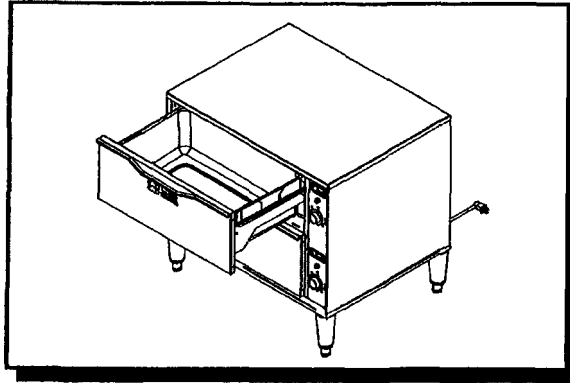
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ITEM 19)



**INSTALLATION
AND
OPERATING
INSTRUCTIONS**



Model: **HDD / HDDS**

HOLDING DRAWERS

INTENDED FOR OTHER THAN HOUSEHOLD USE

RETAIN THIS MANUAL FOR FUTURE REFERENCE
UNIT MUST BE KEPT CLEAR OF COMBUSTIBLES AT ALL TIMES



FOR YOUR SAFETY: Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.



WARNING: Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury or death. Read the Installation, Operating and Maintenance Instructions thoroughly before installing or servicing this equipment.



This equipment has been engineered to provide you with year-round dependable service when used according to the instructions in this manual and standard commercial kitchen practices.



ANSI/NSF4

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Toll Free: +1 (800) 527-2100
Website: www.apwwyott.com
E-mail: info@apwwyott.com

P/N 70505000 9/05

APW WYOTT
729 Third Avenue
Dallas, TX 75226

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1. OWNER'S INFORMATION

General Information:

1. Always clean equipment thoroughly before first use. (See general cleaning instructions).
2. Check rating label for your model designation and electrical rating.
3. For best results, use stainless steel countertops.
4. All dimensions in parenthesis in centimeters unless noted.

General Operation Instructions:

1. All foodservice equipment should be operated by trained personnel.
2. Do not allow your customers to come in contact with any surface labeled "CAUTION HOT".
3. Where applicable: Never pour cold water into dry heated units.
4. Where applicable: Do not cook, warm or hold food directly in liner pans (well pans). Always use steamtable pans/insets, etc.
5. Never hold perishable food below 150°F (66°C).

Warranty Information:

Reliability Backed By APW Wyott's Warranty:

All APW Wyott Holding Drawers are backed by a one year parts and labor warranty, including On-Site Service calls within 50 miles of authorized service technicians.

Service Information:

Service Hotline (800) 733-2203

2. SAFETY INFORMATION

APW Wyott Holding Drawers are designed, built and sold for commercial use and should be operated by trained personnel only. Clearly post all CAUTIONS, WARNINGS and OPERATING INSTRUCTIONS near each unit to insure proper operation and to reduce the chance of personal injury and/or equipment damage.

Always disconnect power before servicing the Holding Drawer. Surfaces will remain hot after power has been turned off. Allow unit to cool before cleaning or servicing. Never clean the Holding Drawer by immersing it in water. The Holding Drawer is not protected against water jets; DO NOT CLEAN HOLDING DRAWER WITH A WATER JET. Always clean equipment before first use.

3. SPECIFICATIONS

Cordset Configuration:

120V: NEMA5-15P plug, 6 foot, 3 wire grounded cord.
208/240V: NEMA6-20P plug, 6 foot, 3 wire grounded cord.




If the supply cord is damaged, the manufacturer or an authorized service agent or a similarly qualified person must replace it to avoid a hazard or voiding the warranty.


STANDARD HOLDING DRAWERS				
	ELECTRIC		DIMENSIONS	SHIPPING WEIGHT
HDD-1	120V, 450W, 3.8 Amps	Base Unit	10 3/8" H x 27 3/4" W x 20 11/16" D (264 mm x 705 mm x 525 mm)	84 lbs. (38 kg)
	208V, 450W, 2.1 Amps 240V, 450W, 1.8 Amps	Cutout	10 3/4" H x 27 13/16" W (273 mm x 706 mm)	
HDD-2	120V, 900W, 7.5 Amps	Base Unit	19 3/4" H x 27 3/4" W x 20 11/16" D (502 mm x 705 mm x 525 mm)	175 lbs. (79 kg)
	208V, 900W, 4.3 Amps 240V, 900W, 3.7 Amps	Cutout	20" H x 27 13/16" W (508 mm x 706 mm)	
HDD-3	120V, 1350W, 11.3 Amps	Base Unit	29 1/8" H x 27 3/4" W x 20 11/16" D (740 mm x 705 mm x 525 mm)	254 lbs. (115 kg)
	208V, 1350W, 6.5 Amps 240V, 1350W, 5.6 Amps	Cutout	29 5/8" H x 27 13/16" W (752mm x 706 mm)	

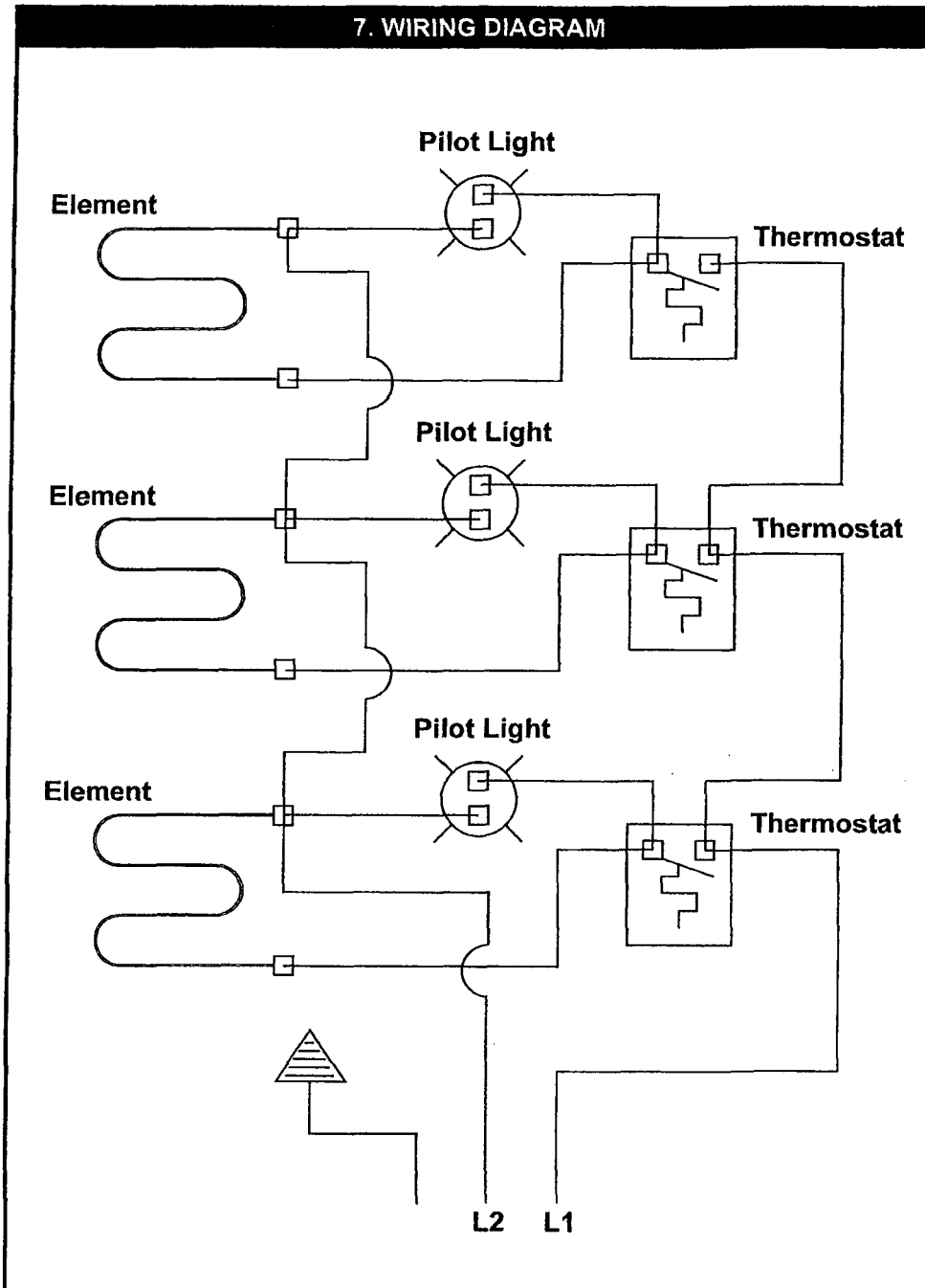
SLIMLINE HOLDING DRAWERS				
	ELECTRIC		DIMENSIONS	SHIPPING WEIGHT
HDDS-1	120V, 450W, 3.8 Amps	Base Unit	11 3/8" H x 20 15/16" W x 28 7/8" D (289 mm x 531 mm x 733 mm)	84 lbs. (38 kg)
	208V, 450W, 2.1 Amps 240V, 450W, 1.8 Amps	Cutout	11 3/4" H x 20 1/2" W (298 mm x 521 mm)	
HDDS-2	120V, 900W, 7.5 Amps	Base Unit	21 1/4" H x 20 15/16" W x 28 7/8" D (545 mm x 531 mm x 733 mm)	175 lbs. (79 kg)
	208V, 900W, 4.3 Amps 240V, 900W, 3.7 Amps	Cutout	21 5/8" H x 20 1/2" W (549 mm x 521 mm)	
HDDS-3	120V, 1350W, 11.3 Amps	Base Unit	31 1/8" H x 20 15/16" W x 28 7/8" D (794 mm x 531 mm x 733 mm)	254 lbs. (115 kg)
	208V, 1350W, 6.5 Amps 240V, 1350W, 5.6 Amps	Cutout	31 1/8" H x 20 1/2" W (790mm x 521 mm)	

WARNING: ELECTRICAL SHOCK HAZARD. FAILURE TO FOLLOW THE INSTRUCTIONS IN THIS MANUAL COULD RESULT IN SERIOUS INJURY OR DEATH.



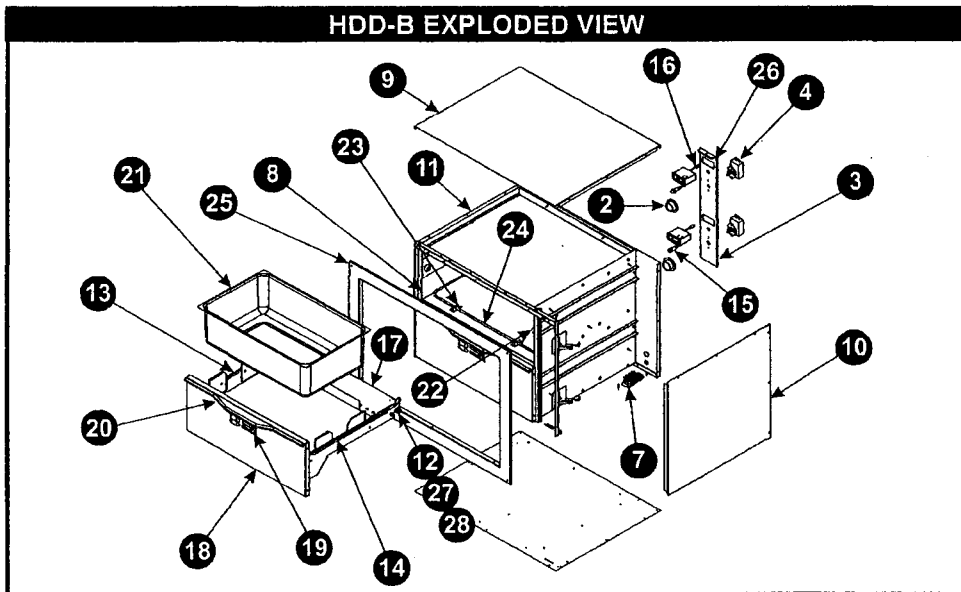
- Electrical Ground is required on this appliance.
- Do not modify the power supply cord plug. If it does not fit into the outlet, have the proper outlet installed by a qualified electrician
- Do not use an extension cord with this appliance.
- Check with a qualified electrician if you are unsure as to whether the appliance is properly grounded.



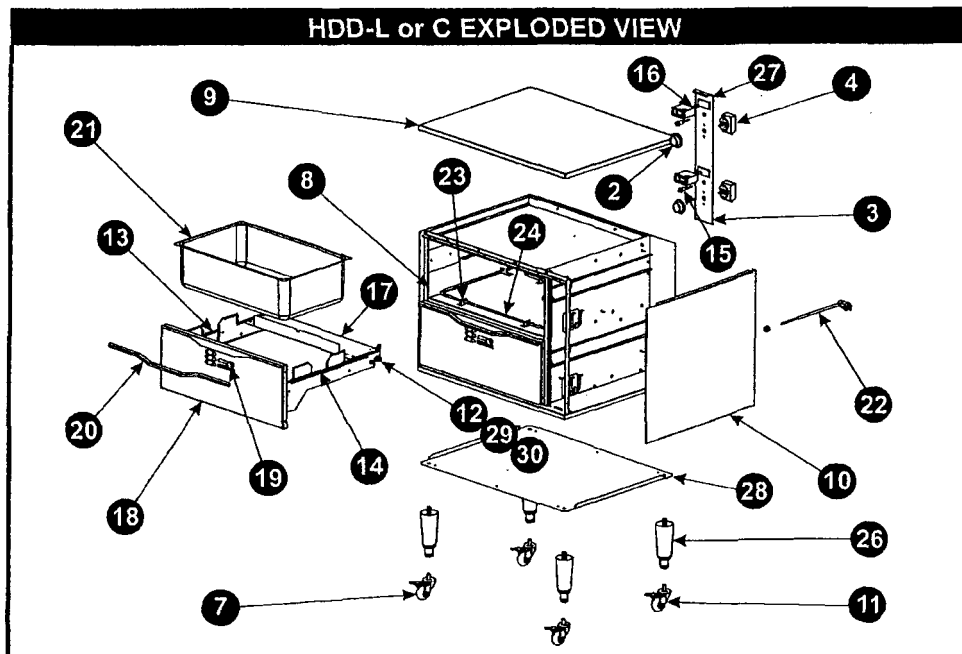


8. PARTS LISTS & EXPLODED VIEWS

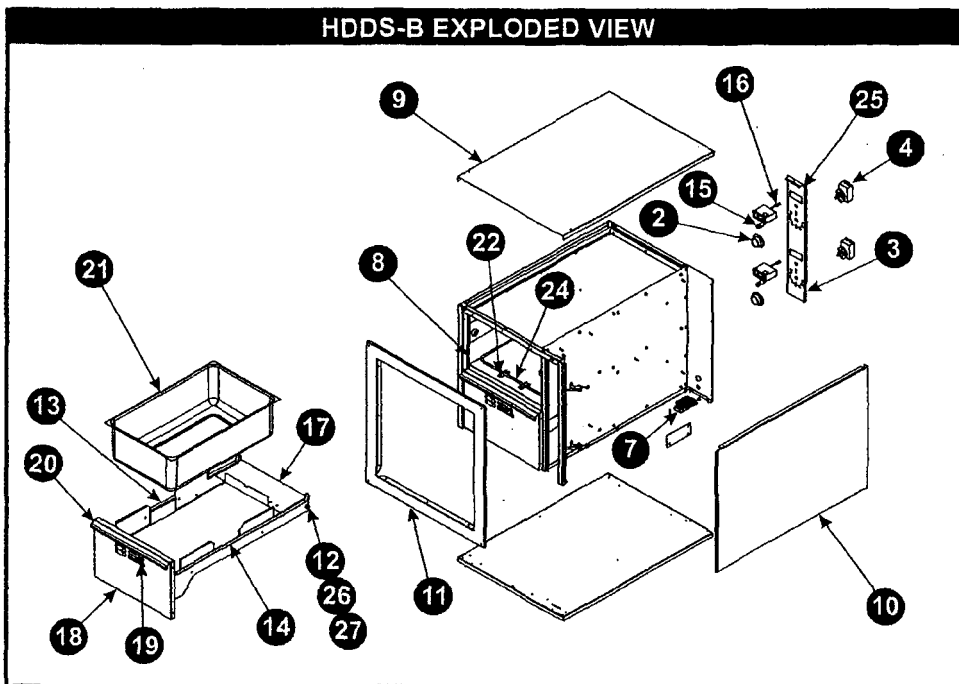
HDD-B PARTS LIST					
ITEM	P/N	DESCRIPTION	ITEM	P/N	DESCRIPTION
1	N/A	Rating Label	19	89167	Drawer Vent Knob
2	56505	Thermostat Knob	20	33154	Drawer Handle Strip
3	33976	HDD1B Control Panel	21	33018	Drawer Pan
	33952	HDD2B Control Panel	22	33397	Thermostat & Thermometer Bracket
	33993	HDD3B Control Panel	23	33156	Element Bracket
4	69120	Thermostat	24	54111	120V Heating Element
N/S	60113	Insulation		54112	208V Heating Element
N/S	32490	HDD1B Wire Set		54113	240V Heating Element
	32491	HDD2B Wire Set	25	33982	HDD1B Front Plate
	33359	HDD3B Wire Set		33963	HDD2B Front Plate
7	89145	Terminal Block		33999	HDD3B Front Plate
8	32438	HDD1B Body Assembly	26	33908	HDD3B Front Poly Panel
	32437	HDD2B Body Assembly		33909	HDD2B Front Poly Panel
	32439	HDD3B Body Assembly		33910	HDD1B Front Poly Panel
9	33962	Top Cover	27	88851	Press Stud
10	33980	HDD1B Side Outer Cover Right	28	89026	Cap Nut
	33960	HDD2B Side Outer Cover Right	N/S	33858	Roller, Drawer Slide
	33997	HDD3B Side Outer Cover Right	N/S	88961	Green Ground Nut
11	33981	HDD1B Side Outer Cover Left	N/S	89071	#10 Flat Washer
	33961	HDD2B Side Outer Cover Left	N/S	89076	1/4 Internal Star Washer
	33998	HDD3B Side Outer Cover Left	N/S	69163	1/4-20 SS Jam Nut
12	88852	Bushing, Bronze	N/S	88909	8-18 X 1/2 Sheet Metal Screw
13	33932	Left Drawer Slide	N/S	89140	Cable Tie
14	33933	Right Drawer Slide	N/S	88894	1/4-20 X 7/8 Press Stud
15	56530	Indicator Light	N/S	89073	8 X 1/2 Screw
16	69145	Thermometer	N/S	88892	1/4-20 X 1 Flat Head SS
17	33938	Drawer Housing Assembly	N/S	88893	1/4-20 Nylon Insert Locknut
18	33944	Drawer Face Assembly			



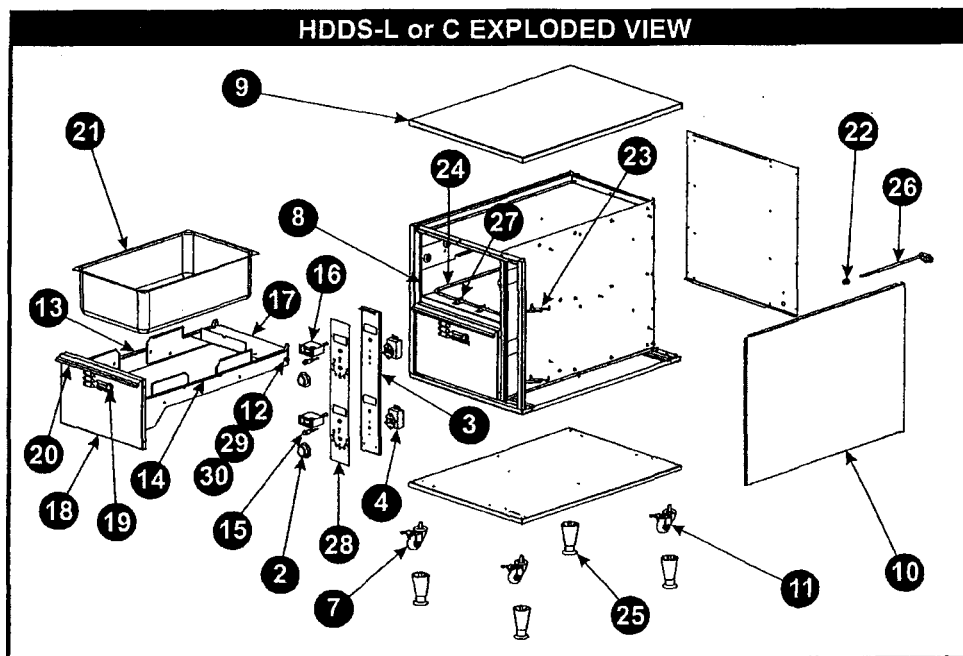
HDD-L or C PARTS LIST					
ITEM	P/N	DESCRIPTION	ITEM	P/N	DESCRIPTION
1	N/A	Rating Label	20	32483	Drawer Handle Strip
2	56505	Thermostat Knob	21	33018	Drawer Pan
3	33976	HDD1B Control Panel	22	55970	Cordset 16/3 SJTO
	33952	HDD2B Control Panel	23	32404	Element Bracket
	33993	HDD3B Control Panel	24	54111	120V Heating Element
4	69120	Thermostat		54112	208V Heating Element
N/S	60113	Insulation		54113	240V Heating Element
N/S	33357	HDD1 Wire Set	N/S	32402	Element Bracket Large
	33358	HDD2 Wire Set	26	86295	Legs 4" Black (Std)
	33359	HDD3 Wire Set	27	33909	HDD1B Front Poly Panel
7	33907	Caster Swival Locking (Opt)		33910	HDD2B Front Poly Panel
8	32425	HDD1 Body Assembly		33908	HDD3B Front Poly Panel
	32403	HDD2 Body Assembly	28	33948	Bottom Panel
	32431	HDD3 Body Assembly	29	88851	Press Stud
9	33936	Top Cover	30	89026	Cap Nut
10	33973	HDD1 Side Outer Cover Panel	N/S	33858	Roller, Drawer Slide
	33934	HDD2 Side Outer Cover Panel	N/S	88961	Green Ground Nut
	33990	HDD3 Side Outer Cover Panel	N/S	89071	#10 Flat Washer
11	33906	Caster Fixed (Opt)	N/S	89076	1/4 Internal Star Washer
12	88852	Bushing, Bronze	N/S	89163	1/4-20 SS Jam Nut
13	32406	Left Drawer Slide	N/S	88909	8-18 X 1/2 Sheet Metal Screw
14	32411	Right Drawer Slide	N/S	89140	Cable Tie
15	56530	Indicator Light	N/S	88894	1/4-20 X 7/8 Press Stud
16	69145	Thermometer	N/S	89073	8 X 1/2 Screw
17	70502023	Drawer Housing Assembly	N/S	88892	1/4-20 X 1 Flat Head SS
18	70502030	Drawer Face Assembly	N/S	88893	1/4-20 Nylon Insert Locknut
19	89167	Drawer Vent Knob			



HDDS-B PARTS LIST					
ITEM	P/N	DESCRIPTION	ITEM	P/N	DESCRIPTION
1	N/A	Rating Label	17	32456	Drawer Housing Assembly
2	56505	Thermostat Knob	18	33366	Drawer Face Assembly
3	33351	HDDS1B Control Panel	19	89167	Drawer Vent Knob
	33387	HDDS2B Control Panel	20	32483	Drawer Handle Strip
	33331	HDDS3B Control Panel	21	33018	Drawer Pan
4	69120	Thermostat	22	32404	Element Bracket
N/S	60113	Insulation	N/S	32402	Element Bracket Large
N/S	32490	HDDS1B Wire Set	24	54114	120V Heating Element
	32491	HDDS2B Wire Set		54115	208V Heating Element
	33359	HDDS3B Wire Set		54116	240V Heating Element
7	89145	Terminal Block	25	58168	HDDS1B Front Panel Poly
8	32477	HDDS1B Body Assembly		58169	HDDS2B Front Panel Poly
	32474	HDDS2B Body Assembly		58170	HDDS3B Front Panel Poly
	32480	HDDS3B Body Assembly	26	88851	Press Stud
9	33301	Top Cover	27	89026	Cap Nut
10	33302	HDDS1B Side Outer Cover Panel	N/S	33858	Roller, Drawer Slide
	33309	HDDS2B Side Outer Cover Panel	N/S	88961	Green Ground Nut
	33316	HDDS3B Side Outer Cover Panel	N/S	89071	#10 Flat Washer
11	33304	HDDS1B Front Plate	N/S	89076	1/4 Internal Star Washer
	33311	HDDS2B Front Plate	N/S	89163	1/4-20 SS Jam Nut
	33318	HDDS3B Front Plate	N/S	88909	8-18 X 1/2 Sheet Metal Screw
12	88852	Bushing, Bronze	N/S	89140	Cable Tie
13	32443	Left Drawer Slide	N/S	88894	1/4-20 X 7/8 Press Stud
14	32448	Right Drawer Slide	N/S	89073	8 X 1/2 Screw
15	56530	Indicator Light	N/S	88892	1/4-20 X 1 Flat Head SS
16	69145	Thermometer	N/S	88893	1/4-20 Nylon Insert Locknut



HDDS-L or C PARTS LIST					
ITEM	P/N	DESCRIPTION	ITEM	P/N	DESCRIPTION
1	N/A	Rating Label	20	32483	Drawer Handle Strip
2	56505	Thermostat Knob	21	33018	Drawer Pan
3	33351	HDDS1 Control Panel	22	89101	Strain Relief, Bushing .625DD
	33387	HDDS2 Control Panel	23	32402	Element Bracket Large
	33331	HDDS3 Control Panel	24	54114	120V Heating Element
4	69120	Thermostat		54115	208V Heating Element
N/S	60113	Insulation		54116	240V Heating Element
N/S	33357	HDDS1 Wire Set	25	86295	Legs 4" Black (Std)
	33358	HDDS2 Wire Set	26	55970	Cordset 16/3 SJTO
	33359	HDDS3 Wire Set		85645	Cordset 16/3 SJTO
7	33907	Caster Swivel Locking (Opt)	27	32404	Element Bracket
8	32462	HDDS1 Body Assembly	28	58168	HDDS1B Front Panel Poly
	32441	HDDS2 Body Assembly		58169	HDDS2B Front Panel Poly
	32468	HDDS3 Body Assembly		58170	HDDS3B Front Panel Poly
9	33360	Top Cover	29	88851	Press Stud
10	33352	HDDS1 Side Outer Cover Panel	30	89026	Cap Nut
	33392	HDDS2 Side Outer Cover Panel	N/S	33858	Roller, Drawer Slide
	33332	HDDS3 Side Outer Cover Panel	N/S	88961	Green Ground Nut
11	33906	Caster Fixed (Opt)	N/S	89071	#10 Flat Washer
12	88852	Bushing, Bronze	N/S	89076	1/4 Internal Star Washer
13	32443	Left Drawer Slide	N/S	89163	1/4-20 SS Jam Nut
14	32448	Right Drawer Slide	N/S	88909	8-18 X 1/2 Sheet Metal Screw
15	56530	Indicator Light	N/S	89140	Cable Tie
16	69145	Thermometer	N/S	88898	1/4-20 NYLON Press Studnut
17	32456	Drawer Housing Assembly	N/S	89073	8 X 1/2 Screw
18	33366	Drawer Face Assembly	N/S	88892	1/4-20 X 1 Flat Head SS
19	89167	Drawer Vent Knob			



9. APW WYOTT EQUIPMENT LIMITED WARRANTY

APW Wyott Foodservice Equipment Company warrants its equipment against defects in materials and workmanship, subject to the following conditions:

This warranty applies to the original owner only and is not assignable.

Should any product fail to function in its intended manner under normal use within the limits defined in this warranty, at the option of APW Wyott such product will be repaired or replaced by APW Wyott or its Authorized Service Agency. APW Wyott will only be responsible for charges incurred or service performed by its Authorized Service Agencies. The use of other than APW Wyott Authorized Service Agencies will void this warranty and APW Wyott will not be responsible for such work or any charges associated with same. The closest APW Wyott Authorized Service Agent must be used.

This warranty covers products shipped into the 48 contiguous United States, Hawaii, metropolitan areas of Alaska and Canada. There will be no labor coverage for equipment located on any island not connected by roadway to the mainland.

Warranty coverage on products used outside the 48 contiguous United States, Hawaii, and metropolitan areas of Alaska and Canada may vary. Contact the international APW Wyott distributor, dealer, or service agency for details.

Time Period

One year for parts and one year for labor, effective from the date of purchase by the original owner. The Authorized Service Agency may, at their option, require proof of purchase. Parts replaced under this warranty are warranted for the un-expired portion of the original product warranty only.

Exceptions

- *Gas/Electric Cookline: Models GCB, GCRB, GF, GGAI, GGT, CHP-H, EF, EG, EHP. Three (3) Year Warranty on all component parts, except switches and thermostats. (2 additional years on parts only. No labor on second or third year.)
- *Broiler Briquettes, Rock Grates, Cooling Grates, Burner Shields, Fireboxes: 90 Day Material Only. No Labor.
- *Heat Strips: Models FD, FDL, FDD, FDDL. Two (2) Year Warranty on element only. No labor second year.
- *Glass Windows, Doors, Seals, Rubber Seals, Light Bulbs: 90 Day Material Only. No Labor.

In all cases, parts covered by extended warranty will be shipped FOB the factory after the first year.

Portable Carry In Products

Equipment weighing over 70 pounds or permanently installed will be serviced on-site as per the terms of this warranty. Equipment weighing 70 pounds or under, and which is not permanently installed, i.e. with cord and plug, is considered portable and is subject to the following warranty handling limitations. If portable equipment fails to operate in its intended manner on the first day of connection, or use, at APW Wyott's option or its Authorized Service Agency, it will be serviced on site or replaced.

From day two through the conclusion of this warranty period, portable units must be taken to or sent prepaid to the APW Wyott Authorized Service Agency for in-warranty repairs. No mileage or travel charges are allowed on portable units after the first day of use. If the customer wants on-site service, they may receive same by paying the travel and mileage charges. Exceptions to this rule: (1) countertop warmers and cookers, which are covered under the Enhanced Warranty Program, and (2) toasters or rollergrills which have in-store service.

Exclusions

The following conditions are not covered by warranty:

- *Equipment failure relating to improper installation, improper utility connection or supply and problems due to ventilation.
- *Equipment that has not been properly maintained, calibration of controls, adjustments, damage from improper cleaning and water damage to controls.
- *Equipment that has not been used in an appropriate manner, or has been subject to misuse or misapplication, neglect, abuse, accident, alteration, negligence, damage during transit, delivery or installation, fire, flood, riot or act of god.
- *Equipment that has the model number or serial number removed or altered.

If the equipment has been changed, altered, modified or repaired by other than an Authorized Service Agency during or after the warranty period, then the manufacturer shall not be liable for any damages to any person or to any property, which may result from the use of the equipment thereafter.

This warranty does not cover services performed at overtime or premium labor rates. Should service be required at times which normally involve overtime or premium labor rates, the owner shall be charged for the difference between normal service rates and such premium rates. APW Wyott does not assume any liability for extended delays in replacing or repairing any items beyond its control.

In all cases, the use of other than APW Wyott Authorized OEM Replacement Parts will void this warranty.

This equipment is intended for commercial use only. Warranty is void if equipment is installed in other than commercial application.

Water Quality Requirements

Water supply intended for a unit that has in excess of 3.0 grains of hardness per gallon (GPG) must be treated or softened before being used. Water containing over 3.0 GPG will decrease the efficiency and reduce the operation life of the unit.

Note: Product failure caused by liming or sediment buildup is not covered under warranty.

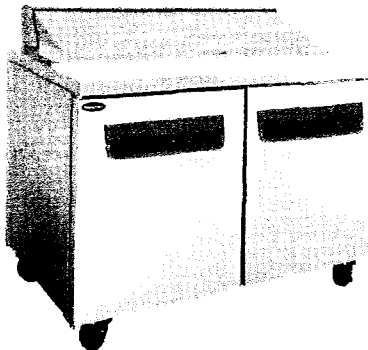
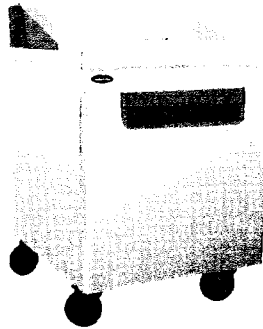
"THE FOREGOING WARRANTY IS IN LIEU OF ANY AND ALL OTHER WARRANTIES EXPRESSED OR IMPLIED INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSES AND CONSTITUTES THE ENTIRE LIABILITY OF APW WYOTT. IN NO EVENT DOES THE LIMITED WARRANTY EXTEND BEYOND THE TERMS STATED HEREIN."

9/05

ITEM 25)



SANDWICH PREP TABLES



SPECIFICATIONS / FEATURES

Construction

- Stainless steel interior and exterior
- Aluminum back and galvanized bottom
- Foamed-in-place with polyurethane insulation
- Insulated pan cover
- 6" casters
- Includes 4" D polycarbonate insert pans. Unit will accommodate 6" D pans.
- 9-1/2" polyethylene cutting board
- Easy to install. No plumbing required.

Doors

- Recessed pocket handle
- Self-closing doors

Shelving

- One epoxy coated shelf per door adjustable in 1/2" increments
- Shelves capable of supporting up to 125 lbs

Refrigeration System

- Self contained forced air refrigeration system
- Condensate is collected and automatically evaporated from an energy efficient hot gas style vaporizer
- Refrigerant flow is controlled by a capillary tube
- R-134a refrigerant
- Temperature range: 32°F to 40°F

Electrical Characteristics

- 115 volt, 60 Hz, 1 phase with cord and NEMA 5-15P plug
- Equipped with 9' cord and plug

Warranty (USA)

- 3 year parts and labor
- 5 year compressor warranty

Approvals

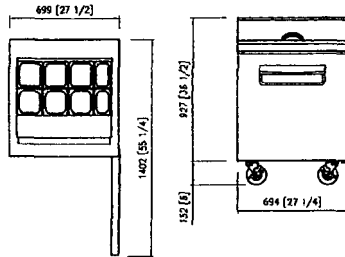
- UL and C-UL
- ETL Sanitation

Specifications subject to change without notice.

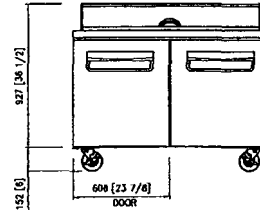
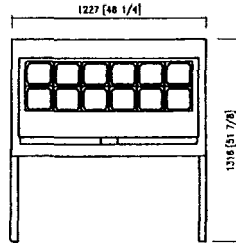


SANDWICH PREP TABLES

APN # 1756949

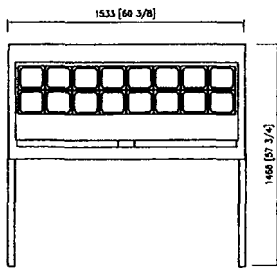


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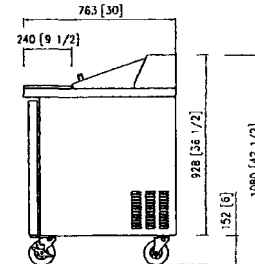
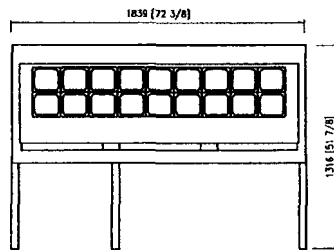


INTERIOR VIEW

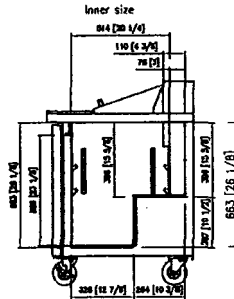
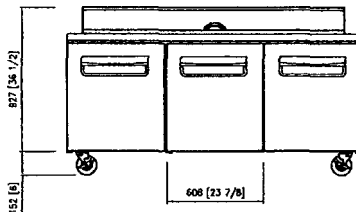
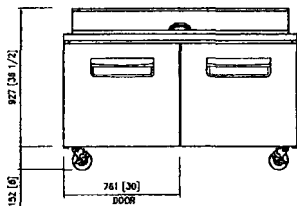
APN # 3565298



APN # 3565306



INTERIOR SIDE VIEW



ROUGH-IN DATA

APN	# of Doors	Cut. Ft	# of Shelves	# of Pans	W x D x H	HP	Electrical	NEMA Plug	Amps	Weight
1756949	1	7	1	(6) 1/6 size (2) 1/9 size	27-1/2" x 30" x 42-1/2"	1/5	115/60/1	5-15P	3.2	212
1756972	2	13	2	(12) 1/6 size	48-1/4" x 30" x 42-1/2"	3/8	115/60/1	5-15P	7.9	304
3565298	2	16	2	(16) 1/6 size	60-3/8" x 30" x 42-1/2"	3/8	115/60/1	5-15P	7.9	344
3565306	3	20	3	(18) 1/6 size	72-3/8" x 30" x 42-1/2"	3/8	115/60/1	5-15P	9.9	384

Specifications subject to change without notice.
 Manufactured exclusively for US Foods Culinary Equipment & Supplies™.
 Rev. Date: 07/01/13

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 01 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. Lump-sum allowances.
- C. Related Sections include the following:
 - 1. Division 01 Section "Contract Modification Procedures" for procedures for submitting and handling Contract Changes for allowances.
 - 2. Division 01 Section "Unit Prices" for procedures for using unit prices.

1.3 WEATHER ALLOWANCE

- A. Included within the completion period for this project are a specified number of "bad weather" days (see Schedule of Allowances).
- B. The Contractor's progress schedule shall clearly indicate the bad weather day allowance as an "activity" or "activities". In the event weather conditions preclude performance of critical work activities for 50% or more of the Contractor's scheduled workday, that day shall be declared unavailable for work due to weather (a "bad weather" day) and charged against the above allowance. Critical work activities will be determined by review of the Contractor's current progress schedule.
- C. The Contractor's Representative and the Construction Representative shall agree monthly on the number of "bad weather" days to be charged against the allowance. This determination will be documented in writing and be signed by the Contractor and the Construction Representatives. If there is a failure to agree on all or part of the "bad weather" days for a particular month, that disagreement shall be noted on this written document and signed by each party's representative. Failure of the Contractor's representative to sign the "bad weather" day documentation after it is presented, with or without the notes of disagreement, shall constitute agreement with the "bad weather" day determination contained in that document.
- D. There will be no modification to the time of contract performance due solely to the failure to deplete the "bad weather" day allowance.
- E. Once this allowance is depleted, a no cost Contract Change time extension will be executed for "bad weather" days, as defined above, encountered during the remainder of the Project.

1.4 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, Designer of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Designer's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Designer from the designated supplier.

1.5 SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Contract Changes.
- B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.6 COORDINATION

- A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.7 ALLOWANCES

- A. N/A

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

- A. N/A

END OF SECTION 012100

SECTION 012200 – UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions and other Division 01 Specification Sections apply to this Section.
- B. Quantities of Units to be included in the Base Bid are indicated in Section 00 43 22 – Unit Prices.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for Unit Prices.
- B. Related Sections include the following:
 - a. Division 01 Section "Allowances" for procedures for using Unit Prices to adjust quantity allowances.
 - b. Division 01 Section "Contract Modification Procedures" for procedures for submitting and handling Contract Changes.

1.3 DEFINITIONS

- A. Unit price is an amount proposed by bidders, stated on the Bid Form Attachment 00 43 22 a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

- A. Unit Prices include all necessary material plus cost for delivery, installation, insurance, overhead, and profit.
- B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of Unit Prices. Methods of measurement and payment for Unit Prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of Work in-place that involves use of established Unit Prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A list of Unit Prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each Unit Price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 LIST OF UNIT PRICES

Unit Price 1 – 24" x 48" x 3/4" Acoustical Ceiling Tile

Description: Remove and replace one 24" x 48" x 3/4" acoustical Ceiling Tile and replace with new 24" x 48" x 3/4" Celotex Cashmere Designer Series acoustical tile CDS-224 (Refer to Specifications -Type I).

Unit of Measurement: One acoustical tile.

END OF SECTION 012200

SECTION 012300 – ALTERNATES

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 governing Alternates.

1.3 DEFINITIONS

- A. Definition: An alternate is an amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to the Base Bid amount if the Owner decides to accept a corresponding change in either the amount of construction to be completed, or in the products, materials, equipment, systems, or installation methods described in the Contract Documents..

- 1. The cost for each alternate is the net addition to the Contract Sum to incorporate the Alternate into the Work. No other adjustments are made to the Contract Sum.

- B. No additional time will be allowed for alternate work unless the number of work days is so stated on the bid form.

1.4 PROCEDURES

- A. Coordination: Modify or adjust affected adjacent Work as necessary to completely and fully integrate the Alternate Work into the Project.

- 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not mentioned as part of the Alternate.

- B. Notification: The award of the Contract will indicate whether alternates have been accepted or rejected.

- C. Execute accepted alternates under the same conditions as other Work of this Contract.

- D. Schedule: A “Schedule of Alternates” is included at the end of this Section. Specification Sections referenced in the Schedule contain requirements for materials necessary to achieve the Work described under each alternate.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate No. 1: In accordance with the requirements of the drawings and specifications, Remove two existing boilers (Boiler #1 and Boiler #2). Provide and install 2 new boilers (Boiler #1 and Boiler #2) in their place. Boilers shall be provided with a boiler controller in accordance with the boiler specifications capable of controlling multiple boilers. This work shall include all revisions to heating water piping, electrical, gas piping, etc. and connection to the DDC Building Automation System.

END OF SECTION 012300

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 01 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 01, Section 01 21 00 "Allowances" for procedural requirements for handling and processing Allowances.
 - 2. Division 01, Section 01 22 00 "Unit Prices" for administrative requirements for using Unit Prices.
 - 3. Division 00, Section 00 72 13, Article 3.1 "Acceptable Substitutions" for administrative procedures for handling Requests for Substitutions made after Contract award.
 - 4. Division 00, Section 00 72 13, 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 Contractor submits a RFI on a time sensitive activity on the current project schedule, the Contractor shall not be entitled to any time extension due to the time it takes the Designer to respond to the request provided that the Designer responds within the ten (10) working days set forth above.
- C. Responses from the Designer will not change any requirement of the Contract Documents. In the event the Contractor believes that a response to a RFI will cause a change to the requirements of the Contract Document, the Contractor shall give written notice to the Designer requesting a 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 oa.mo.gov/fmdc/dc/aeforms.htm or oa.mo.gov/fmdc/dc/contractorforms.htm:
1. Request for Information
 2. Designer's Supplemental Instructions
 3. Request for Proposal
 4. Contract Change Detailed Breakdown – General Contractor (GC)
 5. Contract Change Detailed Breakdown – Subcontractor (SUB)
 6. Contract Change

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 01 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 01 32 00, Section "Schedules – Bar Chart" for preparing and submitting Contractor's Construction Schedule.
 - 2. Articles 1.8.B and 1.8.C of Section 00 72 13 "General Conditions" for coordinating meetings onsite.
 - 3. Article 5.4.H of Section 00 72 13 "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 00 72 13 "General Conditions".
 - 1. Minutes: Designer will record and distribute to Contractor the meeting minutes.

- C. Preinstallation Conferences: Contractor shall conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
 - 1. Attendees: Installer and representatives of Manufacturers and Fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Designer and Construction Representative of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration including requirements for the following:
 - a. The Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Contract Changes.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility problems.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written recommendations.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other Work.
 - w. Required performance results.
 - x. Protection of adjacent Work.
 - y. Protection of construction and personnel.
 - 3. Contractor shall record significant conference discussions, agreements, and disagreements including required corrective measures and actions.

4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
6. Revise paragraph below if Project requires holding progress meetings at different intervals. Insert special intervals such as "every third Tuesday" to suit special circumstances.
7. Project name.
8. Name and address of Contractor.
9. Name and address of Designer.
10. RFI number including RFIs that were dropped and not submitted.
11. RFI description.
12. Date the RFI was submitted.
13. Date Designer's response was received.
14. Identification of related DSI, or Proposal Request, as appropriate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 – SCHEDULES – 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 01 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 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 completion of excavation, concrete foundation work, underground lines, superstructure, rough-ins, enclosure, hanging of fixtures, etc.) which shall serve as check points to determine compliance with the approved Schedule. The Schedule shall also include an activity for the number of "bad" weather days specified in Section 01 21 00 – Allowances.
 - 1. The Contractor shall provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week.
 - a. If practical, use the same Schedule of Values breakdown for schedule time bars.
 - 2. The Contractor shall provide a base activity time bar showing duration for each construction activity. Each bar is to indicate start and completion dates for the activity. The Contractor is to place a contrasting bar below each original schedule activity time for indicating actual progress and planned remaining duration for the activity.

3. The Contractor shall prepare the Schedule on a minimal number of separate sheets to readily show the data for the entire construction period.
 4. Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on schedule with other construction activities. Include minor elements involved in the overall sequence of the Work. Show each activity in proper sequence. Indicate graphically the sequences necessary for completion of related portions of the Work.
 5. Coordinate the Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittal Schedule, progress reports, payment requests, and other required schedules and reports.
 6. Indicate the Intent to Award and the Contract Substantial Completion dates on the schedule.
- B. Phasing: Provide notations on the schedule to show how the sequence of the Work is affected by the following:
1. Requirement for phased completion.
 2. Work by separate contractors.
 3. Work by the Owner.
 4. Pre-purchased materials
 5. Coordination with existing construction.
 6. Limitations of continued occupancies.
 7. Un-interruptible services.
 8. Partial occupancy prior to Substantial Completion.
 9. Site restrictions.
 10. Provisions for future construction.
 11. Seasonal variations.
 12. Environmental control.
- C. Work Stages: Use crosshatched bars to indicate important stages of construction for each major portion of the Work. Such stages include, but are not necessarily limited to, the following:
1. Subcontract awards.
 2. Submittals.
 3. Purchases.
 4. Mockups.
 5. Fabrication.
 6. Sample testing.
 7. Deliveries.
 8. Installation.
 9. Testing.
 10. Adjusting.
 11. Curing.
 12. Startup and placement into final use and operation.

- D. **Area Separations:** Provide a separate time bar to identify each major area of construction for each major portion of the Work. For the purposes of this Article, a “major area” is a story of construction, a separate building, or a similar significant construction element.
1. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural Completion.
 - b. Permanent space enclosure.
 - c. Completion of mechanical installation.
 - d. Completion of the electrical portion of the Work.
 - e. Substantial Completion.

3.3 SCHEDULE OF SUBMITTALS

- A. Upon acceptance of the Construction Progress Schedule, prepare and submit a complete schedule of submittals. Coordinate the submittal schedule with Section 01 33 00 SUBMITTALS, the approved Construction Progress Schedule, list of subcontracts, Schedule of Values and the list of products.
- B. Prepare the schedule in chronological order. Provide the following information
1. Scheduled date for the first submittal.
 2. Related Section number.
 3. Submittal category.
 4. Name of the subcontractor.
 5. Description of the part of the Work covered.
 6. Scheduled date for resubmittal.
 7. Scheduled date for the Designer’s final release or approval.
- C. **Distribution:** Following the Designer’s response to the initial submittal schedule, print and distribute copies to the Designer, Owner, subcontractors, and other parties required to comply with submittal dates indicated.
1. Post copies in the Project meeting room and temporary field office.
 2. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned part of the Work and are no longer involved in construction activities.
- D. **Schedule Updating:** Revise the schedule after each meeting or other activity where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each meeting.

3.4 SCHEDULE OF INSPECTIONS AND TESTS

- A. Prepare a schedule of inspections, tests, and similar services required by the Contract Documents. Submit the schedule with 15 days of the date established for commencement of the Contract Work. The Contractor is to notify the testing agency at least 5 working days in advance of the required tests unless otherwise specified.
- B. **Form:** This schedule shall be in tabular form and shall include, but not be limited to, the following:

1. Specification Section number.
 2. Description of the test.
 3. Identification of applicable standards
 4. Identification of test methods.
 5. Number of tests required.
 6. Time schedule or time span for tests.
 7. Entity responsible for performing tests.
 8. Requirements for taking samples.
 9. Unique characteristics of each service.
- C. Distribution: Distribute the schedule to the Owner, Architect, and each party involved in performance of portions of the Work where inspections and tests are required.

END OF SECTION 013200

SECTION 013300 – SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

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. Notification, 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. Include 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 8-1/2 by 11 inches but no larger than 24 by 36 inches.

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. Include 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. Include 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 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 on-site 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 two sets of prints, black and white, glossy; 8 X 10 inch size; mounted on 8-1/2 X 11 inch soft card stock, with left edge binding margin for three hole punch.
 - 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 week prior to submitting.
 - 4. The Contractor shall take four site photographs from differing directions and a minimum of five 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 and 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.

SECTION	DESCRIPTION	Shop Drawings	Product Data	Sample	Certifications	Manufacturer's Instructions	Test report	Inspection Report	Wiring Diagrams	Record Photographs	Maintenance Data	Operating Instruction	Warranty
079000	Joint Sealers	X	X	X									
092500	Gypsum Drywall and Metal Studs	X	X										
095000	Acoustical Ceilings	X	X	X									X
099100	Painting	X	X	X									
114000	Food Service Equipment	X	X	X	X	X			X		X	X	X
211313	Backflow Preventer		X		X	X	X				X	X	X
211313	Piping and Fittings	X	X				X				X		
211313	Valves		X		X						X	X	X
211313	As-Built Drawings	X							X				
211316	Nitrogen Inerting System	X	X			X	X	X	X		X	X	X
211316	Piping and Fittings	X	X				X				X		
211316	Valves		X		X						X	X	X
211316	As-Built Drawings	X							X				
213000	Fire Pump Rebuild				X	X	X	X			X	X	X
213000	Fire Pump Controller	X	X		X	X	X	X			X	X	X
220519	Plumbing Meters and Gauges		X		X	X					X		X
220523	Plumbing Valves		X		X	X					X		X
220529	Hangers and Supports	X	X		X	X					X		
220553	Plumbing Identification		X										
220700	Plumbing Insulation		X								X		
221113	Domestic Water Pumps	X	X		X	X	X				X	X	X
221116	Plumbing Piping Products		X		X						X		
221119	Mixing Valves	X	X		X	X	X				X	X	X
221119	Strainers		X		X	X					X		
223400	Water Heaters		X		X	X	X				X	X	X

230519	HVAC Meters and Gauges		X		X	X					X		X
230523	HVAC Valves		X		X	X					X		X
230529	Hangers and Supports	X	X		X	X					X		
230553	HVAC Identification		X										
230593	Test and Balance				X		X	X					
230700	HVAC Insulation		X								X		
230923	Direct Digital Controls for HVAC Systems	X	X		X	X			X		X	X	X
230950	Variable Frequency Drives		X		X	X	X		X		X	X	X
231123	Natural Gas Piping		X		X						X		
231123	Natural Gas Valves		X		X	X					X		X
232113	HVAC Hydronic Piping		X		X						X		
232113	Chemical Water Treatment		X				X				X	X	X
233113	Ductwork and Fittings		X		X						X		
233423	Fans (Ventilators)	X	X		X	X	X		X		X	X	X
233813	Kitchen Hoods	X	X		X	X	X		X		X	X	X
235216	Boilers	X	X		X	X	X	X	X		X	X	X
235700	Heat Exchangers	X	X		X	X	X	X			X	X	X
236416	Chillers	X	X		X	X	X	X	X		X	X	X
237313	Packaged Pool HVAC Unit	X	X		X	X	X	X	X		X	X	X
260519	Conductors and Cables		X		X	X							
260526	Conductors and Connectors		X		X	X							
260529	Hangers and Supports	X	X		X	X					X		
260533	Conduits, Boxes, Raceways		X		X	X							
260553	Electrical Identification		X										
262726	Wiring Devices		X		X	X			X		X	X	X
262813	Fuses		X		X	X							
262816	Switches and Breakers		X		X	X			X		X	X	X
262913	Enclosed Controllers		X		X	X			X		X	X	X
265119	LED Light Fixtures		X			X					X	X	X

END OF SECTION 013300

SECTION 013513 – SITE SECURITY AND HEALTH REQUIREMENTS (GENERIC)

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 01 Specification Sections apply to this Section.

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. Normal working hours for this facility are 8:00AM to 5:00PM. 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 who is in charge onsite and who can be contacted in case of an emergency. This individual 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 HEALTH AND TRAFFIC CONTROLS

- A. 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.
- B. Keep project neat, orderly, and in a safe condition at all times. Immediately remove all hazardous waste. Do not allow rubbish to accumulate. Provide on-site containers for collection of rubbish and dispose of it at frequent intervals during progress of work.
- C. No burning will be permitted on the grounds.
- D. Conduct operations and removal of debris to ensure minimum interference with roads, streets, walks, and other adjacent facilities.
- E. Do not obstruct streets or walks or use facilities without permission from the Facility Representative.
- F. No driver shall exceed the facility speed limit. The facility speed limit is 15 MPH unless indicated otherwise.

END OF SECTION 013513

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

1.3 SUBMITTALS

- A. Temporary Utilities: Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.

- B. Implementation and Termination Schedule: Within (15) days of the date established for commencement of the Work, submit a schedule indicating implementation and termination of each temporary utility.

1.4 QUALITY ASSURANCE

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

1.5 PROJECT CONDITIONS

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

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 job-built temporary construction, provide UL-labeled, fire-treated lumber and plywood for framing, sheathing, and siding.
 - 2. For signs and directory boards, provide exterior-type, Grade B-B high-density concrete form overlay plywood of sized and thicknesses indicated.
 - 3. For fences and vision barriers, provide minimum 3/9" (9.5 mm) thick exterior plywood.

4. For safety barriers, sidewalk bridges, and similar uses, provide minimum 5/8" (16 mm) thick exterior plywood.
- C. Gypsum Wallboard: Provide gypsum wallboard on interior walls of temporary offices.
- D. Roofing Materials: Provide UL Class A standard-weight asphalt shingles or UL Class C mineral-surfaced roll roofing on roofs of job-built temporary office, shops, and shed.
- E. Paint: Comply with requirements of Division 09 Section "Painting".
 1. For job-built temporary offices, shops, sheds, fences, and other exposed lumber and plywood, provide exterior-grade acrylic-latex emulsion over exterior primer.
 2. For sign panels and applying graphics, provide exterior-grade alkyd gloss enamel over exterior primer.
 3. For interior walls of temporary offices, provide (2) quarts interior latex-flat wall paint.
- F. 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.
- G. Water: Provide potable water approved by local health authorities.
- H. Open-Mesh Fencing: Provide 0.120" (3 mm) thick, galvanized 2" (50 mm) chainlink fabric fencing 6' (2 m) high with galvanized barbed-wire top strand and galvanized steel pipe posts, 1½" (38 mm) I.D. for line posts and 2½" (64 mm) I.D. 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" (19 mm), heavy-duty, abrasion-resistant, flexible rubber hoses 100' (30 m) 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 120 Volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button, and pilot light for connection of power tools and equipment.
- D. Electrical Power Cords: Provide grounded extension cords. Use hard-service cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage rating.
- E. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered-glass enclosures where exposed to breakage. Provide exterior fixture where exposed to moisture.
- F. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM, or another recognized trade association related to the type of fuel being consumed.

- G. Temporary Offices: Provide prefabricated or mobile units or similar job-built construction 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. General: Engage the appropriate local utility company to install temporary service or connect to existing service. Where company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with company recommendations.
 - 1. Arrange with company and existing users for a time when service can be interrupted, if necessary, to make connections for temporary services.
 - 2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked-in services.
 - 3. Obtain easements to bring temporary utilities to the site where the Owner's easements cannot be used for that purpose.
 - 4. Use Charges: Cost or use charges for temporary facilities are not chargeable to the Owner or Designer. Neither the Owner nor Designer will accept cost or use charges as a basis of claims for Contract Change.
- B. Temporary Water Service: The Owner will provide water for construction purposes from the existing building system. All required temporary extensions shall be provided and removed by the Contractor. Connection points and methods of connection shall be designated and approved by the Construction Representative.
- C. Temporary Electric Power Service: The Owner will provide electric power for construction lighting and power tools. Contractors using such services shall pay all costs of temporary services, circuits, outlet, extensions, etc.
- D. Temporary Lighting: Provide temporary lighting as required.

1. Install and operate temporary lighting that will fulfill security and protection requirements without operating the entire system. Provide temporary lighting that will provide adequate illumination for construction operations and traffic conditions.
- E. **Temporary Heating and Cooling:** The normal heating and/or cooling system of the building shall be maintained in operation during the construction. Should the Contractor find it necessary to interrupt the normal HVAC service to spaces, which have not been vacated for construction, such interruptions shall be pre-scheduled with the Construction Representative.
- F. **Temporary Telephones:** Provide temporary telephone service throughout the construction period for all personnel engaged in construction activities.
- G. **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.
- H. **Wash Facilities:** Install wash facilities supplied with potable water at convenient locations for personnel involved in handling materials that require wash-up for a health and sanitary condition. Dispose of drainage properly. Supply cleaning compounds appropriate for each condition.
 1. Provide paper towels or similar disposable materials for each facility.
 2. Provide covered waste containers for used material.
 3. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.
- I. **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.
- J. **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.
- K. 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:** Install storage sheds sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility service. Sheds may be open shelters or fully enclosed spaces within the building or elsewhere onsite.
- 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 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. **Project Identification and Temporary Signs:** Prepare project identification and other signs of size indicated. Install signs where indicated to inform the public and persons seeking entrance to the Project. Support on posts or framing of preservative-treated wood or steel. Do not permit installation of unauthorized signs.
 - 1. **Project Identification Signs:** Engage an experienced sign painter to apply graphics. Comply with details indicated.
 - 2. **Temporary Signs:** Prepare signs to provide directional information to construction personnel and visitors.
- H. **Collection and Disposal of Waste:** Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than (7) days during normal weather or (3) days when the temperature is expected to rise above 80°F (27°C). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material lawfully.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Except for use of permanent fire protection as soon as available, do not change over from use of temporary security and protection facilities to permanent facilities until Substantial Completion, or longer, as requested by the Designer.
- B. **Temporary Fire Protection:** Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of the types needed to protect against reasonable predictable and controllable fire losses. Comply with NFPA 10 "Standard for Portable Fire Extinguishers" and NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations".
 - 1. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than (1) extinguisher on each floor at or near each usable stairwell.

2. Store combustible materials in containers in fire-safe locations.
 3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for fighting fires. Prohibit smoking in hazardous fire-exposure areas.
 4. Provide supervision of welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
- C. 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.
- D. Enclosure Fence: Not Required.
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.
- E. 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. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where the area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil in the area. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns.

Repair or replace street paving, curbs, and sidewalks at the temporary entrances as required by the governing authority.

3. 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 017329 – CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PROJECT SCOPE

- A. This specification applies to the fire suppression system modifications at the Mt. Vernon Veterans Home in Mount Vernon, Missouri. Refer to specification section 00 10 00 for a complete description of the project scope of work.
- B. The cutting and patching shall be provided as required for access to existing system piping and installation of the new system. This is expected:
 - 1. Near the eave of the ceiling in the respective riser room(s).
 - 2. Where demolition/replacement damages existing ceilings.
 - 3. Near the ceiling and wall are the locations of the axillary drain locations.
 - 4. Where access panels are to be installed as indicated on the drawings.

1.3 QUALITY ASSURANCE

- A. Use skilled labor, thoroughly trained and experienced in the necessary crafts, who are completely familiar with the specified requirements and the methods needed for proper performance of the work in this Section.

1.4 COORDINATION

- A. Coordinate location and timing of cutting and patching work with owner.
- B. Do not disturb existing walls or ceilings without approval from the owner.

1.5 SUBMITTALS

- A. Provide written notice to owner and engineer at least one week before removal of existing wall or ceilings so that the engineer may observe the system with wall or ceiling materials removed.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Patch and repair products and materials shall match the existing and/or adjacent materials and finishes.
- B. Where cutting and patching occurs in a fire or smoke rated assembly the contractor shall submit UL assembly to owner and engineer at least 2 weeks prior for approval.
- C. Repairs shall include a rated assembly equal to or greater than the list assembly that has been damaged or penetrated. See Life Safety drawings for current wall and ceiling assembly ratings.

PART 3 - EXECUTION

3.1 GENERAL

- A. All patch and repair shall be made to match the existing and/or adjacent materials and finishes.
- B. All patch and repair work will be inspected and approved by the owner. Any re-work required by the owner because the patch/repair does not satisfactorily match the adjacent materials and finishes shall be performed at no additional cost.

END OF SECTION 017329

SECTION 017400 – CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 PROGRESS CLEANING

- A. General
 - 1. Retain all stored items in an orderly arrangement allowing maximum access, not impeding drainage or traffic, and providing the required protection of materials.
 - 2. Do not allow the accumulation of scrap, debris, waste material, and other items not required for construction of this Work.
 - 3. At least twice each month, and more often if necessary, completely remove all scrap, debris, and waste material from the job site.
 - 4. Provide adequate storage for all items awaiting removal from the job site, 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 on the site. 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 079000 - JOINT SEALERS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of each form and type of joint sealer is indicated on drawings and by provisions of this section.
- B. The applications for joint sealers as work of this section include the following:
1. Firestopping sealants.
 2. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Tile control and expansion joints.
 - d. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
 - e. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 3. Interior joints in the following horizontal traffic surfaces:
 - a. Control expansion joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
- C. Symbols from ASTM C 920:
1. Type S - Pre-packaged single component.
 2. Type M - Furnished in two or more parts for mixing on jobsite.
 3. Grade P - Has sufficient flow to fill horizontal surface joints and remain level at 40 degrees F.
 4. Grade NS - Can be applied to vertical surface joints without sagging at 40 degrees to 122 degrees F.
 5. Class 50 - Tested capability to remain adhered without failure under repeated expansion and contraction of +100% - 50% of joint width.
 - a. T - Locations subject to pedestrian and vehicular traffic.
 - b. NT - Designed for non-traffic exposures.
 - c. M - Use with mortar.
 - d. G - Use with glass.
 - e. A - Use with aluminum.
 - f. O - Use with various building materials per manufacturer's instructions. Verify product performance history.

1.2 SUBMITTALS

A. **Product Data:** Submit manufacturer's technical data for each joint sealer product and primer required, including instructions for joint preparation and for each application. Submit manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

1.3 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to project site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time and mixing instructions for multicomponent materials. All joint sealers will be inspected by the job superintendent for conformance to specification and submittals.

B. Store and handle materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other cause.

1.4 PROJECT CONDITIONS

A. **Environmental Conditions:** Do not proceed with installation of joint sealers under the following conditions:

1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealer manufacturers.

B. **Joint Width Conditions:** Do not proceed with installation of joint sealers when joint widths are less than allowed by joint sealer manufacturer for application indicated.

C. **Joint-Substrate Conditions:** Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. **Compatibility:** Provide joint sealers, joint fillers, joint primers and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer on testing and field experience.

B. **Colors:** Provide color of exposed joint sealers indicated or, if not otherwise indicated, as selected by Architect from manufacturer's standard colors.

2.2 ELASTOMERIC JOINT SEALANTS

A. **Elastomeric Sealant Standard:** Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated which complies with ASTM C 920 requirements, including those for Type, Grade, Class, and Uses.

B. One-Part Mildew-Resistant Silicone Sealant (INTERIOR APPLICATION ONLY): Type S; Grade NS, Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide for sealing interior joints with nonporous substrates around ceramic tile, showers, sinks and plumbing fixtures, uses NT, M, G, A, and, as applicable to joint substrates indicated, O, subject to compliance with project requirements provide one of the following:

1. "786 Mildew Resistant"; Dow Corning Corp.
2. "Sill Proof"; General Electric Corp.
3. "Proglaze White"; Tremco, Inc.
4. "Spectrum 2"; Tremco, Inc.

C. Multi-Part Nonsag Urethane Sealant: Type M, Grade NS, Class 25 for uses NT, M, A, and as applicable to joint substrates indicate, O. Subject to compliance with project requirements provide one of the following:

1. NP2, Sonneborn Building Products Div., Rexnord Chem. Prod., Inc.
2. "Vulkem 922"; Mameco International, Inc.
3. "Dymeric"; Tremco, Inc.

D. Two-Part Nonsag Urethane Sealant for Use T: Type M; Grade NS; Class 25; Uses T, M, A, and, as applicable to joint substrates indicated, O. Subject to compliance with project requirements provide sealant equal to the following:

1. "THC 901"; Tremco, Inc.
2. "Dynatred"; Pecora Corp.
3. "Vulkem 227"; Mameco International, Inc.

E. One-Part Nonsag Urethane Sealant: Type S; Grade NS; Class 50; Uses NT, M, A, and, as applicable to joint substrates indicated, O. Subject to compliance with project requirements provide one of the following:

1. "Sikaflex 15 cm" – Sika Corp.
2. "Dymonic 100" – Tremco, Inc.
3. "Masterseal NP 150" - BASF

F. One Part Self-Leveling Urethane Sealants: Type S; Grade P; Class 25; Uses T, NT, M, G, A, and as applicable to joint substrates indicated, O. Subject to compliance with project requirements, provide one of the following:

1. "Vulkem 45"; Mameco International, Inc.
2. "SLI"; Sonneborn Building Products Div., Rexnord Chem. Prod., Inc.
3. "THC-900", Tremco, Inc.

2.3 LATEX JOINT SEALANTS

A. Acrylic-Emulsion Sealant: Manufacturer's standard, one part nonsag, acrylic, mildew-resistant, acrylic-emulsion sealant complying with ASTM C 834, formulated to be paintable and recommended for exposed applications on interior involving joint movement of not more than +7.5%. Subject to compliance with project requirements, provide one of the following:

1. "Ac-20"; Pecora Corp.
2. "Sonolac"; Sonneborn Building Products Div.; Rexnord Chemical Prod., Inc.
3. "Tremflex 834"; Tremco, Inc.

2.4 FIRE-RESISTANT JOINT SEALERS

- A. General: Provide manufacturer's standard sealant and accessory materials with fire-resistance rating indicated which are identical to those of assemblies whose fire endurance has been determined by testing per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Foamed-in-Place Fire-Stopping Sealant: Two-part, foamed-in-place, silicone sealant formulated for use as part of a through-penetration fire-stop system for filling openings around cables, conduit, pipes and similar penetrations through walls and floors.
- C. One-Part Fire-Stopping Sealant: One-part elastomeric sealant formulated for use as part of a through-penetration fire-stop system for sealing openings around cables, conduit, pipes and similar penetrations through walls and floors.
- D. Products: Subject to compliance with requirements, provide one of the following:
1. Foamed-In-Place Fire-Stopping Sealant:
 - a. "Dow Corning Fire Stop Foam"; Dow Corning Corp.
 - b. "Pensil 851"; General Electric Co.
 - c. "CP620"; Hilti, Inc.
 2. One-Part Fire-Stopping Sealant:
 - a. "Dow Corning Fire Stop Sealant"; Dow Corning Corp.
 - b. "3M Fire Barrier Caulk CP-25"; Electric Products Div./3M
 - c. "CP 601S"; Hilti, Inc.

2.5 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material and type which are non-staining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Plastic Foam Joint-Fillers: Preformed compressible, resilient, non-waxing, non-extruding strips of plastic foam of material indicated below, and of size, shape and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
1. Non-gassing, closed-cell polyethylene foam, unless otherwise indicated, subject to approval of sealant manufacturer.
- C. Elastomeric Tubing Joint-Fillers: Neoprene, butyl or EPDM or silicone tubing complying with ASTM D 1056, non-absorbent to water and gas, capable of remaining resilient at temperatures down to -26 degrees F (-15 degrees C). Provide products with low compression set and of size and

shape to provide a secondary seal, to control sealant depth and otherwise contribute to optimum sealant performance.

D. **Bond-Breaker Tape:** Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing bond between sealant and joint filler or other materials at back (3rd) surface of joint. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

A. **Surface Cleaning of Joints:** Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above the cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:

3. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. **Joint Priming:** Prime joint substrates where recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

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

D. **Accessory materials for Fire-Stopping Sealants:** Provide forming, joint-fillers, packing and other accessory materials required for installation of fire-stopping sealants as applicable to installation conditions indicated.

PART 3 - EXECUTION

3.1 INSPECTION

A. Require Installer to inspect joints indicated to receive joint sealers for compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealer performance. Obtain Installer's written report listing any conditions detrimental to performance of joint sealer work. Do not allow joint sealer work to proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. **Surface Cleaning of Joints:** Clean out joints immediately before installing joint sealers to comply with recommendations of joint sealer manufacturer and the following requirements:
- B. **Joint Priming:** Prime joint substrates where indicated or where recommended by joint sealer manufacturer based on preconstruction joint sealer-substrate tests or prior experience. Apply primer to comply with joint sealer manufacturer's recommendations. Confine primers to areas of joint sealer bond, do not allow spillage or migration onto adjoining surfaces.
- C. **Masking Tape:** Use masking tape where required to prevent contact of sealant with adjoining surfaces which otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALERS

- A. **General:** Comply with joint sealer manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- B. **Elastomeric Sealant Installation Standard:** Comply with recommendations of ASTM C 962 for use of joint sealants as applicable to materials, applications and conditions indicated.
- C. **Latex Sealant Installation Standard:** Comply with requirements of ASTM C 790 for use of latex sealants.
- D. **Installation of Sealant Backings:** Install sealant backings to comply with the following requirements:
 - 1. Install joint-fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths which allow optimum sealant movement capability.
 - a. Do not leave gaps between ends of joint-fillers.
 - b. Do not stretch, twist, puncture or tear joint-fillers.
 - c. Remove absorbent joint-fillers which have become wet prior to sealant application and replace with dry material.
 - 2. Install bond breaker tape between sealants and joint-fillers, compression seals or back of joints where required to prevent third-side adhesion of sealant to back of joint.
 - 3. Install compressible seals serving as sealant backings to comply with requirements indicated above for joint-fillers.
- E. **Installation of Sealants:** Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint

configuration and providing uniform, cross-sectional shapes and depths relative to joint widths which allow optimum sealant movement capability.

F. **Installation of Preformed Foam Sealants:** Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, and complying with sealant manufacturer's directions for installation methods, materials and tools which produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in conformance with sealant manufacturer's recommendations.

G. **Installation of Fire-Stopping Sealant:** Install sealant, including forming, packing and other accessory materials to fill openings around mechanical and electric services penetrating floors and walls to provide fire-stops with fire resistance ratings indicated for floor or wall assembly in which penetration occurs.

3.4 PROTECTION AND CLEANING

A. Protect joint sealers during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of substantial completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealers immediately and reseal joints with new materials to produce joint sealer installations with repaired areas indistinguishable from original work.

B. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealers and of products in which joints occur.

END OF SECTION 079000

SECTION 092500 - GYPSUM DRYWALL AND METAL STUDS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. Types of work include:
 - 1. Gypsum drywall including screw-type support system.
 - 2. Gypsum drywall directly applied to solid (continuous) substrates.
 - 3. Gypsum backing boards for application of other finishes.
 - 4. Drywall finishing (joint tape-and-compound treatment).

1.2 QUALITY ASSURANCE:

- A. Gypsum Board Standard: GA-216 by Gypsum Association.
- B. Metal Support Standard: ASTM C 754.
- C. Fire-Resistance Rating: Where gypsum drywall system with fire resistance ratings are indicated or are required to comply with governing regulations, provide materials and installations identical with applicable assemblies which have been tested and listed by recognized authorities, including UL and AIA.
- D. Allowable Tolerances: 1/8" offsets between planes of board faces, and 1/4" in 8'-0" for plumb, level, warp, and bow.

1.3 PRODUCT HANDLING:

- A. Deliver, identify, store and protect gypsum drywall materials to comply with referenced standards.

PART 2 - PRODUCTS

2.1 CEILING SUPPORT MATERIALS AND SYSTEMS:

- A. General: Size ceiling support components to comply with ASTM C 754 unless indicated otherwise.
- B. Main Runners: Steel channels with rust inhibitive paint finish, hot or cold-rolled.
- C. Hanger Wire: ASTM A 641, soft, Class I galvanized.
- D. Hanger Rods and Flats: Mild steel with zinc or equally rust inhibitive coating for rods and zinc or rust-inhibitive paint finish for flats.
- E. Hanger Anchorage Devices: Screws, clips, bolts, cast-in-place concrete inserts or other devices applicable to the indicated method of structural anchorage for ceiling hangers and whose suitability for use intended has been proven through standard construction practices or by certified test data. Size devices for 3 x calculated load supported except size direct pull-out concrete inserts for 5 x calculated loads.

2.2 WALL/PARTITION SUPPORT MATERIALS:

- A. Studs: ASTM C 645
 - 1. Gage:

- a. 20 gage at interior walls unless otherwise indicated.
 - b. 18 gage at all exterior walls, fascias and soffits unless otherwise indicated.
2. Depth of Section: 3-5/8", except as otherwise indicated.
 3. Runners: Match studs; type recommended by stud manufacturer for floor and ceiling support of studs, and for vertical abutment of drywall work at other work.
 4. Stud Systems Accessories: Provide stud manufacturer's standard clips, shoes, ties, reinforcements, fasteners and other accessories as needed for a complete stud system.
 5. Furring Members: ASTM C 645; 25 gage, hat-shaped.
 6. Fasteners for Furring Members: Type and size recommended by furring manufacturer for the substrate and application indicated.

2.3 GYPSUM BOARD PRODUCTS:

- A. Exposed Gypsum Board: (Also known as gypsum wallboard.) Regular type with tapered long edges.
- B. Thicknesses: As indicated and, where not otherwise indicated, comply with thickness requirements of GA-216 for each application and support spacing. Comply with requirements for indicated fire-resistance ratings indicated.

2.4 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. American Gypsum
 2. CertainTeed Corporation
 3. Georgia-Pacific Gypsum, LLC
 4. National Gypsum Company
 5. USG Corporation
- B. Gypsum Wallboard: ASTM C 1396/C 1396M.
 1. Thickness: 1/2" or 5/8"; except where otherwise indicated. See drawings for thickness.
 2. Long Edges: Tapered.
- C. Gypsum Board, Type X: ASTM C 1396/C 1396M.
 1. Thickness: 5/8"
 2. Long Edges: Tapered.
- D. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
 1. Thickness: 1/2" or 5/8" except where otherwise indicated. See drawings for thickness.
 2. Long Edges: Tapered.

2.5 TRIM ACCESSORIES:

- A. General: Provide manufacturer's standard trim accessories of types indicated for drywall work, formed of galvanized steel unless otherwise indicated, with either knurled and perforated or expanded flanges for

nailing or stapling, and beaded for concealment of flanges in joint compound. Provide corner beads, L-type edge trim beads, U-type edge trim beads, special L-kerf-type trim-beads, and one-piece control joint beads.

B. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc
2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - f. Expansion (control) joint.

2.6 JOINT TREATMENT MATERIALS:

- A. General: ASTM C 475; type recommended by the manufacturer for the application indicated, except as otherwise indicated.
- B. Joint Tape: Perforated type.
- C. Joint Compound: On interior work provided chemical-hardening-type for bedding and filling, ready-mixed vinyl-type or vinyl-type powder type for topping.

2.7 MISCELLANEOUS MATERIALS:

- A. General: Provide auxiliary materials for gypsum drywall work of the type and grade recommended by the manufacturer of the gypsum board.
- B. Laminating Adhesive: Special adhesive or joint compound specifically recommended for laminating gypsum boards.
- C. Fastening Adhesive (for Wood): ASTM C 557.
- D. Gypsum Board Fasteners: Comply with GA-216.
- E. Concealed Acoustical Sealant: Nondrying, nonhardening, nonskinning, nonstaining, nonbleeding, gunnable sealant complying with requirements specified in Division 7 - Section "Joint Sealers."

PART 3 - EXECUTION

3.1 INSTALLATION OF METAL SUPPORT SYSTEMS:

- A. Do not bridge building expansion joints with support system, frame both sides of joints with furring and other support as indicated.
- B. Nail or screw furring members to wood framing as indicated.
- C. Ceiling Support Suspension Systems:
 1. Secure hangers to structural support by connecting directly to structure when possible, otherwise connect to inserts, clips or other anchorage devices or fasteners as indicated.
 2. Space furring members 16" o.c., except as otherwise indicated.

3. Install auxiliary framing at termination of drywall work, and at openings for light fixtures and similar work, as required for support of both the drywall construction and other work indicated for support thereon.

D. Wall/Partition Support Systems:

1. Install supplementary framing, blocking and bracing to support fixtures, equipment, services, heavy trim, furnishings and similar work which cannot be adequately supported on gypsum board alone.
2. Extend partition stud system through acoustical ceilings and elsewhere as indicated to the structural support of substrate above the ceiling.
3. Space studs 16" o.c., except as otherwise indicated.

3.2 GENERAL GYPSUM BOARD INSTALLATION REQUIREMENTS:

- A. Install wall/partition boards vertically to avoid end-butt joints wherever possible. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs.
- B. Install exposed gypsum board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1/16" open space between boards. Do not force into place.
- C. Locate either edge or end joints over supports, except in horizontal applications or where intermediate supports or gypsum board back-blocking is provided behind end joints. Position boards so that both tapered edge joints abut, and mill-cut or field-cut end joints abut. Do not place tapered edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions.
- D. Attach gypsum board to framing and blocking as required for additional support at openings and cutouts.
- E. Form control joints and expansion joints with space between edges of boards, prepare to receive trim accessories.
- F. Isolate perimeter of non-load-bearing drywall partitions at structural abutments. Provide 1/4" to 1/2" space and trim edge with J-type semi-finishing edge trim. Seal joints with acoustical sealant. Do not fasten drywall directly to stud system runner tracks.
- G. Space fasteners in gypsum boards in accordance with referenced standards and manufacturer's recommendations, except as otherwise indicated.
- H. Gypsum Board Finishing: Per "recommended levels of gypsum board finish" GA-214-70, achieve "Level 5" on all interior exposed to view surfaces.

3.3 METHODS OF GYPSUM DRYWALL APPLICATION:

- A. Single-Layer Application: Install exposed gypsum board.
 1. On partitions/walls apply gypsum board vertically (parallel), unless otherwise indicated, and provide sheet lengths which will minimize end joints.
- B. Single-Layer Fastening Methods: Apply gypsum boards to supports as follows:
 1. Fasten with screws.

3.4 INSTALLATION OF DRYWALL ACCESSORIES:

- A. General: Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to the supports. Otherwise, fasten flanges by nailing or stapling in accordance with manufacturer's instructions and recommendations.
- B. Install metal corner beads at external corners of drywall work.
- C. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed, and except where plastic trim is indicated. Provide type with face flange to receive joint compound except where semi-finishing type is indicated. Install L-type trim where work is tightly abutted to other work, and install special kerf-type where other work is kerfed to receive long leg of L-type trim. Install U-type trim where edge is exposed, revealed, gasketed, or sealant-filled (including expansion joints).
- D. Install metal control joint (beaded-type) at any expanse of 20'-0" length of continuous gypsum board installation horizontally.

3.5 INSTALLATION OF DRYWALL FINISHING:

- A. General: Apply treatment at gypsum board joints (both directions), flanges of trim accessories, penetrations, fasteners heads, surface defects and elsewhere as required to prepare work for decoration. Prefill open joints and rounded or beveled edges, using type of compound recommended by manufacturer.
 - 1. Apply joint tape at joints between gypsum boards, except where a trim accessory is indicated.
 - 2. Apply compound in 3 coats (not including prefill of openings in base), and sand between last 2 coats and after last coat.
- B. Partial Finishing: Omit third coat (if specified) and sanding on concealed drywall work which is indicated for drywall finishing or which requires finishing to achieve fire resistance rating, sound rating or to act as air or smoke barrier.
- C. Refer to sections on painting, coatings and wall-coverings in Division 9 for decorative finishes to be applied to drywall work.

3.6 PROTECTION OF WORK:

- A. Installer shall advise Contractor of required procedures for protecting gypsum drywall work from damage and deterioration during remainder of construction period.

END OF SECTION 092500

SECTION 095000 - Acoustical Ceilings

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.2 SUMMARY

A. Section Includes

1. Acoustical ceiling panels
2. Exposed grid suspension system
3. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings
4. Perimeter Trim

1.3 SYSTEM DESCRIPTION

- A. Lay-In Acoustical Ceiling and Grid
- B. Discontinuous/Open Plenum System

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.

B. Samples: Minimum 6 inch x 6 inch samples of specified acoustical panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees.

C. Shop Drawings: Layout and details of acoustical ceilings show locations of items that are to be coordinated with, or supported by the ceilings.

D. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material must carry an approved independent laboratory classification of NRC, CAC, and AC.

E. If the material supplied by the acoustical subcontractor does not have an Underwriter's Laboratory classification of acoustical performance on every carton, subcontractor shall be required to send material from every production run appearing on the job to an independent or NVLAP approved laboratory for testing, at the architect's or owner's discretion. All products not conforming to manufacturer's current published values must be removed, disposed of and replaced with complying product at the expense of the Contractor performing the work.

1.5 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.

1. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.

2. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 Classification.

3. Fire Resistance: As follows tested per ASTM E119 and listed in the appropriate floor or roof design in the Underwriters Laboratories Fire Resistance Directory

B. Acoustical Panels: As with other architectural features located at the ceiling, may obstruct or skew the planned fire sprinkler water distribution pattern through possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device. Designers and installers are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems are present.

C. Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.7 WARRANTY

A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:

1. Acoustical Panels: Sagging and warping
2. Grid System: Rusting and manufacturer's defects

B. Warranty Period:

1. Acoustical panels: Ten (10) years from date of substantial completion.
2. Grid: Ten (10) years from date of substantial completion.

C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.8 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.

1. Acoustical Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount installed.

2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 CEILING UNITS

A. Acoustical Panels:

B. General: Provide manufacturer's standard lay-in panels of type recommended by manufacturer for application indicated. Provide sizes shown by reflected ceiling plans.

C. Acoustical Panels - Type I: Panels to be lay-in type 24" x 48" x 3/4" mineral fiber, with edges of panel cut back for recessing support. Material shall be Celotex, Cashmere Designer Series, CDS-224.

D. Acoustical Panels - Type II: Panels to be lay-in type 24" x 48" x 1" mineral fiber, with edges of panel cut back for recessing support. Material shall be equal to Armstrong, Ultima High NRC, 9/16" Beveled Tegular, 1945 or approved equal. Use Armstrong 9/16" superfine grid system or equal.

2.2 CEILING SUSPENSION MATERIALS

A. General: Comply with ASTM C 635, as applicable to type of suspension system required for type of ceiling units indicated.

B. Coordinate with other work supported by or penetrating through ceilings, including light fixtures, HVAC equipment, and partition system (if any).

C. Structural Class: Intermediate-duty system.

D. High-Humidity Finishes: Where suspension system supports exterior ceiling or soffit, and also where interior space is indicated as "High-Humidity" area of project, comply with ASTM C 635 requirements for "Severe Environment Performance" for "High-Humidity Test."

E. Attachment Devices: Size for 5 times design load indicated in ASTM C 635, Table I, Direct Hung.

1. Hanger Wires: Galvanized carbon steel, ASTM A 641, soft temper, prestretched, yield-stress load of at least 3 times design load, but not less than 12 gage (0.106").

F. Type of System: Either direct-hung or indirect-hung suspension system, at Contractor's option.

G. Edge Moldings: Manufacturer's standard channel molding for edges and penetrations of ceiling, with single flange of molding exposed, white baked enamel finish unless otherwise indicated.

H. Exposed Suspension System: Manufacturer's standard exposed runners, cross-runners and accessories, of types and profiles indicated, with exposed runners coped to lay flush with main runners.

1. Finish of Exposed Members: Provide uniform factory-applied finish on exposed surfaces of ceiling suspension system, including moldings, trim and accessories.

- A. Finish: Manufacturer's standard baked enamel finish, white unless otherwise selected by Architect.

2.3 MISCELLANEOUS MATERIALS

- A. Edge Trim Molding: Metal or extruded PVC plastic, of types and profiles indicated, white finish unless otherwise indicated.
- B. Hold-Down Clips: Where required for wind uplift resistance or fire-resistance rating, provide standard spring steel clips, except provide accessible type at locations indicated on drawings.

2.4 MANUFACTURERS

A. Ceiling Panels:

1. Armstrong World Industries, Inc.
2. Chicago Metallic
3. Certainteed

B. Suspension Systems:

1. Chicago Metallic Corp.
2. Donn Corp.
3. Armstrong World Industries, Inc.

C: Perimeter Systems

1. Armstrong World Industries, Inc.
2. Chicago Metallic
3. Certainteed

2.5 ACOUSTICAL CEILING UNITS

A. Acoustical Panels Type AP

1. Surface Texture: undefined
2. Composition: Metal
3. Color: White
4. Size: Per Plans
5. Edge Profile: Vector
6. Sabin: N/A
7. Articulation Class (AC):
8. Flame Spread: ASTM E 1264; Class A

2.6 ALUMINUM CUSTOM TRIM - EXTRUDED

Product/Manufacturer: Axiom Trim Channel: 6in Axiom Vector Straight Armstrong World Industries, Incorporated or approved equal.

A. Commercial quality extruded aluminum alloy 6063 trim channel, factory finished in baked polyester paint. Commercial quality galvanized steel unfinished T-bar connection clips; galvanized steel splice plates.

1. Color: White
2. Size: Per Plans
3. Recycle Content: Post-Consumer - 50% Pre-Consumer - 0%

4. Acceptable Product: 6in Axiom Vector Straight, AX6VESTR as manufactured by Armstrong
World Industries or approved equal

B. Axiom Trim Channel: 6in Axiom Vector Straight

C. Axiom Outside Corner Posts (Straight Only): 6in Axiom Vector Quick Ship Outside Corner

D. Axiom Inside Corners (Straight Only)

E. Axiom Accessories: AXVE6WE - 6in Axiom Vector Welded End Cap

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not proceed with installation until all wet work such as plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

3.3 INSTALLATION

A. Follow manufacturer installation instructions.

B. Install suspension system and panels in accordance with the manufacturer's instructions, and in compliance with ASTM C 636 and with the authorities having jurisdiction.

C. Suspend main beam from overhead construction with hanger wires spaced 4'-0" on center along the length of the main runner. Install hanger wires plumb and straight.

D. Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps.

E. For reveal edge panels: Cut and reveal or rabbet edges of ceiling panels at border areas and vertical surfaces.

F. Install acoustical panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings.

3.4 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.

B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove any ceiling products that cannot be successfully cleaned and or repaired. Replace with attic stock or new product to eliminate evidence of damage.

3.5 EXTRA STOCK

A. Deliver stock of maintenance materials to Owner. Furnish maintenance materials from same manufactured lot as materials installed and enclosed in protective packaging with appropriate identifying labels:

1. Two (2) full boxes of Type II tiles shall be furnished.

END OF SECTION 095000

SECTION 099100 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following substrates:
 - 1. Steel.
 - 2. Galvanized metal.
 - 3. Gypsum board.

1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
 - 5. Submit wood stain sample on actual sample of wood substrate.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI (Master Painters Institute) Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
3. VOC content.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.
 2. Stains and Transparent Finishes: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints in snow, rain, fog or mist or when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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:

Benjamin Moore & Co.
Cloverdale Paint.
Color Wheel Paints & Coatings.
Columbia Paint & Coatings.
Coronado Paint.

Euclid Chemical Company.
General Paint.
Hallman Lindsay Paints.
ICI Paints.
Kelly-Moore Paints.
McCormick Paints.
PPG Architectural Finishes, Inc.
Pratt & Lambert.
Scott Paint.
Sherwin-Williams Company (The).
Southern Diversified Products, LLC.
Smith Paint Products.
Vista Paint.

- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in other Part 2 articles for the paint category indicated.

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

- B. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and Green Seal Standard GS-11.

Flat Paints and Coatings: 50 g/L.
Nonflat Paints and Coatings: 150 g/L.
Dry-Fog Coatings: 400 g/L.
Primers, Sealers, and Undercoaters: 200 g/L.
Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
Zinc-Rich Industrial Maintenance Primers: 340 g/L.
Pretreatment Wash Primers: 420 g/L.
Floor Coatings: 100 g/L.
Shellacs, Clear: 730 g/L.
Shellacs, Pigmented: 550 g/L.

- D. Low-Emitting Materials: Interior paints and coatings 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."

- E. Colors: As indicated in a color schedule.

2.3 PRIMERS/SEALERS

Primer Sealer, Latex, Interior: MPI #50
Primer, Latex for Exterior Wood: MPI #6.
Primer, Alkali Resistant, Water Based: MPI #3.
Primer Sealer, Interior, Institutional Low Odor/VOC: MPI #149.
Primer, Latex, for Interior Wood: MPI #39.
Primer Sealer, Alkyd, Interior: MPI #45.
Primer, Alkyd for Exterior Wood: MPI #5.
Primer, Bonding, Water Based: MPI #17.
Primer, Bonding, Solvent Based: MPI #69.
Primer, Oil for Exterior Wood: MPI #7.
Preservative for Exterior Wood: MPI #37.
Alkyd, Sanding Sealer, Clear: MPI #102.
Shellac: MPI #88.

2.4 METAL PRIMERS

Primer, Rust-Inhibitive, Water Based: MPI #107.
Primer, Alkyd, Anti-Corrosive, for Metal: MPI #79.
Primer, Galvanized, Water Based: MPI #134.

2.5 WATER-BASED PAINTS

Latex, Interior, Flat, (Gloss Level 3): MPI #52.
Latex, Interior, Flat, (Gloss Level 1): MPI #53.
Latex, Exterior Flat, (Gloss Level 1): MPI #10.
Latex, Exterior Semi-Gloss, (Gloss Level 5): MPI #11.
Latex, Exterior, Gloss, (Gloss Level 6): MPI #119.
Latex, Interior, Semi-Gloss, (Gloss Level 5): MPI #54.
Latex, Interior, Gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees):
MPI #114.
Latex, Interior, Institutional Low Odor/VOC, Flat (Gloss Level 1): MPI #143.
Latex, Interior, Institutional Low Odor/VOC, (Gloss Level 2): MPI #144.
Latex, Interior, Institutional Low Odor/VOC, Semi-Gloss (Gloss Level 5): MPI #147.
Latex, Interior, High Performance Architectural, (Gloss Level 2): MPI #138.
Latex, Interior, High Performance Architectural, Semi-Gloss (Gloss Level 5): MPI #141.

2.6 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner may engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove non-complying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.
4. Owner may direct Contractor to stop applying wood finishes if test results show materials being used do not comply with product requirements. Contractor shall remove non-complying materials from Project site, pay for testing, and re-finish surfaces finished with rejected materials.

Contractor will be required to remove rejected materials from previously finished surfaces before re-finishing with complying materials if the two finishes are incompatible or produce results that, in the opinion of the Architect, are aesthetically unacceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

- G. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - 2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 PAINTING SCHEDULE

A. Interior Paint Systems (IPS):

1. IPS-11

- 1st Coat: Primer Sealer, Latex, Interior, MPI #50.
- 2nd Coat: Latex, Interior (Gloss Level 3), MPI #52.
- 3rd Coat: Latex, Interior (Gloss Level 3), MPI #52.

2. IPS-20

- 1st Coat: Primer, Rust-Inhibitive, Water Based, MPI #107.
- 2nd Coat: Latex, Interior (Gloss Level 5), MPI #147.
- 3rd Coat: Latex, Interior (Gloss Level 3), MPI #147.

3. IPS-27

- 1st Coat: Stain, Semi-Transparent, for Interior Wood, MPI #90.
- 2nd Coat: Varnish, Interior, Polyurethane, Oil-Modified (Gloss Level 6), MPI #56.
- 3rd Coat: Varnish, Interior, Polyurethane, Oil-Modified (Gloss Level 6), MPI #56.
- 4th Coat: Varnish, Interior, Polyurethane, Oil-Modified (Gloss Level 6), MPI #56.

END OF SECTION 099100

SECTION 114000 - FOOD SERVICE EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. The extent of food service equipment (FdSvEqp) is indicated on the drawings and by provisions of this section, including schedule and equipment lists associated with either drawings or this section.
- B. The types of equipment/facilities required for project include the following:
 - 1. Food distribution equipment.

1.2 QUALITY ASSURANCE:

- A. NSF Standards: Comply with applicable NSF standards and recommended criteria. Provide each principal item of food service equipment with a "Seal of Approval" by NSF.
- B. UL Labels: Where available, provide UL labels on items of food service equipment with prime electrical components. Provide UL "recognized marking" on other items with electrical components, signifying listing by UL, where available.
- C. ANSI Standards: Comply with applicable ANSI standards for gas-burning appliances, for piping to compressed gas cylinders, and for vacuum breakers and air gaps to prevent siphonage in water piping (ANSI Z21-series, B57.1, A40.6 and A40.4).
- D. NFPA Codes: Comply with "National Electrical Code" and with NFPA No. 96 for exhaust system equipment.
- E. ASME Boiler Code: For steam generating and steam heated equipment comply with ASME requirements and provide inspections, stamps and registration of equipment with National Board.
- F. National Electrical Code: Comply with NFPA Volume 5 for electrical wiring and devices included with food service equipment.
- G. Fabricator/Installer: Where indicated units of equipment require shop-field custom fabrication, provide units fabricated and installed by shops which are skilled and which have a minimum of 5 years of experience in similar work.

1.3 SUBMITTALS:

- A. Product Data: Submit manufacturer's product specifications and installation instructions for each item; include rough-in dimensions, service connections, performances, power/fuel requirements water/drainage requirements and similar information.
- B. Shop Drawings: Submit plans, elevations, sections and details of custom-fabricated units and of assembled units made up of manufactured equipment. Show required services by size and location on separate "Roughing-in Requirements Drawings" submitted in plan at 1/4" scale and accurately dimensioned for all services.
- C. Maintenance Manuals: Submit bound manual for maintenance of operative food service equipment items. For each item, include operating and cleaning/maintenance instruction, parts listing, recommended parts inventory listing, purchase source listing, copy of warranties, and similar applicable information.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Metals:

1. **Stainless Steel:** AISI Type 302/304, hardest workable temper, No. 4 directional polish.
2. **Galvanized Steel Sheet:** ASTM A 526, except ASTM A 527 for extensive forming; ASTM A 525, G90 zinc coating, chemical treatment.
 - a. Where unpainted exposure in food service equipment is indicated, provide special sheet with extra smooth surface, produced by temper rolling of minimum-spangle galvanized sheet.
3. **Steel Sheet:** ASTM A 569 hot-rolled carbon steel.
4. **Galvanized Steel Pipe:** ASTM A 53 or ASTM A 120, welded or seamless, schedule 40, galvanized.
5. **Steel Structural Members:** Hot rolled or cold formed, carbon steel unless stainless steel is indicated.
 - a. **Galvanized Finish:** ASTM A 123 hot-dipped zinc coating, applied after fabrication.
6. **Aluminum:** ASTM B209/B221 sheet, plate and extrusion (as indicated); alloy, temper and finish as determined by manufacturer/fabricator, except 0.40-mill natural anodized finish on exposed work unless another finish is indicated.

B. Plastic Laminate: Color-Through high pressure laminate

1. Panels shall comply with the following:

- a. **Sheet Thickness:** 0.028 inches (0.711 mm) typical; thickness up to 1 inch (25 mm) available.
- b. **Sheet Width:** As selected from manufacturer's standard widths of 30 inches (762 mm), 36 inches (914 mm), 48 inches (1219 mm), or 60 inches (1524 mm). No seams allowed.
- c. **Sheet Length:** As selected from manufacturer's standard lengths of 96 inches (2438 mm), 120 inches (3048 mm) or 144 inches (3658 mm).
- e. **Adhesive:** Clear drying adhesive such as white glue (PVA), clear epoxy or equivalent as recommended by manufacturer.
- f. **Colors and Patterns:** As selected by Architect from manufacturer's offering.
- g. **Approved Manufacturers:** Panolam Industries International, Inc., by Nevamar, Pionite or Formica

C. Insulation:

1. **Cooled-Component Insulation:** Rigid, closed-cell polyurethane foam, either heat-aged slab stock for adhesive lamination with face sheets, or foamed-in-place using Freon II as expanding agent; k-value or 0.15; not less than 1.15; not less than 1.7 lbs. per cu. ft. density.
2. **Heated-Component Insulation:** Rigid board, semi-rigid blanket or adhesively applied blanket of glass fiber or other mineral fiber insulation, certified by manufacturer to withstand long-term exposure to heat

(Temperature rating of each insulated equipment item) without deterioration; k-value of not more than 0.30 density of not less than 1.5 lbs. per cu. ft.

D. Joint Materials:

1. Sealants: One-part or 2-part, polyurethane or silicone based, liquid elastomeric sealant, FS TT-S-00277 or FS-TT-S-00230, non-solvent-release type, mildew-resistant, Shore A hardness of 30 except 45 if subject to traffic or similar abuse.
2. Backer Rod: Polyethylene rod stock, larger than joint width.
3. Gaskets: Solid or hollow (but not cellular) neoprene or polyvinyl chloride; light grey, minimum of 40 Shore A hardness, self-adhesive or prepared for either adhesive application or mechanical anchorage.

E. Paint and Coatings:

1. General: Provide types of painting and coating materials which, after drying, setting or curing, are suitable for use in conjunction with food service, and which are durable, non-toxic, non-dusting, non-flaking, mildew resistant and comply with governing regulations and NSF recommendations for food service.
2. Special Coating: Where indicated in equipment listing as "Special Coating," provide powdered epoxy or epoxy-polyester type thermo-setting coating of 2.0 mils thickness.
3. Sound Deadening: Heavy-bodied resinous coating, filled with granulated cork or other resilient material, compounded for permanent, non-flaking adhesion to metal in a 2/8" thick coating.

2.2 FABRICATED PRODUCTS:

A. Hardware:

1. General: Manufacturer's standard, but not less than compliance with ANSI A156.9 (BHMA Std. 201) Type 2 (Institutional), satin finish stainless steel or dull chrome finish on brass, bronze, or steel.
2. Cabinet Catches: Heavy-duty magnetic type, except as otherwise indicated.
3. Drawer Sliders: Ball-bearing type, side-mounting, self-closing.
4. Sliding Door Hardware: Overhead track with tandem nylon steel hangers for door leaves over 5 sq. ft. area; rollerless sanitary slides for smaller doors (comply with NSF standards).

B. Casters:

1. General: Type and size indicated or, if not indicated, as recommended by caster manufacturer for type and weight of equipment supported; but not less than 4" diameter with 15/16" tread width, with sealed self-lubricating ball bearings, cadmium plated steel disc wheels and solid light-grey synthetic rubber tires. Provide stainless steel horns and accessories. Unless otherwise indicated, equip each item with 2 swivel-type casters and 2 fixed casters, and provide foot brakes on 2 casters.

C. Plumbing Fittings, Trim and Accessories:

2. General: Where exposed or semi-exposed, provide bright chrome-plated brass or polished stainless steel units. Provide copper or brass where not exposed.

3. **Water Outlets:** At sinks and at other locations where water is supplied (by manual, automatic or remote control), provide commercial quality faucets, valves, dispensers or fill devices, of type and size indicated and as required to operate as indicated. Include manual cut-off valves and connecting stem pipes to permit outlet servicing without shut-down of water supply piping systems.
 - a. **Vacuum Breakers:** Provide with food service equipment where required by governing regulations, including locations where water outlets are equipped for hose attachment.
4. **Waste Fittings:** Except as otherwise indicated, provide 2" remote lever waste valve, and 3/5" strainer basket, and include connected overflow on sinks. Integrate unit for direct connection with waste grinder where indicated.

D. Electrical Materials:

1. **General:** Provide standard materials, devices and components as recommended by manufacturer/fabricator, selected and installed in accordance with NEMA standards and recommendations, and as required for safe and efficient use and operation of food service equipment, without objectionable noise, vibration and sanitation problems.
2. **Controls and Signals:** Provide recognized commercial grade signals, "on-off" push buttons or switches, and other speed and temperature controls as required for operation of each item, complete with pilot lights and permanent signs and graphics to assist user or each item. Provide stainless steel cover plates at controls and signals.
3. **Connections:** Equip each item requiring electrical power with either a terminal box for permanent connection or cord-and-plug for interruptible connection, as indicated. Provide standard light grey grounded-type plug-and-cord units, matching outlets specified in Division 16.
4. **Motors:** Totally enclosed type, except drip-proof type where not exposed to dust or moisture condition; ball bearings, except sleeve bearings on small timing motors; windings impregnated to resist moisture; horse-power and duty-cycle ratings as required for the service indicated.
5. **Power Characteristics:** Refer to Division 26 Specifications for project power characteristics. Also, refer to individual equipment requirements for loads and ratings.

E. Nameplates:

1. Where possible, locate nameplates and labels on manufactured items in accessible position, but not within customer's normal view. do not apply nameplates or labels on custom-fabricated work, except as required for compliance with governing regulations insurance requirements or operator performance.

2.3 FABRICATION OF METAL WORK:

- A. **Work-Surface Fabrication:** Fabricate metal work-surfaces by forming and welding to provide seamless construction, using welding rods matching sheet metal, grinding and polishing. Where necessary for disassembly, provide waterproof gasketed draw-type joints with concealed bolting.
 1. Reinforce work-surfaces 30" O.C. both ways with galvanized or stainless concealed structural members. Reinforce edges which are not self-reinforcing by forming.

3.0 SERVING EQUIPMENT

A. Modular Counters:

1. Description: As called out on the plans.
 - a. Cabinet Face Panels: Stainless steel and through-color laminate faces.
 - b. Accessories:
 - 1) Tray slide – stainless steel solid.
 - 2) Work shelf – stainless steel solid.
 - 3) Casters.
 - 4) Electrical receptacle.
 - 5) Cam-action latch locks with trigger release to mate with adjoining modular counters.
 - 6) Tempered-glass, food-protector shield.
 - c. Electrical Service: Equip unit for connection to service indicated on Drawings.
 - d. Color: As selected by Architect from manufacturer's full range.
- B. Approved Manufacturer's
 1. Duke Manufacturing
 2. LTI/Color Point
 3. Mod-U-Serv

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION

- A. Rough-In Work: Installer of food service equipment must examine roughed-in mechanical and electrical services, and installation of floors, walls, columns and ceilings, and conditions under which the work is to be installed; and must verify dimensions of services and substrates before fabricating the work. Notify Contractor in writing of unsatisfactory locations and dimensions of other work, and of unsatisfactory conditions for proper installation of food service equipment. Do not proceed with fabrication and installation until unsatisfactory dimensions and conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION:

- A. Service Lines and Equipment Connections: All water, gas drainage and electrical connections will be performed by the Electrical and Mechanical Contractors.
- B. Set each item of nonmobile and nonportable equipment securely in place, leveled and adjusted to correct height. Anchor to supporting substrate where indicated and where required for sustained operation and use without shifting or dislocation. Conceal anchorages when possible. Adjust counter tops and other work surfaces to a level tolerance of 1/16" maximum offset, and maximum variation from level or indicated slope of 1/16" per ft.
- C. Complete field assembly joints in the work (joints which cannot be completed in shop) by welding, bolting-and-gasketing, or similar methods as indicated. Grind welds smooth and restore finish. Set or trim baskets flush, except for "T" gaskets as indicated.
- D. Treat enclosed spaces (inaccessible after equipment installation) by covering horizontal surfaces with powdered borax at a rate of 4 oz. per sq. ft.
- E. Install closure plates and stripes where required, with joints coordinated with units of equipment.
- F. Install sealants and gaskets all around each unit to make joints air-tight, weatherproof, vermin-proof and sanitary for cleaning purposes. In general, make sealed joints not less than 1/8" wide, and stuff with backer rod to shape sealant bead properly, at 1/4" depth. Shape exposed surfaces of sealant slightly concave, with

edges flush with faces of materials at joint. At internal-corner joints, apply sealant or gaskets to form a sanitary cove, of not less than 3/8" radius. Provide sealant-filled or gasketed joints up to 3/4" joint width; metal closure strips for wider joints, with sealant application each side of strips. Anchor gaskets mechanically or with adhesives to prevent displacement.

3.3 CLEANING, RESTORING FINISHES:

- A. After completion of installation, and completion of other major work in food service areas, remove protective coverings, if any, and clean food service equipment, internally and externally. Restore exposed and semi-exposed finishes to remove abrasions and other damages; polish exposed-metal surfaces and touch-up painted surfaces. Replace work which cannot be successfully restored.

3.4 TESTING, START-UP AND INSTRUCTIONS:

- A. General: Delay start-up of food service equipment until service lines have been tested, balanced, and adjusted for pressure, voltage and similar considerations; and until water and steam lines have been cleaned and treated for sanitation.
- B. Test each item of operational equipment to demonstrate that it is operating properly, and that controls and safety devices are functioning. Repair or replace equipment which is found to be defective in its operation, including units which are below capacity or operating with excessive noise or vibration.
- C. Instruct Owner's operation personnel in proper operation and maintenance procedures for each item of operational food service equipment.
- D. Final Cleaning: After testing and start-up, and before the time of substantial completion, clean and sanitize food service equipment, and leave in condition ready for use in food service.

3.5 ITEMIZED EQUIPMENT SPECIFICATION:

- A. All of the following items shall be built in strict compliance with all general specifications or manufacturer's specifications as applicable to item number unless otherwise stated.
- B. Complete listing of new equipment is shown on the drawings and following per Item (also refer to Summary of Work Section 011000 for additional equipment provided by Owner, installed or re-installed by Contractor):

ITEM 1 DESSERT COUNTER

Quantity: One (1)
Manufacturer: Duke Manufacturing
Model: XP60FT
SIS No.:

Expressions Frost Top Unit, custom enclosed cabinet, welded uni-body modular counter, 14ga 300 series stainless steel frame & supports, 18ga 300 series stainless steel body and under-shelf, per plan and manufacturer's standard construction.

Manufacturer provides:

Built-in frosted display, raised stainless refrigerated top, 4 section 50.25"L and 17"W, perimeter stainless trough, 1" brass drain, self-contained compressor/condenser, drain routed to condensate evaporator, R134A, 7.6 amps, 115 volts 60 cycle 1 phase

14ga stainless steel countertop, polished & hemmed edges, 34" high, 33" wide, 62" long, extended over filler

Decor panels, Formica plastic laminate (or equal) on exterior grade wood backer panel, 2" stainless steel edge trim, mounted on front & one end

12" tray slide, 14ga stainless steel, polished & hemmed edges, raised rubbing tracks, mounted on stainless steel brackets, and located on front
Décor lights, LED light strip mounted under tray slide and wired to on/off switch inside counter
Compressor compartment, stainless steel, slide-out system for service, and stainless steel hinged grille
Electric wire chase in base, stainless steel full length raceway & removable cover, receptacles & circuit breakers, and access openings to wire to electric load center
6" legs, 1-5/8" dia. stainless steel tube, and stainless steel adjustable feet
Kickplates, stainless steel, adjustable height & removable, recessed, and mounted on all sides
Model #TS530-60-1SN Designer Food Shield, self-service flip-up clear guard one side, clear end enclosures, stainless steel shelf & end stanchions, and LED lights mounted under shelf and wired to switch in counter, 120v/60/1ph
FSEC to coordinate color selection with Owner/Architect

ITEM 3 BEVERAGE COUNTER

Quantity: One (1)
Manufacturer: Duke Manufacturing
Model: XP88ST
SIS No.:

Expressions Solid Top Unit, custom enclosed cabinet, welded uni-body modular counter, 14ga 300 series stainless steel frame & supports, 18ga 300 series stainless steel body and under-shelf, per plan and manufacturer's standard construction.

Manufacturer provides:

14ga stainless steel countertop, polished & hemmed edges, 34" high, 33" wide, 100" long, extended over filler
Decor Panels, Formica plastic laminate (or equal) on exterior grade wood backer panel, 2" stainless steel edge trim, and mounted on front
12" tray slide, 14ga stainless steel, polished & hemmed edges, raised rubbing tracks, mounted on stainless steel brackets, and located on front
Décor lights, LED light strip mounted under tray slide and wired to on/off switch inside counter
Countertop utility cutouts and plastic grommets
Electric wire chase in base, stainless steel full length raceway & removable cover, receptacles & circuit breakers, and access openings to wire to electric load center
6" legs, 1-5/8" dia. stainless steel tube, and stainless steel adjustable feet
Kickplates, stainless steel, adjustable height & removable, recessed, and mounted on all sides
FSEC to coordinate color selection with Owner/Architect

ITEM 4 SERVING COUNTER

Quantity: One (1)
Manufacturer: Duke Manufacturing
Model: XP32ST
SIS No.:

Expressions Solid Top Unit, custom enclosed cabinet, welded uni-body modular counter, 14ga 300 series stainless steel frame & supports, 18ga 300 series stainless steel body and under-shelf, per plan and manufacturer's standard construction.

Manufacturer provides:

14ga stainless steel countertop, polished & hemmed edges, 34" high, 33" wide, 32" long
Decor Panels, Formica plastic laminate (or equal) on exterior grade wood backer panel, 2" stainless steel edge trim, and mounted on front
12" tray slide, 14ga stainless steel, polished & hemmed edges, raised rubbing tracks, mounted on stainless steel brackets, and located on front
Décor lights, LED light strip mounted under tray slide and wired to on/off switch inside counter

Electric wire chase in base, stainless steel full length raceway & removable cover, receptacles & circuit breakers, and access openings to wire to electric load center

6" legs, 1-5/8" dia. stainless steel tube, and stainless steel adjustable feet

Kickplates, stainless steel, adjustable height & removable, recessed, and mounted on all sides

FSEC to coordinate color selection with Owner/Architect

ITEM 5 SKELETON UNIT

Quantity: One (1)
Manufacturer: Duke Manufacturing
Model: XP380
SIS No.:

Expressions Skeleton Unit, custom enclosed skeleton cabinet, welded uni-body modular counter, 14ga 300 series stainless steel frame & supports, 18ga 300 series stainless steel body and under-shelf, per plan and manufacturer's standard construction.

Manufacturer provides:

14ga stainless steel countertop, polished & hemmed edges, 34" high, 31" wide, 18" SPACE

Decor Panels, Formica plastic laminate (or equal) on exterior grade wood backer panel, 2" stainless steel edge trim, and mounted on front

12" tray slide, 14ga stainless steel, polished & hemmed edges, raised rubbing tracks, mounted on stainless steel brackets, located on front and mitered corner to adjacent counter

6" legs, 1-5/8" dia. stainless steel tube, and stainless steel adjustable feet

Kickplates, stainless steel, adjustable height & removable, recessed, and mounted on all sides

FSEC to coordinate color selection with Owner/Architect

ITEM 6 SERVING COUNTER

Quantity: One (1)
Manufacturer: Duke Manufacturing
Model: XP46ST
SIS No.:

Expressions Solid Top Unit, custom enclosed cabinet, welded uni-body modular counter, 14ga 300 series stainless steel frame & supports, 18ga 300 series stainless steel body and under-shelf, per plan and manufacturer's standard construction.

Manufacturer provides:

14ga stainless steel countertop, polished & hemmed edges, 34" high, 31" wide, 34" long

Decor Panels, Formica plastic laminate (or equal) on exterior grade wood backer panel, 2" stainless steel edge trim, and mounted on front

12" tray slide, 14ga stainless steel, polished & hemmed edges, raised rubbing tracks, mounted on stainless steel brackets, located on front and mitered corner to adjacent counter

Décor lights, LED light strip mounted under tray slide and wired to on/off switch inside counter

6" legs, 1-5/8" dia. stainless steel tube, and stainless steel adjustable feet

Kickplates, stainless steel, adjustable height & removable, recessed, and mounted on all sides

FSEC to coordinate color selection with Owner/Architect

ITEM 9 HOT FOOD COUNTER

Quantity: One (1)
Manufacturer: Duke Manufacturing
Model: XP74HF
SIS No.:

Expressions Hot Food Unit, custom enclosed cabinet, welded uni-body modular counter, 14ga 300 series stainless steel frame & supports, 18ga 300 series stainless steel body and under-shelf, per plan and manufacturer's standard construction.

Manufacturer provides:

Built-in heat wells, electric, (5) stainless steel lined compartments 12" x 20" with 3/4" brass drains, copper manifolded drains with unions, factory assembled high temperature compression fittings, master valve, 4ft. high temperature hose, 4.5KW, 21.6 amps, 208 volts 60 cycle 1 phase

14ga stainless steel countertop, polished & hemmed edges, recessed 1" to fit sheet pans, 34" high, 33" wide, 74" long

Fill faucet, hot/cold valves, 6" swivel spout, and quick disconnect hoses

Decor panels, Formica plastic laminate (or equal) on exterior grade wood backer panel, 2" stainless steel edge trim, mounted on front

12" tray slide, 14ga stainless steel, polished & hemmed edges, raised rubbing tracks, mounted on stainless steel brackets, located on front and mitered corner to adjacent counter

Décor lights, LED light strip mounted under tray slide and wired to on/off switch inside counter

Stainless steel control panel, (5) thermostats and light switches

Electric wire chase in base, stainless steel full length raceway & removable cover, receptacles & circuit breakers, and access openings to wire to electric load center

6" legs, 1-5/8" dia. stainless steel tube, and stainless steel adjustable feet

Kickplates, stainless steel, adjustable height & removable, recessed, and mounted on all sides

Model #TS560-74 Designer Food Shield, full-service glass protector guard on front, clear end enclosures, stainless steel shelf & end stanchions, and LED lights mounted under shelf and wired to switch in counter, 120v/60/1ph
FSEC to coordinate color selection with Owner/Architect

ITEM 10 SERVING COUNTER

Quantity: One (1)
Manufacturer: Duke Manufacturing
Model: XP18ST
SIS No.:

Expressions Solid Top Unit, custom enclosed cabinet, welded uni-body modular counter, 14ga 300 series stainless steel frame & supports, 18ga 300 series stainless steel body and under-shelf, per plan and manufacturer's standard construction.

Manufacturer provides:

14ga stainless steel countertop, polished & hemmed edges, 34" high, 33" wide, 20-1/2" long, & overhang one end

Decor Panels, Formica plastic laminate (or equal) on exterior grade wood backer panel, 2" stainless steel edge trim, and mounted on front & one end

12" tray slide, 14ga stainless steel, polished & hemmed edges, raised rubbing tracks, mounted on stainless steel brackets, and located on front

Décor lights, LED light strip mounted under tray slide and wired to on/off switch inside counter

Electric wire chase in base, stainless steel full length raceway & removable cover, receptacles & circuit breakers, and access openings to wire to electric load center

6" legs, 1-5/8" dia. stainless steel tube, and stainless steel adjustable feet

Kickplates, stainless steel, adjustable height & removable, recessed, and mounted on all sides

FSEC to coordinate color selection with Owner/Architect

ITEM 12 COLD FOOD COUNTER

Quantity: One (1)
Manufacturer: Duke Manufacturing
Model: XP60CM-N7
SIS No.:

Expressions Cold Food Unit, custom enclosed cabinet, welded uni-body modular counter, 14ga 300 series stainless steel frame & supports, 18ga 300 series stainless steel body and under-shelf, per plan and manufacturer's standard construction.

Manufacturer provides:

Built-in cold pan per NSF standard 7, stainless steel 10" deep 4 section liner, 1" brass drain, self-contained compressor/condenser, drain routed to condensate evaporator, R134A, 7.6 amps, 115 volts 60 cycle 1 phase 14ga stainless steel countertop, polished & hemmed edges, 34" high, 33" wide, 60" long

Decor panels, Formica plastic laminate (or equal) on exterior grade wood backer panel, 2" stainless steel edge trim, mounted on front

12" tray slide, 14ga stainless steel, polished & hemmed edges, raised rubbing tracks, mounted on stainless steel brackets, and located on front

Décor lights, LED light strip mounted under tray slide and wired to on/off switch inside counter

Compressor compartment, stainless steel, slide-out system for service, and stainless steel hinged grille

Electric wire chase in base, stainless steel full length raceway & removable cover, receptacles & circuit breakers, and access openings to wire to electric load center

6" legs, 1-5/8" dia. stainless steel tube, and stainless steel adjustable feet

Kickplates, stainless steel, adjustable height & removable, recessed, and mounted on all sides

Model #TS580-88-1SN Designer Food Shield, self-service double deck glass display shelves, glass guards one side, clear end enclosures, stainless steel shelf frames & end stanchions, and LED lights mounted under shelves and wired to switch in counter, 120v/60/1ph

FSEC to coordinate color selection with Owner/Architect

ITEM 12.1 BREAD COUNTER

Quantity: One (1)
Manufacturer: Duke Manufacturing
Model: XP32ST
SIS No.:

Expressions Solid Top Unit, custom enclosed cabinet, welded uni-body modular counter, 14ga 300 series stainless steel frame & supports, 18ga 300 series stainless steel body and under-shelf, per plan and manufacturer's standard construction.

Manufacturer provides:

14ga stainless steel countertop, L-shape fit & finish, polished & hemmed edges, 34" high, 33" wide, 30" long

Decor Panels, Formica plastic laminate (or equal) on exterior grade wood backer panel, 2" stainless steel edge trim, and mounted on front

12" tray slide, 14ga stainless steel, polished & hemmed edges, raised rubbing tracks, mounted on stainless steel brackets, and located on front

Décor lights, LED light strip mounted under tray slide and wired to on/off switch inside counter

Electric load center in base, panel box & cover, stainless steel raceway & removable cover, circuit breakers, access openings to pass wires and removable access panels for service, 120/208 volt, 1 phase, 15.5KW, 75 amps

Hinged door in front of panel box, stainless steel load center enclosure & door

6" legs, 1-5/8" dia. stainless steel tube, and stainless steel adjustable feet

Kickplates, stainless steel, adjustable height & removable, recessed, and mounted on all sides

FSEC to coordinate color selection with Owner/Architect

ITEM 13 TRAY & UTENSIL STAND

Quantity: One (1)
Manufacturer: Duke Manufacturing
Model: TTD-1418-SSS
SIS No.:

Tray Dispenser Unit, enclosed cabinet, welded uni-body modular counter, 14ga 300 series stainless steel frame & supports, 20ga 300 series stainless steel body per plan and manufacturer's standard construction.

Manufacturer provides:

Utensil holder, clear over-shelf with round cutouts, stainless steel tube posts, and (8) silverware cups

14ga stainless steel countertop, 36" high, 24" wide, 25" long

Stainless steel self-leveling rack inside for 14" x18" trays

Decor Panels, Formica plastic laminate (or equal) applied to body, stainless steel edge trim, and veneered on front & ends

5" dia. casters, swivel style with brakes, and gray poly tires

ITEM 17 GRIDDLE STAND

Quantity: One (1)

Manufacturer: Duke Manufacturing

Model: TST-60SS

SIS No.:

Thurmaduke Solid Top Unit, modified enclosed cabinet, welded uni-body modular counter, 14ga 300 series stainless steel frame & supports, 20ga 300 series stainless steel body and under-shelf, per plan and manufacturer's standard construction.

Manufacturer provides:

14ga stainless steel countertop, recessed to fit griddle, 36" high, 31" wide, 60" long

5" high countertop backsplash on 3 sides

5" dia. gray poly swivel casters with brakes

END OF SECTION 114000

SECTION 211313 – WET PIPE SPRINKLER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PROJECT SCOPE

- A. This specification applies to the fire suppression system modifications at the Mt. Vernon Veterans Home in Mount Vernon, Missouri. Refer to specification section 01 10 00 for a complete description of the project scope of work.

1.3 SUMMARY

- A. All existing Schedule 10 piping shall be replaced with Schedule 40.
- B. Replace existing backflow prevention assembly with new, same make and model.
- C. Relocate existing ITC to riser room and add low point drain valve as indicated on drawings.
- D. All definitions, general system requirements, and Technician involvement shall apply to Section 21 13 13 as well.

1.4 DEFINITIONS

- A. Contractor: The Missouri state licensed fire Sprinkler Company who is awarded this project.
- B. Technician: An individual who has achieved NICET Level III or IV certification in Water-Based Fire Suppression Systems Layout and who has the knowledge, experience, and skills necessary to layout fire protection systems. The Technician shall be an employee of the contractor. The Technician shall supervise or perform all submittals, installation, and testing indicated in this specification section.
- C. Engineer: An individual who is a licensed professional engineer who demonstrates sound knowledge and judgment in the application of science and engineering to protect the health, safety, and welfare of the public from the impacts of fire. For this particular project, the Engineer of Record is Poole Fire Protection.

1.5 GENERAL SYSTEM REQUIREMENTS

- A. All submittals, products, installation, and testing shall comply with NFPA 13, "Installation of Sprinkler Systems", 2016 Edition, except where modified by this specification section and the contract drawings.
- B. All aboveground piping and components shall be listed for a minimum 175 psig working pressure.

- C. Welding: If welding is required, it shall be in accordance with NFPA 13 section 6.5.2 (fabrication, fittings, methods, qualifications, and documentation).
- D. For purposes of this project where existing branch lines are to be reconnected to new mains mechanical couplings are allowed.

1.6 FIRE ALARM SYSTEM COORDINATION

- A. The contractor shall coordinate the addition of control valves and waterflow switches with the Owner and Engineer.

1.7 DESIGN REQUIREMENTS

- A. The sprinkler system shall be designed to deliver the required minimum densities as indicated by NFPA 13.
- B. A confirming water supply test is required to be performed by the contractor post-award and prior to shop drawing submission. However, basis of bid flow test data is as follows:
 - 1. Date: January 26, 2016
 - 2. Time: 15:30
 - 3. Flow: Fire Pump.
 - 4. Flow (zero)gpm: Churn=132psi / Suction=33psi
 - 5. Flow 521gpm: Discharge=118psi / Suction=26psi
 - 6. Flow 755gpm: Discharge=95psi / Suction=20psi
 - 7. Pump Rating: 500 GPM
 - a. 91 psi @ 100%
 - b. 71.5 psi @ 150%
- C. If unforeseen circumstances require modification to the project scope of work, the contractor shall immediately notify the owner and engineer before proceeding with associated work.
- D. If the contractor's hydrant flow test data yields significantly different results than the basis of design hydrant flow test values, the contractor shall notify the owner and engineer immediately.
- E. Provide a new backflow prevention assembly, same make and model as currently installed.
 - Make: AMES
 - Model: 200a DC-0014 6" Stainless Steel Backflow Assembly

1.8 SYSTEM RISER(S)

- A. The existing wet pipe riser and associated equipment shall be reused unless otherwise determined by the installing contractor.
- B. Existing riser location to remain.
- C. Location of riser equipment shall allow access to existing mechanical equipment in this space.
- D. New Inspectors Test Connection and Pressure Relief valve shall be provided on each wing system riser as indicated on drawings.

- E. New low point drain valve and access hatch shall be added installed at end of each wing as indicated on drawings (at 4 locations per wing). The access hatch shall be 1-½ fire rated hatch similar to the existing attic access hatches located in the wings.

1.9 SUBMITTALS

- A. General: All submittals shall be developed or immediately supervised by the Technician. All submittals below shall be submitted to the Engineer for review. The submittals are only required to be developed to reflect the project scope of work.
- B. Format: Unless noted otherwise below, all submittals shall be provided electronically in .PDF file format. Each file name shall clearly identify its contents. Where multiple submittals are combined into one file, electronic bookmarks shall be provided which clearly indicate its contents. Drawings, product data, calculation, and test report files shall be generated using software, not a scanner. Submittals not complying with these requirements will be immediately rejected.
- C. Sequence:
 - 1. Each submittal indicated below shall first be submitted for review to the Engineer. Upon approval by the Engineer, the Technician shall forward the submittals necessary for permitting to the authority having jurisdiction (AHJ).
 - 2. The following submittals shall all be submitted together in one complete package: Qualifications, Product Data, Shop Drawings, Water Delivery Time Calculations, Hydraulic Calculations, and Hydrant Flow Test. 'Piece-mealed' submittals will be immediately rejected.
- D. Qualification Data: Submit qualifications for Technician.
- E. Product Data: Submit product data for each system component required to be listed by NFPA 13. Model, size, orientation, finish, and other options shall be clearly indicated for each product.
- F. Shop Drawings: Comply with NFPA 13 Chapter 23 Plans and Calculations. Drawings shall comply with Working Plan requirements of NFPA 13 Section 23.1.
- G. Hydraulic Calculations: Comply with NFPA 13 Chapter 23 Plans and Calculations.
- H. Hydrant flow test results: The contractor's confirming hydrant flow test shall be documented to confirm compliance with NFPA 291. This shall include the location, date, and time of the test; number, size, and coefficient of outlets; static and residual pressures; and flow measurements. Gauges shall be calibrated within the last 6 months.
- I. Acceptance Test Notice: The Technician shall submit written request to schedule system acceptance testing at least 14 days prior to the scheduled testing. This request shall be submitted to the Engineer and the AHJ. Acceptance test results will not be considered unless the tests are witnessed by the Engineer and the AHJ. The written request shall include a statement which verifies that the updated as-built drawings will be available at the scheduled acceptance test.
- J. Acceptance Test Reports: The Technician shall complete the *Contractor's Material and Test Certificate for Aboveground Piping* provided in NFPA 13. This certificate shall be submitted to the Engineer for review no later than 7 days after the completion of the acceptance testing.

- K. Record Drawing Red-Lines: The Technician shall clearly indicate any revisions to the bid documents in red. This submittal shall be provided no later than 14 days after completion of final acceptance testing.
- L. As-Built Drawings: The Technician shall maintain at least one set of approved shop drawings with all field changes clearly annotated. The as-built drawings shall be accurate within +/- 6 inches. The as-built drawings shall be available during final acceptance testing for review by the Engineer. Upon project completion, the Technician shall submit the shop drawings with all red-lines incorporated into the AutoCAD files. The as-built drawings shall be submitted in both .PDF and .DWG format.
- M. Operation and Maintenance Manual: The Technician shall assemble an O&M Manual which consists of: table of contents, warranty statement, parts list, service company contact information, 11"x17" as-built drawings, approved product data, acceptance test reports, maintenance intervals, and troubleshooting process for typical system malfunctions. Other than drawings, all pages shall be 8.5"x11" and shall be bound by a durable binding method (3-ring binder, for example), and shall be clearly labeled and organized.

1.10 QUALITY ASSURANCE

- A. The Technician shall visit the project site, at least periodically, to ensure the system is being installed in accordance with the approved submittals. Upon request, the Technician shall be able to provide documentation of site visits.
- B. Installers shall have been regularly engaged in projects of similar scope and complexity for at least 6 months prior to the award of this contract. Upon request, documentation of their experience shall be available.
- C. Electrical Components, Devices, and Accessories: All system electrical components (local waterflow horn/strobe, for example) shall be listed and labeled as defined in NFPA 72 and NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.11 COORDINATION

- A. The Technician shall ensure the sprinkler system layout is coordinated with all other trades.

1.12 EXTRA MATERIALS

- A. Sprinkler Cabinets: Factory applied red finish, wall-mounted, steel cabinet with hinged cover, Include number of sprinklers required by NFPA 13 and sprinkler wrench. Shall be labeled "spare sprinklers".

1.13 WARRANTY

- A. Contractor shall provide a warranty for all system failures as a result of manufacturing, installation, or workmanship. The warranty period shall be one year from the date of beneficial occupancy (established by engineer). Include the warranty statement in the O&M manual.
- B. Warranty claims which are necessary for proper system operation shall be responded to, and their repair scheduled, within 24 hours of warranty claim (the actual time allowed for the repair work shall be negotiated with the building owner at the time of warranty claim).

- C. Warranty claims which are not necessary for proper system operation shall be responded to, and their repair scheduled, within one week of warranty claim (the actual time allowed for the repair work shall be negotiated with the building owner at the time of warranty claim).

PART 2 - PRODUCTS

2.1 GENERAL

- A. New products shall match existing system components when still commercially available.
- B. All products permitted by NFPA 13 are acceptable, except where modified by this specification section.
- C. All products of the same type (fittings, for example) shall be from the same manufacturer.
- D. The following system components are not required to be listed:
 - 1. Components which do not affect system performance such as drain piping, drain valves, and signs.
 - 2. Hangers certified by a registered professional engineer.
 - 3. Mild steel hangers formed from rods.
 - 4. Fasteners in accordance with NFPA 13 paragraph 9.1.1.4.3.
- E. Where this specification indicates a particular manufacturer and/or model, a substitute may be used if approved by the Engineer. When requesting a substitute, the contractor shall include a written explanation documenting how the proposed product is equal to or greater than the specified product.

2.2 ABOVEGROUND PIPING

- A. Comply with requirements of NFPA 13 for aboveground piping.
- B. Aboveground piping shall be schedule 40 black steel.
- C. All aboveground components shall be listed for 175-psig minimum working pressure.
- D. Side outlet tees are only permissible where connecting to existing piping.

2.3 WATERFLOW SWITCH

- A. The new wet pipe system shall be permitted to reuse the existing waterflow switch unless existing device is deemed unusable.

2.4 ISOLATION CONTROL VALVES

- A. New control valves shall be the butterfly type with integral tamper switches.

2.5 BACKFLOW PREVENTION ASSEMBLY

- A. Provide a new backflow prevention assembly, same make and model as currently installed.
 - 1. Make: AMES
 - 2. Model: 200a DC-0014 6" Stainless Steel Backflow Assembly

2.6 CHECK VALVE

- A. The check valve shall be the swing-type.

PART 3 - EXECUTION

3.1 GENERAL

- A. All materials shall be stored, installed, and tested in accordance with NFPA 13 and the manufacturer's instructions.
- B. All system components shall be installed in a neat, workmanlike manner. Installation shall be straight and true with building structure.

3.2 CONSTRUCTION SEQUENCE

- A. The existing wet pipe system(s) may be taken out of service in close coordination with the renovation schedule to allow the building to remain usable unless approved (by owner).
- B. The existing wet pipe system shall be maintained in service throughout the duration of the project except when necessary to modify system.

3.3 EXISTING SYSTEM DEMOLITION

- A. Completely demolish all existing wet pipe system components which are to be replaced by the scope of this project.
- B. The contractor shall remove all demolished system components from the project site or an approved on-site disposal container with authorization from Site Facilities Manager.
- C. Do not store demolished system components where they obstruct egress, obstruct facility operation, or are visible to facility patrons.

3.4 DOWNTIME COORDINATION

- A. The contractor shall coordinate system downtime with the Owner and ensure that the system is not taken out of service unless the Owner-provided fire watch is prepared.
- B. The existing sprinkler systems shall not be isolated from the water supply source without approval from the Owner's representative.

3.5 PIPING INSTALLATION

- A. In areas with ceilings, piping shall be concealed above the ceiling. Piping shall be inspected, tested, and approved before being concealed.
- B. Exposed piping shall not diminish exit access widths, corridors, or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.
- C. Risers and similar vertical runs of piping in finished areas shall be concealed if possible.

- D. Pipe shall be arranged in accordance with NFPA 13 to avoid trapped water; this includes proper slope and auxiliary drains to ensure that the system can be completely drained.

3.6 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1 (no more than four threads shall be visible when joint is fully made-up). Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads (male only threads).
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- G. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.7 FIRESTOPPING

- A. Where new system piping penetrates an existing fire-resistance rated wall, the contractor shall protect the penetration with a listed firestopping assembly. A permanent label shall be provided on the wall adjacent to the penetration identifying the listed firestopping assembly, penetrating item, date of installation, and initials of installer. The listed assembly shall be submitted for approval prior to installation.
- B. Reference the Life Safety drawings for rated wall and ceiling locations.

3.8 CLEANING

- A. Clean dirt and debris from all new and existing sprinklers, valves, riser, and all riser components.

3.9 INSTRUCTIONS

- A. Provide instructions in a laminated or glass frame near the system riser and nitrogen inerting system which provides basic operational instructions written for use by building maintenance personnel.

3.10 TRAINING

- A. Provide at least 2 hours of training to building maintenance personnel for operation of all new valves, equipment, locations of new low point drains, and typical system troubleshooting procedures.
- B. Training shall be documented and distributed to the owner for their use.

3.11 SYSTEM ACCEPTANCE

- A. The contractor shall provide all labor, tools, and equipment necessary to conduct all acceptance tests required by NFPA 13. This specifically includes the pneumatic tests, hydrostatic tests, valve supervisory switch tests, waterflow switch tests, main drain tests, and backflow preventer flushing.
- B. The contractor shall notify the owner, engineer, and AHJ at least two weeks prior to test so it can be witnessed by the necessary personnel.
- C. The contractor shall provide updated as-built drawings at the final acceptance test. These drawings shall have all changes electronically incorporated. Field mark-ups will not be considered adequate.

3.12 ENGINEER'S SITE VISITS

- A. The Technician shall notify the Engineer in writing at least 14 days prior to the following phases of construction to allow the Engineer to perform observations and witness acceptance testing. At each of the following visits, the Contractor shall possess the approved shop drawings with all field revisions noted.
 - 1. During the aboveground piping installation, but before any piping is concealed by ceilings. During this visit, the Engineer will observe the installation for compliance with the approved design and submittals.
 - 2. After all aboveground piping has been installed, but before any piping is concealed by ceilings. During this visit, the Engineer will witness the aboveground pneumatic and hydrostatic tests required by NFPA 13, waterflow switch tests, valve supervisory tests, main drain tests, backflow preventer flushing, and nitrogen inerting system operation. The Engineer will also spot-check the accuracy of the as-builts and verify pipe slope during this site visit.

END OF SECTION 21 13 13

SECTION 211316 – DRY PIPE SPRINKLER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PROJECT SCOPE

- A. This specification applies to the fire suppression system modifications at the Mt. Vernon Veterans Home in Mount Vernon, Missouri. Refer to specification section 01 10 00 for a complete description of the project scope of work.

1.3 SUMMARY

- A. The existing dry pipe sprinkler systems shall be converted to use a nitrogen inerting system. The existing air compressor shall be replaced with a nitrogen inerting system skid. See paragraph 2.5, Nitrogen Inerting System, for details on the nitrogen system.
- B. All definitions, general system requirements, and Technician involvement shall apply to Section 21 13 16 as well.

1.4 DEFINITIONS

- A. Contractor: The Missouri state licensed fire Sprinkler Company who is awarded this project.
- B. Technician: An individual who has achieved NICET Level III or IV certification in Water-Based Fire Suppression Systems Layout and who has the knowledge, experience, and skills necessary to layout fire protection systems. The Technician shall be an employee of the contractor. The Technician shall supervise or perform all submittals, installation, and testing indicated in this specification section.
- C. Engineer: An individual who is a licensed professional engineer who demonstrates sound knowledge and judgment in the application of science and engineering to protect the health, safety, and welfare of the public from the impacts of fire. For this particular project, the Engineer of Record is Poole Fire Protection.

1.5 GENERAL SYSTEM REQUIREMENTS

- A. All submittals, products, installation, and testing shall comply with NFPA 13, "Installation of Sprinkler Systems", 2016 Edition, except where modified by this specification section and the contract drawings.
- B. All aboveground piping and components shall be listed for a minimum 175 psig working pressure.
- C. Welding: If welding is required, it shall be in accordance with NFPA 13 section 6.5.2 (fabrication, fittings, methods, qualifications, and documentation).

- D. For purposes of this project where existing branch lines are to be reconnected to new mains mechanical couplings are allowed.

1.6 FIRE ALARM SYSTEM COORDINATION

- A. The contractor shall coordinate the addition of control valves and pressure switches (if required) with the Owner and Engineer.

1.7 DESIGN REQUIREMENTS

- A. The existing sprinkler system(s) shall remain.
- B. If unforeseen circumstances require modification to the project scope of work, the contractor shall immediately notify the owner and engineer before proceeding with associated work.
- C. If the contractor's hydrant flow test data yields significantly different results than the basis of design hydrant flow test values, the contractor shall notify the owner and engineer immediately.

1.8 SYSTEM RISER(S)

- A. The existing dry system(s) riser and associated trim shall be reused unless otherwise determined by installing contractor.
- B. Existing riser location to remain.
- C. New nitrogen generator will be connected to existing air distribution piping to provide nitrogen throughout the facility.
- D. Location of riser equipment shall allow access to existing mechanical equipment in this space.

1.9 SUBMITTALS

- A. General: All submittals shall be developed or immediately supervised by the Technician. All submittals below shall be submitted to the Engineer for review. The submittals are only required to be developed to reflect the project scope of work.
- B. Format: Unless noted otherwise below, all submittals shall be provided electronically in .PDF file format. Each file name shall clearly identify its contents. Where multiple submittals are combined into one file, electronic bookmarks shall be provided which clearly indicate its contents. Drawings, product data, calculation, and test report files shall be generated using software, not a scanner. Submittals not complying with these requirements will be immediately rejected.
- C. Sequence:
 - 1. Each submittal indicated below shall first be submitted for review to the Engineer. Upon approval by the Engineer, the Technician shall forward the submittals necessary for permitting to the authority having jurisdiction (AHJ).
 - 2. The following submittals shall all be submitted together in one complete package: Qualifications, Product Data, and Shop Drawings. 'Piece-mealed' submittals will be immediately rejected.
- D. Qualification Data: Submit qualifications for Technician.

- E. **Product Data:** Submit product data for each system component required to be listed by NFPA 13. Model, size, orientation, finish, and other options shall be clearly indicated for each product.
- F. **Shop Drawings:** Comply with NFPA 13 Chapter 23 Plans and Calculations. Drawings shall comply with Working Plan requirements of NFPA 13 Section 23.1.
- G. **Acceptance Test Notice:** The Technician shall submit written request to schedule system acceptance testing at least 14 days prior to scheduled testing. This request shall be submitted to the Engineer and the AHJ. Acceptance test results will not be considered unless the tests are witnessed by the Engineer and the AHJ. The written request shall include a statement which verifies that the updated as-built drawings will be available at the scheduled acceptance test.
- H. **Acceptance Test Reports:** The Technician shall complete the *Contractor's Material and Test Certificate for Aboveground Piping* provided in NFPA 13. This certificate shall be submitted to the Engineer for review no later than 7 days after the completion of the acceptance testing.
- I. **Record Drawing Red-Lines:** The Technician shall clearly indicate any revisions to the bid documents in red. This submittal shall be provided no later than 14 days after completion of final acceptance testing.
- J. **As-Built Drawings:** The Technician shall maintain at least one set of approved shop drawings with all field changes clearly annotated. The as-built drawings shall be accurate within +/- 6 inches. The as-built drawings shall be available during final acceptance testing for review by the Engineer. Upon project completion, the Technician shall submit the shop drawings with all red-lines incorporated into the AutoCAD files. The as-built drawings shall be submitted in both .PDF and .DWG format.
- K. **Operation and Maintenance Manual:** The Technician shall assemble an O&M Manual which consists of: table of contents, warranty statement, parts list, service company contact information, 11"x17" as-built drawings, approved product data, acceptance test reports, maintenance intervals, and troubleshooting process for typical system malfunctions. Other than drawings, all pages shall be 8.5"x11" and shall be bound by a durable binding method (3-ring binder, for example), and shall be clearly labeled and organized.

1.10 QUALITY ASSURANCE

- A. The Technician shall visit the project site, at least periodically (not less than two site visits per month), to ensure the system is being installed in accordance with the approved submittals. Upon request, the Technician shall be able to provide documentation of site visits.
- B. Installers shall have been regularly engaged in projects of similar scope and complexity for at least 6 months prior to the award of this contract. Upon request, documentation of their experience shall be available.
- C. **Electrical Components, Devices, and Accessories:** All system electrical components (local waterflow horn/strobe, for example) shall be listed and labeled as defined in NFPA 72 and NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.11 COORDINATION

- A. The Technician shall ensure the sprinkler system layout is coordinated with all other trades.

1.12 WARRANTY

- A. Contractor shall provide a warranty for all system failures as a result of manufacturing, installation, or workmanship. The warranty period shall be one year from the date of beneficial occupancy (established by engineer). Include the warranty statement in the O&M manual.
- B. Warranty claims which are necessary for proper system operation shall be responded to, and their repair scheduled, within 24 hours of warranty claim (the actual time allowed for the repair work shall be negotiated with the building owner at the time of warranty claim).
- C. Warranty claims which are not necessary for proper system operation shall be responded to, and their repair scheduled, within one week of warranty claim (the actual time allowed for the repair work shall be negotiated with the building owner at the time of warranty claim).

PART 2 - PRODUCTS

2.1 GENERAL

- A. New products shall match existing system components when still commercially available.
- B. All products permitted by NFPA 13 are acceptable, except where modified by this specification section.
- C. All products of the same type (fittings, for example) shall be from the same manufacturer.
- D. The following system components are not required to be listed:
 - 1. Components which do not affect system performance such as drain piping, drain valves, and signs.
 - 2. Hangers certified by a registered professional engineer.
 - 3. Mild steel hangers formed from rods.
 - 4. Fasteners in accordance with NFPA 13 paragraph 9.1.1.4.3.
- E. Where this specification indicates a particular manufacturer and/or model, a substitute may be used if approved by the Engineer. When requesting a substitute, the contractor shall include a written explanation documenting how the proposed product is equal to or greater than the specified product.

2.2 ABOVEGROUND PIPING

- A. Comply with requirements of NFPA 13 for aboveground piping.
- B. Aboveground piping shall be schedule 40 black steel.
- C. All aboveground components shall be listed for 175-psig minimum working pressure.
- D. Side outlet tees are only permissible where connecting to existing piping.

2.3 NITROGEN INERTING SYSTEM

- A. The basis of design nitrogen inerting system is the Engineered Corrosion Solutions (ECS) PGEN-20 with ECS PSV-D vent(s).

- B. The contractor shall coordinate with the nitrogen inerting system manufacturer for a complete list of equipment and connections necessary to provide the complete working system.
- C. Alternatives to the basis of design system are acceptable but shall include a bulleted list of comparison to prove the proposed system is at least equal.
- D. The nitrogen inerting system skid shall be located in the Mechanical Room.
- E. The point of contact at Engineered Corrosion Solutions (ECS) is Gerard van Moorsel. Phone Number: (314) 432-1377 x384.

2.4 PROHIBITED PRODUCTS

- A. Galvanized piping, fittings, and couplings are not permitted.

PART 3 - EXECUTION

3.1 GENERAL

- A. All materials shall be stored, installed, and tested in accordance with NFPA 13 and the manufacturer's instructions.
- B. All system components shall be installed in a neat, workmanlike manner. Installation shall be straight and true with building structure.

3.2 CONSTRUCTION SEQUENCE

- A. The existing dry pipe system(s) may be taken out of service in close coordination with the renovation schedule to allow the building to remain usable unless approved (by owner).
- B. The existing dry pipe system(s) shall be maintained in service throughout the duration of the project except when necessary to modify the system.

3.3 EXISTING SYSTEM DEMOLITION

- A. Completely demolish all existing dry pipe system components which are to be replaced by this project.
- B. The contractor shall remove all demolished system components from the project site or an approved on-site disposal container with authorization from Site Facilities Manager. The contractor shall consult site maintenance staff prior to removing any material from the site to see if existing equipment will be put in storage for future use.
- C. Do not store demolished system components where they obstruct egress, obstruct facility operation, or are visible to facility patrons.

3.4 DOWNTIME COORDINATION

- A. The contractor shall coordinate system downtime with the Owner and ensure that the system is not taken out of service unless the Owner-provided fire watch is prepared.

- B. The existing sprinkler systems shall not be isolated from the water supply source without approval from the Owner's representative.

3.5 PIPING INSTALLATION

- A. Pipe shall be arranged in accordance with NFPA 13 to avoid trapped water; this includes proper slope and auxiliary drains to ensure that the system can be completely drained.

3.6 NITROGEN INERTING SYSTEM INSTALLATION

- A. The contractor shall provide all labor, equipment, and tools as necessary to completely install, plumb, and wire the nitrogen inerting system in accordance with the manufacturer's requirements and recommendations.
- B. The contractor shall coordinate the location of the nitrogen inerting system with the Owner and Engineer prior to installation.
- C. Refer to Section 26 05 19 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

3.7 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1 (no more than four threads shall be visible when joint is fully made-up). Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads (male only threads).
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- G. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.8 FIRESTOPPING

- A. Where new system piping penetrates an existing fire-resistance rated wall, the contractor shall protect the penetration with a listed firestopping assembly. A permanent label shall be provided

on the wall adjacent to the penetration identifying the listed firestopping assembly, penetrating item, date of installation, and initials of installer.

3.9 CLEANING

- A. Clean dirt and debris from all new and existing sprinklers, valves, riser, and all riser components.

3.10 INSTRUCTIONS

- A. Provide instructions in a laminated or glass frame near the system riser and nitrogen inerting system which provides basic operational instructions written for use by building maintenance personnel.

3.11 TRAINING

- A. Provide at least 2 hours of training to building maintenance personnel by for operation of dry valve, nitrogen inerting systems, location of all drains, and typical system troubleshooting procedures.
- B. Training shall be documented and distributed to the owner for their use.
- C. ECS shall provide factory trained personnel to train maintenance staff on nitrogen inerting system maintenance and testing procedures.

3.12 SYSTEM ACCEPTANCE

- A. The contractor shall provide all labor, tools, and equipment necessary to conduct all acceptance tests required by NFPA 13. This specifically includes the pneumatic tests, hydrostatic tests, water deliver time tests, valve supervisory switch tests, waterflow switch tests, main drain tests, and backflow preventer flushing.
- B. The contractor shall notify the owner, engineer, and AHJ at least two weeks prior to test so it can be witnessed by the necessary personnel.
- C. The contractor shall provide updated as-built drawings at the final acceptance test. These drawings shall have all changes electronically incorporated. Field mark-ups will not be considered adequate.

3.13 ENGINEER'S SITE VISITS

- A. The Technician shall notify the Engineer in writing at least 14 days prior to the following phases of construction to allow the Engineer to perform observations and witness acceptance testing. At each of the following visits, the Contractor shall possess the approved shop drawings with all field revisions noted.
 - 1. During the aboveground piping installation, but before any piping is concealed by ceilings. During this visit, the Engineer will observe the installation for compliance with the approved design and submittals.
 - 2. After all aboveground piping has been installed, but before any piping is concealed by ceilings. During this visit, the Engineer will witness the aboveground pneumatic and hydrostatic tests required by NFPA 13, waterflow switch tests, valve supervisory tests,

main drain tests, backflow preventer flushing, and nitrogen inerting system operation.
The Engineer will also spot-check the accuracy of the as-builts and verify pipe slope
during this site visit.

END OF SECTION 21 13 16

SECTION 213000 – FIRE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PROJECT SCOPE

- A. This specification applies to the fire suppression system modifications at the Mt. Vernon Veterans Home in Mount Vernon, Missouri. Refer to specification section 01 10 00 for a complete description of the project scope of work.

1.3 SUMMARY

- A. This section is applicable to the Fire Pump, Controller, and associated equipment.
- B. All definitions, general system requirements, and Technician involvement shall apply to Section 21 30 00 as well.
- C. Except as modified in this Section or on the drawings, install fire pumps in conformance with NFPA 20, NFPA 70, and NFPA 72, including all recommendations and advisory portions, which shall be considered mandatory.
- D. The existing Fire Pump bearings shall be repacked. The internals shall be inspected for damage and replaced if necessary. Piping leading into the suction side of the fire pump shall be replaced as necessary to allow for installation of new eccentric reducer.
- E. The existing Fire Pump Controller voltage/amperage readout shall be replaced with new display.

1.4 DEFINITIONS

- A. Contractor: The Missouri state licensed fire Sprinkler Company who is awarded this project.
- B. Technician: An individual who has achieved NICET Level III or IV certification in Water-Based Fire Suppression Systems Layout and who has the knowledge, experience, and skills necessary to layout fire protection systems. The Technician shall be an employee of the contractor. The Technician shall supervise or perform all submittals, installation, and testing indicated in this specification section.
- C. Engineer: An individual who is a licensed professional engineer who demonstrates sound knowledge and judgment in the application of science and engineering to protect the health, safety, and welfare of the public from the impacts of fire. For this particular project, the Engineer of Record is Poole Fire Protection.

1.5 GENERAL SYSTEM REQUIREMENTS

- A. All submittals, products, installation, and testing shall comply with NFPA 20, "Standard for the Installation of Stationary Pumps for Fire Protection", 2016 Edition, except where modified by this specification section and the contract drawings.
- B. All aboveground piping and components shall be listed for a minimum 175 psig working pressure.
- C. Seismic Performance: Seismic bracing is not required.
- D. Welding: If welding is required, it shall be in accordance with NFPA 13 section 6.5.2 (fabrication, fittings, methods, qualifications, and documentation).

1.6 FIRE ALARM SYSTEM COORDINATION

- A. The contractor shall coordinate the addition of control valves and fire pump points with the Owner and Engineer.

1.7 DESIGN REQUIREMENTS

- A. If unforeseen circumstances require modification to the project scope of work, the contractor shall immediately notify the owner and engineer before proceeding with associated work.

1.8 SUBMITTALS

- A. General: All submittals shall be developed or immediately supervised by the Technician. All submittals below shall be submitted to the Engineer for review. The submittals are only required to be developed to reflect the project scope of work.
- B. Format: Unless noted otherwise below, all submittals shall be provided electronically in .PDF file format. Each file name shall clearly identify its contents. Where multiple submittals are combined into one file, electronic bookmarks shall be provided which clearly indicate its contents. Drawings, product data, calculation, and test report files shall be generated using software, not a scanner. Submittals not complying with these requirements will be immediately rejected.
- C. Sequence:
 - 1. Each submittal indicated below shall first be submitted for review to the Engineer. Upon approval by the Engineer, the Technician shall forward the submittals necessary for permitting to the authority having jurisdiction (AHJ).
 - 2. The following submittals shall all be submitted together in one complete package: Qualifications, Product Data, Shop Drawings, Water Delivery Time Calculations, Hydraulic Calculations, and Hydrant Flow Test. 'Piece-mealed' submittals will be immediately rejected.
- D. Qualification Data: Submit qualifications for Technician.
- E. Product Data: Submit product data for each system component required to be listed by NFPA 13. Model, size, orientation, finish, and other options shall be clearly indicated for each product.

- F. Shop Drawings: Comply with NFPA 13 Chapter 23 Plans and Calculations and NFPA 20. Drawings shall comply with Working Plan requirements of NFPA 13 Section 23.1.
- G. Acceptance Test Notice: The Technician shall submit written request to schedule system acceptance testing at least 14 days prior to scheduled testing. This request shall be submitted to the Engineer and the AHJ. Acceptance test results will not be considered unless the tests are witnessed by the Engineer and the AHJ. The written request shall include a statement which verifies that the updated as-built drawings will be available at the scheduled acceptance test.
- H. Acceptance Test Reports: The Technician shall complete the *Contractor's Material and Test Certificate for Aboveground Piping* provided in NFPA 13. This certificate shall be submitted to the Engineer for review no later than 7 days after the completion of the acceptance testing.
- I. Record Drawing Red-Lines: The Technician shall clearly indicate any revisions to the bid documents in red. This submittal shall be provided no later than 14 days after completion of final acceptance testing.
- J. As-Built Drawings: The Technician shall maintain at least one set of approved shop drawings with all field changes clearly annotated. The as-built drawings shall be accurate within +/- 6 inches. The as-built drawings shall be available during final acceptance testing for review by the Engineer. Upon project completion, the Technician shall submit the shop drawings with all red-lines incorporated into the AutoCAD files. The as-built drawings shall be submitted in both .PDF and .DWG format.
- K. Operation and Maintenance Manual: The Technician shall assemble an O&M Manual which consists of: table of contents, warranty statement, parts list, service company contact information, 11"x17" as-built drawings, approved product data, acceptance test reports, maintenance intervals, and troubleshooting process for typical system malfunctions. Other than drawings, all pages shall be 8.5"x11" and shall be bound by a durable binding method (3-ring binder, for example), and shall be clearly labeled and organized.

1.9 QUALITY ASSURANCE

- A. The Technician shall visit the project site, at least periodically (not less than two site visits per month), to ensure the system is being installed in accordance with the approved submittals. Upon request, the Technician shall be able to provide documentation of site visits.
- B. Installers shall have been regularly engaged in projects of similar scope and complexity for at least 6 months prior to the award of this contract. Upon request, documentation of their experience shall be available.
- C. Electrical Components, Devices, and Accessories: All system electrical components (local waterflow horn/strobe, for example) shall be listed and labeled as defined in NFPA 72 and NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.10 COORDINATION

- A. The Technician shall ensure the sprinkler system layout is coordinated with all other trades.

1.11 WARRANTY

- A. Contractor shall provide a warranty for all system failures as a result of manufacturing, installation, or workmanship. The warranty period shall be one year from the date of beneficial occupancy (established by engineer). Include the warranty statement in the O&M manual.
- B. Warranty claims which are necessary for proper system operation shall be responded to, and their repair scheduled, within 24 hours of warranty claim (the actual time allowed for the repair work shall be negotiated with the building owner at the time of warranty claim).
- C. Warranty claims which are not necessary for proper system operation shall be responded to, and their repair scheduled, within one week of warranty claim (the actual time allowed for the repair work shall be negotiated with the building owner at the time of warranty claim).

PART 2 - PRODUCTS

2.1 GENERAL

- A. All products permitted by NFPA 20 are acceptable, except where modified by this specification section.
- B. All products of the same type (fittings, for example) shall be from the same manufacturer.
- C. Where this specification indicates a particular manufacturer and/or model, a substitute may be used if approved by the Engineer. When requesting a substitute, the contractor shall include a written explanation documenting how the proposed product is equal to or greater than the specified product.

2.2 FIRE PUMP

- A. The existing Fire Pump rings, seals, packing, etc. shall be replaced. Upon inspection if damage is observed to the pump internals the contractor shall stop and identify the issue to maintenance personnel. The internals shall be inspected for damage and replaced if necessary. Piping leading into the suction side of the fire pump shall be replaced as necessary to allow for installation of new eccentric reducer.
 - 1. Existing Fire Pump Information:
Fairbanks Morse – Centrifugal Fire Pump
Type: 3” 1824F Split Case
SN: 03-9666058
Rated GPM: 500
Rated Head Feet: 196
Rated R.P.M.: 3560

2.3 FIRE PUMP CONTROLLER

- A. The existing Fire Pump Controller (Metron) is to be reused but the voltage/ampereage readout shall be replaced with new display.
 - 1. Electric Fire Pump Controller
Make: Metron
Model No.: M300-40-480C
Serial No.: SE-03N16387-11

- 2. Electrical Rating: 40HP; 480 Volts; 3 Phase; 60 Hz
- 2. Fire Pump Automatic Transfer Switch
- Make: Metron
- Model No.: MTS – 100A
- Serial No.: SE-03N16367-11
- Electrical Rating: 480 Volts; 100 Amps; 3 Phase; 60 Hz

2.4 PRESSURE MAINTENANCE PUMP CONTROLLER

- A. Existing to remain.

2.5 REQUIREMENTS FOR FIRE PROTECTION SERVICE

- A. General Requirements
 - 1. Materials and Equipment shall have been tested by UL or FM listed or approved.
- B. Alarms
 - 1. Provide audible and visual alarms as required by NFPA 20 on the controller. Provide remote supervision as required by NFPA 20, in accordance with NFPA 72. Exterior alarm devices shall be weatherproof type. Provide alarm silencing switch and red signal lamp, with signal lamp arranged to come on when switch is place in off position.

2.6 ABOVEGROUND PIPING

- A. Comply with requirements of NFPA 13 for aboveground piping.
- B. Aboveground piping shall be schedule 40 black steel. Steel pipe shall be joined by means of flanges mechanical grooved only. Piping shall not be joined by welding or weld fittings.
- C. All aboveground components shall be listed for 175-psig minimum working pressure.
- D. All fittings shall be of grooved type or flanged type.
- E. Valves shall be UL list or FM approved for fire protection service.
- F. Relief valve shall be pilot operated or spring operated type conforming to NFPA 20. A means of detecting water motion in the relief lines shall be provided where the discharge is not visible within the pump house.

2.7 ISOLATION CONTROL VALVES

- A. New control valves shall be the butterfly type with integral tamper switches.

2.8 CHECK VALVE

- A. The check valve shall be the swing-type.

2.9 PROHIBITED PRODUCTS

- A. Plain end fittings with mechanical couplings and fittings that use steel gripping devices to bite into the pipe are prohibited.
- B. Side outlet mechanical tees using rubber gasket fittings are prohibited in new construction.

PART 3 - EXECUTION

3.1 GENERAL

- A. All materials shall be stored, installed, and tested in accordance with NFPA 20 and the manufacturer's instructions.
- B. All system components shall be installed in a neat, workmanlike manner. Installation shall be straight and true with building structure.

3.2 CONSTRUCTION SEQUENCE

- A. The existing pump system may be taken out of service for limited duration during the project.

3.3 EXISTING SYSTEM DEMOLITION

- A. Completely demolish all existing pump system components which are to be replaced by this project.
- B. The contractor shall remove all demolished system components from the project site or an approved on-site disposal container with authorization from Site Facilities Manager.
- C. Do not store demolished system components where they obstruct egress, obstruct facility operation, or are visible to facility patrons.

3.4 DOWNTIME COORDINATION

- A. The contractor shall coordinate system downtime with the Owner and ensure that the system is not taken out of service unless the Owner-provided fire watch is prepared.
- B. The existing sprinkler systems shall not be isolated from the water supply source without approval from the Owner's representative.

3.5 PIPING INSTALLATION

- A. In areas with ceilings, piping shall be concealed above the ceiling. Piping shall be inspected, tested, and approved before being concealed.
- B. Exposed piping shall not diminish exit access widths, corridors, or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.
- C. Risers and similar vertical runs of piping in finished areas shall be concealed if possible.

3.6 FIRESTOPPING

- A. Where new system piping penetrates an existing fire-resistance rated wall, the contractor shall protect the penetration with a listed firestopping assembly. A permanent label shall be provided on the wall adjacent to the penetration identifying the listed firestopping assembly, penetrating item, date of installation, and initials of installer.

3.7 CLEANING

- A. Clean dirt and debris from all new and existing piping, valves, riser, and all riser components.

3.8 TRAINING

- A. Provide at least 1 hour of training to building maintenance personnel for operation of fire pump, location of all test headers, and typical system troubleshooting procedures.
- B. Training shall be documented and distributed to the owner for their use.

3.9 SYSTEM ACCEPTANCE

- A. The contractor shall provide all labor, tools, and equipment necessary to conduct all acceptance tests required by NFPA 13, NFPA 20 and NFPA 25. This specifically includes the fire pump flow tests, hydrostatic tests, and valve supervisory switch tests.
- B. The contractor shall notify the owner, engineer, and AHJ at least two weeks prior to test so it can be witnessed by the necessary personnel.
- C. The contractor shall provide updated as-built drawings at the final acceptance test. These drawings shall have all changes electronically incorporated. Field mark-ups will not be considered adequate.
- D. Upon completion of packing the existing fire pipe a pump test shall be conducted to ensure the pump is able to meet or exceed the largest system demand.

3.10 ENGINEER'S SITE VISITS

- A. The Technician shall notify the Engineer in writing at least 14 days prior to the following phases of construction to allow the Engineer to perform observations and witness acceptance testing. At each of the following visits, the Contractor shall possess the approved shop drawings with all field revisions noted.
 - 1. During the aboveground piping installation, but before any piping is concealed by ceilings. During this visit, the Engineer will observe the installation for compliance with the approved design and submittals.

END OF SECTION 21 30 00

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Sleeves.
 - 5. Escutcheons.
 - 6. Plumbing demolition.
 - 7. Equipment installation requirements common to equipment sections.
 - 8. Supports and anchorages.

1.2 SUBMITTALS

- A. Welding certificates.

1.3 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 0.125-inch maximum thickness unless thickness or specific material is indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250 psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 or 300 psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300 psig minimum working pressure at 225 deg F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300 psig minimum working pressure at 225 deg F.

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Carbon steel. Include two (2) for each sealing element.

- D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" requirements and procedures.

- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved by project engineer.

- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas. Where installed above accessible ceiling install piping tight to structure.

- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

- E. Do not install any wet systems in area subject to freezing.

- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

- G. Install piping to permit valve servicing.

- H. Install piping at required slopes for proper drainage.

- I. Install piping free of sags and bends.

- J. Install fittings for changes in direction and branch connections. Fittings shall be full size and manufactured fittings. Pulled "tees" will not be allowed.
- K. Install piping to allow application of insulation. Insulation shall be continuous through all supports.
- L. Select system components with pressure rating equal to or greater than system operating pressure.
- M. Install escutcheons for penetrations of walls, ceilings, and floors.
- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Joint Sealers" for materials.
- P. Verify final equipment locations for roughing-in.
- Q. Refer to equipment specifications in other Sections of these specifications for roughing-in requirements.
- R. Contractor shall be responsible for final connections to all commercial kitchen equipment.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.

- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

- C. Attach to substrates as required to support applied loads.

END OF SECTION 220500

SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements for single-phase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 HP shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.

- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 220513

SECTION 220519 - METERS AND GAUGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Bimetallic-actuated thermometers.
 - 2. Liquid-in-glass thermometers.
 - 3. Thermowells.
 - 4. Dial-type pressure gauges.
 - 5. Gage attachments.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product certificates.
- C. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Marsh Bellofram.
 - 2. Miljoco Corporation.
 - 3. Palmer Wahl Instrumentation Group.
 - 4. Tel-Tru Manufacturing Company.
 - 5. Trerice, H. O. Co.
 - 6. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 7. Weiss Instruments, Inc.
- B. Standard: ASME B40.200.
- C. Case: Liquid-filled and sealed types; stainless steel with 5-inch nominal diameter.
- D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.
- E. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.
- F. Connector Size: 0.5-inch, with ASME B1.1 screw threads.
- G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.
- H. Window: Plain glass.
- I. Ring: Stainless steel.

- J. Element: Bimetal coil.
- K. Pointer: Dark-colored metal.
- L. Accuracy: Plus or minus 1 percent of scale range.

2.2 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flo Fab Inc.
 - b. Miljoco Corporation.
 - c. Palmer Wahl Instrumentation Group.
 - d. Tel-Tru Manufacturing Company.
 - e. Trerice, H. O. Co.
 - f. Weiss Instruments, Inc.
2. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
3. Case Form: Adjustable angle unless otherwise indicated.
4. Tube: Glass with magnifying lens and blue or red organic liquid.
5. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
6. Window: Glass.
7. Stem: Aluminum and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
8. Connector: 1.25 inches, with ASME B1.1 screw threads.
9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ernst Flow Industries.
 - b. Marsh Bellofram.
 - c. Miljoco Corporation.
 - d. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - e. Weiss Instruments, Inc.
2. Standard: ASME B40.200.
3. Case: Plastic; 7-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass.
8. Stem: Aluminum, brass, or stainless steel and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
9. Connector: 1.25 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 THERMOWELLS

- A. Thermowells:
 - 1. Standard: ASME B40.200.
 - 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 - 3. Type: Stepped shank unless straight or tapered shank is indicated.
 - 4. External Threads: NPS 1/2, ASME B1.20.1 pipe threads.
 - 5. Internal Threads: 0.5, with ASME B1.1 screw threads.
 - 6. Bore: Diameter required to match thermometer bulb or stem.
 - 7. Insertion Length: Length required to match thermometer bulb or stem.
 - 8. Lagging Extension: Include on thermowells for insulated piping and tubing.
 - 9. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

- B. Heat-Transfer Medium: Mixture of graphite and glycerin .

2.4 PRESSURE GAUGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gauges:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft Inc.
 - b. Ernst Flow Industries.
 - c. Flo Fab Inc.
 - d. Marsh Bellofram.
 - e. Miljoco Corporation.
 - f. Trerice, H. O. Co.
 - g. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - h. Weiss Instruments, Inc.
 - 2. Case: Liquid-filled Sealed type(s); cast aluminum; 4.5-inch normal diameter.
 - 3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 - 4. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 - 5. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
 - 7. Pointer: Dark-colored metal.
 - 8. Window: Glass.
 - 9. Ring: Metal.
 - 10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

- B. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gauges:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft Inc.
 - b. Flo Fab Inc.
 - c. Marsh Bellofram.
 - d. Miljoco Corporation.
 - e. Trerice, H. O. Co.
 - f. Weiss Instruments, Inc.

- g. WIKA Instrument Corporation - USA.
2. Standard: ASME B40.100.
3. Case: Sealed type; plastic; 4.5-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending one-third of pipe diameter to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install direct-mounted pressure gauges in piping tees with pressure gage located on pipe at the most readable position.
- H. Install remote-mounted pressure gauges on panel.
- I. Install valve and snubber in piping for each pressure gage for fluids.
- J. Install thermometers in the following locations:
 1. Inlet and outlet of each water heater.
 2. Inlets and outlets of each domestic water heat exchanger.
 3. Inlet and outlet of each domestic hot-water storage tank.
 4. Inlet and outlet of each remote domestic water chiller.
- K. Install pressure gauges in the following locations:
 1. Building water service entrance into building.

2. Inlet and outlet of each pressure-reducing valve.
 3. Suction and discharge of each domestic water pump.
- L. Install meters and gauges adjacent to machines and equipment to allow service and maintenance of meters, gauges, machines, and equipment.
- M. Adjust faces of meters and gauges to proper angle for best visibility.

3.2 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
1. Liquid-filled, bimetallic-actuated type.
 2. Industrial-style, liquid-in-glass type.
- B. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be one of the following:
1. Liquid-filled, bimetallic-actuated type.
 2. Industrial-style, liquid-in-glass type.
- C. Thermometer stems shall be of length to match thermowell insertion length.

3.3 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.
- B. Scale Range for Domestic Hot-Water Piping: 20 to 240 deg F.

3.4 PRESSURE-GAGE SCHEDULE

- A. Pressure gauges at discharge of each water service into building shall be one of the following:
1. Liquid-filled, direct-mounted, metal case.
 2. Sealed, direct-mounted, plastic case.
- B. Pressure gauges at inlet and outlet of each water pressure-reducing valve shall be one of the following:
1. Liquid-filled, direct-mounted, metal case.
 2. Sealed, direct-mounted, plastic case.

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Water Service Piping: 0 to 100 psi.
- B. Scale Range for Domestic Water Piping: 0 to 100 psi.

END OF SECTION 220519

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Bronze ball valves.
 - 2. Bronze swing check valves.
 - 3. Bronze globe valves.

- B. Related Sections:
 - 1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.2 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.3 QUALITY ASSURANCE

- A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

- B. NSF Compliance: NSF 61 for valve materials for potable-water service.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.

- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

- C. Valve Sizes: Same as upstream piping unless otherwise indicated.

- D. Valve Actuator Types:

1. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.

- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

- F. Valve-End Connections:
 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 2. Solder Joint: With sockets according to ASME B16.18.
 3. Threaded: With threads according to ASME B1.20.1.

2.2 BRONZE BALL VALVES

- A. One-Piece, Reduced-Port, Bronze Ball Valves with Bronze Trim:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 400 psig.
 - c. Body Design: One piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE or TFE.
 - g. Stem: Bronze.
 - h. Ball: Chrome-plated brass.
 - i. Port: Reduced.

- B. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.

- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

2.3 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.

2.4 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. NIBCO INC.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.

- B. Class 125, Bronze Globe Valves with Nonmetallic Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

3.2 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 1. Shutoff Service: Ball valves.
 2. Throttling Service: Globe or ball valves.
 3. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.

- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.

3.4 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Bronze Angle Valves: Class 125, bronze disc.
 - 3. Ball Valves: One piece, full port, bronze with bronze trim.
Bronze Swing Check Valves: Class 125 disc.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Equipment supports.

1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment. Seismic restraint hangers shall be designed by a registered engineer licensed in the state of the project.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Powder-actuated fastener systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.

3. Equipment supports.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

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.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. Grinnell Corp.
3. National Pipe Hanger Corporation.
4. Anvil International

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100 psig minimum, compressive-strength insulation insert encased in sheet metal shield.

- B. Manufacturers:
 - 1. ERICO/Michigan Hanger Co.
 - 2. Pipe Shields, Inc.
 - 3. Value Engineered Products, Inc.

- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate Water-repellent treated, ASTM C 552, Type II cellular glass with vapor barrier.

- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.

- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.6 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000 psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 - 7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 - 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1.25 inches.
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

3.2 HANGER AND SUPPORT INSTALLATION

- A. **Steel Pipe Hanger Installation:** Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. **Trapeze Pipe Hanger Installation:** Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. **Pipes of Various Sizes:** Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. **Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.**
- C. **Metal Framing System Installation:** Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. **Thermal-Hanger Shield Installation:** Install in pipe hanger or shield for insulated piping. Insulation shall be continuous at all supports.
- E. **Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.**
- F. **Equipment Support Installation:** Fabricate from welded-structural-steel shapes.
- G. **Install hangers and supports to allow controlled thermal and seismic 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.**
- H. **Install lateral bracing with pipe hangers and supports to prevent swaying.**
- I. **Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.**
- J. **Load Distribution:** Install hangers and supports so piping live and dead loads 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 maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- L. Insulated Piping: Comply with the following:
1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 5. Pipes NPS 8 and Larger: Include wood inserts.
 6. Insert Material: Length at least as long as protective shield.
 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- 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 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with 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 no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touch Up: 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.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.
- C. All piping exposed in finished space shall be painted to match structure unless otherwise indicated or insulation color matches structure.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Equipment labels.
 2. Warning signs and labels.
 3. Pipe labels.

1.2 SUBMITTAL

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 0.125-inch- thick, and having predrilled holes for attachment hardware.
 2. Letter Color: Black.
 3. Background Color: Black.
 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2.5-inch by 0.75-inch.
 6. Minimum Letter Size: 0.25-inch for name of units if viewing distance is less than 24 inches, 0.5-inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 0.0625-inch-thick, and having predrilled holes for attachment hardware.

- B. Letter Color: Black.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2.5-inch by 0.75-inch.
- F. Minimum Letter Size: 0.25-inch for name of units if viewing distance is less than 24 inches, 0.5-inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1.5 inches high.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Painting."
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 100 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule:
 - 1. Domestic Water Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials:
 - a. Flexible elastomeric.
 - 2. Insulating cements.
 - 3. Adhesives.
 - 4. Mastics.
 - 5. Sealants.
 - 6. Factory-applied jackets.
 - 7. Tapes.
 - 8. Securements.
 - 9. Corner angles.

- B. Related Sections include the following:
 - 1. Division 23 Section "HVAC Insulation."

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Shop Drawings:
 - 1. Detail attachment and covering of heat tracing inside insulation.
 - 2. Detail insulation application at pipe expansion joints for each type of insulation.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- D. Flexible Elastomeric: Closed-cell materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aeroseal.
 - b. Armacell LCC; 520 Adhesive.
 - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - b. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
 - c. Marathon Industries, Inc.; 405.
 - d. Pittsburgh Corning Corporation; Pittseal 444.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.5 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fason 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fason 0827.
 - b. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - c. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fason 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.

5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.6 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 0.5-inch wide with wing or closed seal.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
- B. Staples: Outward-clinching insulation staples, nominal 0.75-inch-wide, stainless steel or Monel.

2.7 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches OC.
 - 3. Overlap jacket longitudinal seams at least 1.5 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches OC.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.

- 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.

- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.

- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Division 07 Section "Joint Sealers" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Joint Sealers."

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, 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. Each piece shall be butted tightly against adjoining piece and bonded 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 and polyolefin, install fitted PVC cover over elbows, tees, strainers, 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.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. 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.
- D. 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 long 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.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
1. Apply two (2) continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.7 FINISHES

- A. Equipment and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
1. Flat Acrylic Finish: Two (2) finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground cold or chilled piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Hot and Recirculated Hot Water: Insulation shall be the following:
 - 1. Flexible Elastomeric: 0.5-inch thick up to 1.25-inch pipe size. Provide 1-inch-thick for all piping larger than 1.25 inches.
- B. Domestic Cold Water: Insulation shall be 0.5-inch thick.
- C. Exposed, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities: Insulation shall be the following:
 - 1. Flexible Elastomeric: 0.5-inch-thick.

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 - 1. None.
- D. Piping, Exposed:
 - 1. None.

END OF SECTION 220700

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
 - 2. Flexible connectors.
 - 3. Escutcheons.
 - 4. Sleeves and sleeve seals.

1.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions as required per local authority.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Material Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L and ASTM B 88, Type M water tube, drawn temper.
 - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
5. Copper Pressure-Seal-Joint Fittings:

2.3 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
 1. Description:
 - a. Pressure Rating: 150 psig at 180 deg F.
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 1. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 150 psig.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Kits:
 1. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.
- E. Dielectric Couplings:
 1. Description:
 - a. Galvanized-steel coupling.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Female threaded.
 - d. Lining: Inert and noncorrosive, thermoplastic.
- F. Dielectric Nipples:
 1. Description:
 - a. Electroplated steel nipple complying with ASTM F 1545.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Male threaded or grooved.
 - d. Lining: Inert and noncorrosive, propylene.

2.4 FLEXIBLE CONNECTORS

- A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200.
 - 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 - 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

- B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig.
 - 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
 - 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.5 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

- B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.

- C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.

- D. One Piece, Stamped Steel: Chrome-plated finish with spring clips.

- E. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.

- F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge, spring clips.

- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.6 SLEEVES

- A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

- D. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
- E. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.7 SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Carbon steel.
 - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install shutoff valve immediately upstream of each dielectric fitting.
- D. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- E. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- F. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

- H. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- J. Install piping adjacent to equipment and specialties to allow service and maintenance.
- K. Install piping to permit valve servicing.
- L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and branch connections.
- O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- P. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
- Q. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.
- R. Install thermometers on outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

- D. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- E. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping NPS 2 and smaller. Use butterfly valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.

3.4 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for 2 inches and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for 2.5 inches and larger: Use dielectric flanges.

3.5 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.
- C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.
 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 3. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 0.375-inch.
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 3/4 and Smaller: 60 inches with 0.375-inch rod.
 2. NPS 1 and NPS 1-1/4: 72 inches with 0.375-inch rod.
 3. NPS 1-1/2 and NPS 2: 96 inches with 0.375-inch rod.
 4. NPS 2-1/2: 108 inches with 0.5-inch rod.
 5. NPS 3 to NPS 5: 10 feet with 0.5-inch rod.
 6. NPS 6: 10 feet with 0.625-inch rod.
- E. Install supports for vertical copper tubing every 10 feet.
- F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 2. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.

B. Escutcheons for New Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
4. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.9 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealers" for joint sealants.
- G. Install sleeves that are large enough to provide 0.25-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- H. Install sleeve materials according to the following applications:
 1. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
 - c. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
- I. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Joint Sealers" for firestop materials and installations.

3.10 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.

- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.11 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

3.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

- B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

- C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.13 CLEANING

- A. Clean and disinfect potable and non-potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three (3) hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.14 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller.
 - 2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Hot-Water Circulation Piping, Balancing Duty: Flow control valves.
 - 3. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Temperature-actuated water mixing valves.
 - 2. Strainers.
 - 3. Drain valves.

1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. NSF Compliance:
 - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 TEMPERATURE-ACTUATED WATER MIXING VALVES

- A. Primary, Thermostatic, Water Mixing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.

- b. Leonard Valve Company.
 - c. Powers; a Watts Industries Co.
 - d. Symmons Industries, Inc.
2. Pressure Rating: 125 psig.
 3. Type: Exposed-mounting, thermostatically controlled water mixing valve.
 4. Material: Bronze body with corrosion-resistant interior components.
 5. Connections: Threaded union inlets and outlet.
 6. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 7. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
 8. Reference drawings for temperature, flow and pressure requirements.

2.2 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Drain: Factory-installed, hose-end drain valve.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 1. Install thermometers and water regulators if specified.
 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- C. Install Y-pattern strainers for water on supply side of each control valve and pump.
- D. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.2 FIELD QUALITY CONTROL

- A. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.3 ADJUSTING

- A. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

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END OF SECTION 221119

SECTION 221123 - DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. In-line, circulating pump.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. 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.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

PART 2 - PRODUCTS

2.1 IN-LINE, CIRCULATING PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong Pumps Inc.
 - 2. Bell & Gossett Domestic Pump; ITT Corporation.
 - 3. Grundfos Pumps Corp.
 - 4. TACO Incorporated.
- B. Description: Factory-assembled and -tested, in-line, wet rotor circulation pumps.
- C. Pump Construction:
 - 1. Pump and Motor Assembly: 100 percent lead free bronze with carbon bearings and ceramic shaft.
 - 2. Casing: Bronze, with threaded or companion-flange connections.
 - 3. Impeller: Plastic.

4. Motor: Single speed, unless otherwise indicated with built in thermal protection.

- D. Capacities and Characteristics: (See Pump Schedule on Plans)

2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."
 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

2.3 CONTROLS

- A. Thermostats: Electric; adjustable for control of hot-water circulation pump.
 1. Type: Water-immersion temperature sensor, for installation in piping.
 2. Range: 65 to 200 deg F.
 3. Enclosure: NEMA 250, Type 4X.
 4. Operation of Pump: On or off.
 5. Transformer: Provide if required.
 6. Power Requirement: 120 V, ac.
 7. Settings: Start pump at 95 deg F and stop pump at 110 deg F unless otherwise indicated.

PART 3 - EXECUTION

3.1 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install continuous-thread hanger rods and spring hangers of size required to support pump weight.
 1. Comply with requirements for hangers and supports specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Install thermostats in hot-water return piping.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Division 22 Section "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Install piping adjacent to pumps to allow service and maintenance.

- C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
 - 1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
 - a. Comply with requirements for flexible connectors specified in Division 22 Section "Domestic Water Piping."
 - 2. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping" and comply with requirements for strainers specified in Division 22 Section "Domestic Water Piping Specialties."
 - 3. Install pressure gage at suction of each pump and pressure gage at discharge of each pump. Install at integral pressure-gage tapings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Comply with requirements for pressure gages and snubbers specified in Division 22 Section "Meters and Gages for Plumbing Piping."

- D. Comply with Division 26 Sections for electrical connections, and wiring methods.

- E. Connect thermostats and timers to pumps that they control.

3.3 ADJUSTING

- A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.

- B. Adjust initial temperature set points.

- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 221123

SECTION 223400 - FUEL-FIRED DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following fuel-fired water heaters:
 - 1. Direct-vent, storage, gas water heaters.
 - 2. Water heater accessories.

1.2 SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.
- D. Warranty.

1.3 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. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:

- a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Period(s): From date of Substantial Completion:
- a. Gas Water Heaters: Five years.

PART 2 - PRODUCTS

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.

2.2 DIRECT VENT, GAS WATER HEATERS

- A. Direct-Vent, Storage, Gas Water Heaters: Comply with ANSI Z21.10.1/CSA 4.1.
1. Manufacturers:
 - a. Bradford White Corporation.
 - b. Rheem Water Heater Div.; Rheem Manufacturing Company.
 - c. Ruud Water Heater Div.; Rheem Manufacturing Company.
 - d. A.O. Smith
 2. Storage-Tank Construction: Steel.
 - a. Tappings: Non-ASME B1.20.1 pipe thread. Provide ASME rated tank for all units with heater larger than 199 MBH
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
 3. Factory-Installed, Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1-2004.
 - e. Jacket: Steel with enameled finish.
 - f. Burner: For use with direct-vent water heaters.
 - g. Automatic Ignition: ANSI Z21.20, electric, automatic, gas-ignition system.
 - h. Temperature Control: Adjustable thermostat.
 - i. Add Safety controls.
 - j. Add Comb. Temp and pressure relief valves
 - k. Heat Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.

- I. Combination Temperature and Pressure Relief Valve: ANSI Z21.22/CSA 4.4. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
 4. Direct-Vent System: Through-wall or roof, coaxial- or double-channel, vent assembly with water heater manufacturers' outside intake/exhaust screen per drawings.
- B. Reference Schedule for Capacity and Characteristics:

2.3 WATER HEATER ACCESSORIES

- A. Gas Shutoff Valves: ANSI Z21.15/CGA 9.1, manually operated. Furnish for installation in piping.
- B. Gas Pressure Regulators: ANSI Z21.18, appliance type. Include pressure rating, capacity, and pressure differential required between gas supply and water heater.
- C. Gas Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.
- D. Water Heater Stands: Water heater manufacturer's factory-fabricated steel stand for floor mounting and capable of supporting water heater and water. Provide dimension that will support bottom of water heater a minimum of 18 inches above the floor.
- E. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.
- F. Drain Pans: Corrosion-resistant metal with raised edge. Provide dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.
- G. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1-2004.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

- A. Install commercial water heaters on concrete bases.
 1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket or suspended platform.
 2. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

- B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

- C. Install gas water heaters according to NFPA 54.
 - 1. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.
 - 2. Install gas pressure regulators on gas supplies to gas water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
 - 3. Install automatic gas valves on gas supplies to gas water heaters, if required for operation of safety control.

- D. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial, water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain or as otherwise noted.

- E. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.

- F. Install thermometer on outlet piping of water all heaters. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

- G. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.

- H. Fill water heaters with water.

- I. Provide insulated compression tank for all water heaters.

3.2 CONNECTIONS

- A. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.

- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Engage a factory-authorized service representative to inspect installation, including connections.

- B. Perform the following field tests and inspections:
 - 1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial water heaters.

END OF SECTION 223400

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Sleeves.
 - 5. Escutcheons.
 - 6. HVAC demolition.
 - 7. Equipment installation requirements common to equipment sections.
 - 8. Supports and anchorages.

1.2 DEFINITIONS

- A. Design Engineer, hereinafter abbreviated D/E shall mean the Engineering firm, Malone Finkle Eckhardt & Collins, Inc., Telephone (913) 322-1400. Contact person: Brian Clark.
- B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- D. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- E. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- F. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 QUALITY ASSURANCE

- A. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- B. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting

electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements. Mechanical Contractor shall include all additional costs incurred by electrical contractor within bid.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 0.125-inch maximum thickness unless thickness or specific material is indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- E. Welding Filler Metals: Comply with AWS D10.12.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Carbon steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, duct and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" for requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.

3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
1. Piping installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to piping layout.
 2. Suspend ceiling components.
 3. Structural members to which piping will be attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Penetrations of smoke barriers and fire-rated construction.
 6. Coordination between other trades.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes and required per industry standards.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation and approved hanger/supports per Division 22.

- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop materials. Refer to Division 07 Section "Joint Sealers" for materials.
- O. Verify final equipment locations for roughing-in.
- P. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- Q. All exterior piping shall be painted unless otherwise indicated. All pipe shall be painted with one primer coat and two finish coats. All pipe insulation exposed to exterior shall be painted with two (2) coats of UV resistant paint or provided with aluminum jacket.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Joints shall not be installed underground beneath buildings.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.8 GENERAL REQUIREMENTS

- A. Provide every device and accessory necessary for proper operation and completion of mechanical system. Visit site and determine existing local conditions affecting work in contract. Failure to determine site conditions or nature of existing or new construction will not be considered a basis for granting additional compensation.

- B. Provide work in accordance with applicable codes, rules, ordinances, and regulations of Local, State and Federal Government and other authorities having lawful jurisdiction. Conform to latest editions and supplements of following codes, standards or recommended practices as adopted by the authority having jurisdiction. Drawings and specifications indicate minimum construction standards, but should any work indicated be sub-standard to any ordinances, laws or codes, rules or regulations bearing on work, Contractor shall execute work in accordance with such without increased cost to owner, but not until he has referred such variances to A/E for approval.
 - a. Applicable Codes:
 1. 2015 International Plumbing Code
 2. 2015 International Mechanical Code
 3. 2015 International Building Code
 4. 2015 International Fire Code
 5. NFPA No. 54 Gas Appliance and Gas Piping Code, Current Edition
 6. NFPA No. 89M Clearances, Heat Producing Appliances, Current Edition
 7. NFPA NO. 90A Air Conditioning and Ventilation Systems, Current Edition
 8. NFPA NO. 91 Blower and Exhaust System, Current Edition
- C. M/C shall secure and pay for necessary permits and certificates of inspection required by governmental ordinances, laws, rules or regulations. Keep a written record of all permits and inspection certificates and submit two copies to A/E with request for final inspection.
- D. M/C shall perform initial start-up of systems and equipment and shall provide necessary supervision and labor to make first seasonal changeover of systems. Personnel qualified to start-up and service this equipment, including E/M's technicians when specified, and Owner's operating personnel shall be present during these operations.

3.9 CONTRACT CHANGES:

- A. All change proposals shall be itemized indicating separately the costs for materials, labor, restocking charges, freight, bonds, insurance, overhead and profit. All materials shall be listed separately with quantities and individual unit prices. Labor factors shall be from a nationally recognized source with appropriate adjustment factors. If proposals are not itemized they will be rejected and returned for proper submittal. The maximum allowable profit for any change order shall be ten percent (10%).

3.10 PRE-FINAL AND FINAL CONSTRUCTION REVIEW

- A. At M/C's request, A/E will make pre-final construction review to determine if to the best of their knowledge project is completed in accordance with plans and specifications. Items found by A/E as not complete or not in accordance with requirements of contract will be outlined in report to M/C. After completion and/or correction of these items M/C shall notify A/E he is ready for final review. All necessary system adjustments including air and water systems balancing shall be completed and all specified records and reports submitted in sufficient time to be received by A/E at least ten working days prior to date of final construction review.
- B. At final construction review, M/C and his major subcontractors shall be present or shall be represented by a person of authority. Each contractor shall demonstrate, as directed by A/E,

that his work complies with purpose and intent of plans and specifications. Respective contractor shall provide labor, services, instruments or tools necessary for such demonstrations and tests.

3.11 ELECTRICAL REQUIREMENTS

- A. Consult Division 26 of electrical specifications for work to be provided by E/C in conjunction with installation of mechanical equipment. Electrical work required to operate and/or control mechanical equipment which is not shown on plans or specified under Division 26 shall be included in M/C's base bid proposal.
- B. M/C shall be responsible for providing supervision to E/C to insure that required connections, interlocking and interconnection of mechanical and electrical equipment are made to attain intended control sequences and system operation. Furnish six complete sets of electrical wiring diagrams to A/E and three complete sets to E/C. Diagrams shall show factory and field wiring of components and controls. Control devices and field wiring to be provided by E/C shall be clearly indicated by notation and drawing symbols on wiring diagrams.
- C. Safety disconnect switches and manual magnetic motor starters shall be provided by E/C. Exceptions will be allowed where mechanical equipment is specified with these devices installed as part of factory built control systems.

END OF SECTION 230500

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.

- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 3254T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.

- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

- D. Motors 1/20 HP and Smaller: Shaded-pole type.

- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230519 - METERS AND GAUGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Liquid-in-glass thermometers.
 - 2. Thermowells.
 - 3. Dial-type pressure gauges.
 - 4. Gauge attachments.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flo Fab Inc.
 - b. Miljoco Corporation.
 - c. Palmer Wahl Instrumentation Group.
 - d. Tel-Tru Manufacturing Company.
 - e. Trerice, H. O. Co.
 - f. Weiss Instruments, Inc.
 - g. Winters Instruments - U.S.
 - 2. Standard: ASME B40.200.
 - 3. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
 - 4. Case Form: Adjustable angle unless otherwise indicated.
 - 5. Tube: Glass with magnifying lens and blue or red organic liquid.
 - 6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
 - 7. Window: Plastic.
 - 8. Stem: Aluminum and of length to suit installation.
 - a. Design for Air-Duct Installation: With ventilated shroud.
 - b. Design for Thermowell Installation: Bare stem.
 - 9. Connector: 1.25 inches, with ASME B1.1 screw threads.
 - 10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 DUCT-THERMOMETER MOUNTING BRACKETS

- A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.3 THERMOWELLS

- A. Thermowells:
1. Standard: ASME B40.200.
 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 3. Material for Use with Copper Tubing: CNR or CUNI.
 4. Material for Use with Steel Piping: CRES.
 5. Type: Stepped shank unless straight or tapered shank is indicated.
 6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
 7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
 8. Bore: Diameter required to match thermometer bulb or stem.
 9. Insertion Length: Length required to match thermometer bulb or stem.
 10. Lagging Extension: Include on thermowells for insulated piping and tubing.
 11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

2.4 PRESSURE GAUGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gauges:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Flo Fab Inc.
 - d. Marsh Bellofram.
 - e. Miljoco Corporation.
 - f. Palmer Wahl Instrumentation Group.
 - g. Tel-Tru Manufacturing Company.
 - h. Trerice, H. O. Co.
 - i. Weiss Instruments, Inc.
 - j. Winters Instruments - U.S.
 2. Standard: ASME B40.100.
 3. Case: Liquid-filled type; cast aluminum or drawn steel; 4.5-inch nominal diameter.
 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 6. Movement: Mechanical, with link to pressure element and connection to pointer.
 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
 8. Pointer: Dark-colored metal.
 9. Window: Plastic.
 10. Ring: Metal.

11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 GAUGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Siphons: Loop-shaped section of brass pipe with NPS 1/4 or NPS 1/2 pipe threads.
- C. Valves: Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.
- G. Install direct-mounted pressure gauges in piping tees with pressure Gauge located on pipe at the most readable position.
- H. Install valve and snubber in piping for each pressure Gauge for fluids (except steam).
- I. Install thermometers in the following locations:
 1. Inlet and outlet of each hydronic boiler.
 2. Inlet and outlet of each hydronic coil in air-handling units.
- J. Install pressure Gauges in the following locations:
 1. Discharge of each pressure-reducing valve.
 2. Suction and discharge of each pump.

3.2 CONNECTIONS

- A. Install meters and adjacent to machines and equipment to allow service and maintenance of meters, gauges, machines, and equipment.

3.3 ADJUSTING

- A. Adjust faces of meters and gauges to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each hydronic boiler shall be the following:
 - 1. Industrial-style, liquid-in-glass type.
- B. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be the following:
 - 1. Industrial-style, liquid-in-glass type.
- C. Thermometer stems shall be of length to match thermowell insertion length.

3.5 PRESSURE-GAUGE SCHEDULE

- A. Pressure gauges at discharge of each pressure-reducing valve shall be the following:
 - 1. Liquid-filled, direct-mounted, metal case.
- B. Pressure gauges at suction and discharge of each pump shall be the following:
 - 1. Liquid-filled, direct-mounted, metal case.

END OF SECTION 230519

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Iron, single-flange butterfly valves.
3. Bronze swing check valves.
4. Iron swing check valves with closure control.
5. Chainwheels.

B. Related Sections:

1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.2 SUBMITTALS

- A. Product Data:** For each type of valve indicated.

1.3 QUALITY ASSURANCE

- A. Source Limitations for Valves:** Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:** ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.**
- B. Valve Pressure and Temperature Ratings:** Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes:** Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller.
4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bray Controls; a division of Bray International.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 150 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.

2.4 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze Swing Check Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - l. Zy-Tech Global Industries, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.5 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

- A. Class 125, Iron Swing Check Valves with Spring-Closure Control:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane.
 - b. NIBCO INC.
 - c. Milwaukee
 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Design: Clear or full waterway.
 - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - f. Ends: Flanged.
 - g. Trim: Bronze.
 - h. Gasket: Asbestos free.
 - i. Closure Control: Factory-installed, exterior spring.

2.6 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Babbitt Steam Specialty Co.
 2. Roto Hammer Industries.
 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 2. Attachment: For connection to butterfly valve stems.
 3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for butterfly valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly valves.
 - 2. Throttling Service: Ball or butterfly valves.
 - 3. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
 - b. NPS 2-1/2 and Larger: Iron swing check valves with spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

- C. Select valves, except wafer types, with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Ball Valves: Two piece, full port, bronze with stainless steel trim.
 3. Bronze Swing Check Valves: Class 125 disc.
- B. Pipe NPS 2-1/2 and Larger:
1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, aluminum-bronze disc.
 3. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12: Class 125, lever and spring.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Equipment supports.

- B. See Division 21 Sections for pipe hangers for fire-protection piping.

- C. See Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

- B. Manufacturer's Standardization Society (MSS) specification.

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

- C. Design seismic-restraint hangers and supports for piping and equipment as per local authority.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.

3. Powder-actuated fastener systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
1. Trapeze pipe hangers. Include Product Data for components.
 2. Metal framing systems. Include Product Data for components.
 3. Equipment supports.
- C. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

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.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Available Manufacturers:
1. B-Line Systems, Inc.; a division of Cooper Industries.
 2. Tolco
 3. Empire Industries, Inc.
 4. ERICO/Michigan Hanger Co.
 5. Globe Pipe Hanger Products, Inc.
 6. Grinnell Corp.
 7. National Pipe Hanger Corporation.
 8. PHD Manufacturing, Inc.
 9. PHS Industries, Inc.
 10. Anvil International
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Available Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. Power-Strut Div.; Tyco International, Ltd.
 - 3. Thomas & Betts Corporation.
 - 4. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig-minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Available Manufacturers:
 - 1. PHS Industries, Inc.
 - 2. Pipe Shields, Inc.
 - 3. Rilco Manufacturing Company, Inc.
- C. Insulation-Insert Material for Cold Hydronic Piping over 4 inches in Diameter: Insulate hangers and supports from direct contact with cold surfaces with Styrofoam HD-300 plastic foam inserts of half or full sections of premolded pipe insulation equal in thickness to adjoining insulation. Provide inserts with vapor barrier jacket for lapping 2 inches over adjacent pipe insulation jacket. Protect insulation with insulation shields supporting lower 180 degrees of pipe insulation sized so that pipe compressive load does not exceed one third of insulation insert compressive strength. Seal joints with vapor barrier sealer specified for insulation type used.

- D. Insulation-Insert Material for Hot Hydronic Piping over 4 inches in diameter: Insulate hangers and supports from direct contact with cold surfaces with Styrofoam HD-300 plastic foam inserts of half or full sections of premolded pipe insulation equal in thickness to adjoining insulation. Provide inserts with vapor barrier jacket for lapping 2 inches over adjacent pipe insulation jacket. Protect insulation with insulation shields supporting lower 180 degrees of pipe insulation sized so that pipe compressive load does not exceed one third of insulation insert compressive strength. Seal joints with vapor barrier sealer specified for insulation type used.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Available Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Hilti, Inc.
 - c. ITW Ramset/Red Head.
 - d. Powers Fasteners.

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 - 7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 - 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
 - 3. Provide cast iron soil pipe support at every floor and steel and copper tubing at every other floor except where otherwise indicated.

- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 10. Provide steel wall bracket for piping supported from walls. Brackets shall be carbon steel and selected to meet load. Finish shall be hot dip galvanized in outdoor applications and 304 stainless steel in corrosive areas.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1.25 inches.
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- O. Provide combination pipe saddle with adjustor to support piping from floor. Provide complete with pedestal type floor stand.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

- H. Install hangers and supports to allow controlled thermal and seismic 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. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 and Larger: Include wood inserts.
 - 6. Insert Material: Length at least as long as protective shield.
 - 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
 - 8. Mount hangers for insulated piping on outside of pipe, hangers sized to allow for full thickness of insulation. Insulation shall be continuous at all supports.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- 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 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with 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 no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touch Up: 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.
- B. 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 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Equipment labels.
 2. Warning signs and labels.
 3. Pipe labels.
 4. Duct labels.
 5. Stencils.
 6. Valve tags.
 7. Warning tags.

1.2 SUBMITTAL

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
1. 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:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. Craftmark Pipe Markers.
 - d. Marking Services, Inc.
 - e. Seton Identification Products.
 2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 0.625-inch thick, and having predrilled holes for attachment hardware.
 3. Letter Color: White.
 4. Background Color: Black.
 5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 6. Minimum Label Size: Length and width vary for required label content, but not less than 2.5-inch by 0.75-inch.
 7. Minimum Letter Size: 0.25-inch for name of units if viewing distance is less than 24 inches, 0.5-inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

8. Fasteners: Stainless steel rivets or self-tapping screws.
 9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules), plus the specification section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8.5-inch by 11-inch bond paper. Tabulate equipment identification number and identify drawing numbers where equipment is indicated (plans, details, and schedules), plus the specification section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- 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:
1. Brady Corporation.
 2. Carlton Industries, LP.
 3. Craftmark Pipe Markers.
 4. Marking Services Inc.
 5. Seton Identification Products.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
- C. Letter Color: Red.
- D. Background Color: White.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- G. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

- 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:
 - 1. Brady Corporation.
 - 2. Carlton Industries, LP.
 - 3. Craftmark Pipe Markers.
 - 4. Marking Services Inc.
 - 5. Seton Identification Products.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1.5 inches high.

2.4 DUCT LABELS

- 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:
 - 1. Brady Corporation.
 - 2. Carlton Industries, LP.
 - 3. Craftmark Pipe Markers.
 - 4. Marking Services Inc.
 - 5. Seton Identification Products.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
- C. Letter Color: Black.
- D. Background Color: White.

- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- G. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

2.5 STENCILS

- A. Stencils for Ducts:
 - 1. 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:
 - a. Carlton Industries, LP.
 - b. Craftmark Pipe Markers.
 - c. Marking Sevcies Inc.
 - 2. Lettering Size: Minimum letter height of 1-1/4 inches (32 mm) for viewing distances up to 15 feet (4-1/2 m) and proportionately larger lettering for greater viewing distances.
 - 3. Stencil Material: Aluminum.
 - 4. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.
 - 5. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.
- B. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:
 - 1. 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:
 - a. Carlton Industries, LP.
 - b. Craftmark Pipe Markers.
 - c. Marking Sevcies Inc.

2. Lettering Size: Minimum letter height of 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm) and proportionately larger lettering for greater viewing distances.
3. Stencil Material: Aluminum.
4. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.
5. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.

2.6 WARNING TAGS

- 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:
 1. Brady Corporation.
 2. Carlton Industries, LP.
 3. Craftmark Pipe Markers.
 4. Marking Services Inc.
 5. Seton Identification Products.
- B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
 1. Size: Approximately 4 by 7 inches (100 by 178 mm).
 2. Fasteners: Reinforced grommet and wire or string.
 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 4. Color: Safety-yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Painting."

- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

- C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

- D. Pipe Label Color Schedule:
 - 1. Chilled-Water Piping: White letters on a safety-green background.
 - 2. Condenser-Water Piping: White letters on a safety-green background.
 - 3. Heating Water Piping: White letters on a safety-green background.

3.4 DUCT LABEL INSTALLATION

- A. Install plastic-laminated self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.
 - 2. Yellow: For hot-air supply ducts.
 - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.

- B. Stenciled Duct Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.

- C. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 - 2. Balancing Hydronic Piping Systems:
 - a. Primary-secondary hydronic systems.
 - 3. Testing, Adjusting, and Balancing Equipment:
 - a. Heat exchangers.
 - b. Motors.
 - c. Chillers.
 - d. Cooling towers.
 - e. Boilers.
 - 4. Testing, adjusting, and balancing existing systems and equipment.
 - 5. Duct leakage tests.
 - 6. Control system verification.

1.2 DEFINITIONS

- A. BAS: Building automation systems.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TAB Specialist: An entity engaged to perform TAB Work.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 60 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 90 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

- C. Strategies and Procedures Plan: Within 90 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. System Readiness Checklists: Within 90 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.
- G. Sample report forms.
- H. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.4 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by NEBB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by NEBB.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by NEBB as a TAB technician.
- B. Certify TAB field data reports and perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this specification.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by Architect.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

- A. Subject to compliance with requirements, engage one of the following:
 - 1. Pro Balance – Duke Yeokum (816) 228-7800.
 - 2. Precisionaire of the Midwest, Inc. – David Keller (816) 847-1380.
 - 3. C & C Group – Brent Blankenship (913) 888-6200
 - 4. Doyle Field Services – Dennis Doyle (913) 677-3374
 - 5. Total Air Balance, LLC – Bill Trotter (417) 207-9999

3.2 EXAMINATION

- A. Examine the contract documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.

- H. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- K. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.
- L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- M. Examine system pumps to ensure absence of entrained air in the suction piping.
- N. Examine operating safety interlocks and controls on HVAC equipment.
- O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

- A. Prepare a TAB plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Airside:
 - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
 - b. Duct systems are complete with terminals installed.
 - c. Volume, smoke, and fire dampers are open and functional.
 - d. Clean filters are installed.
 - e. Fans are operating, free of vibration, and rotating in correct direction.
 - f. Variable-frequency controllers' startup is complete and safeties are verified.
 - g. Automatic temperature-control systems are operational.
 - h. Ceilings are installed.
 - i. Windows and doors are installed.
 - j. Suitable access to balancing devices and equipment is provided.

2. **Hydronics:**
 - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
 - b. Piping is complete with terminals installed.
 - c. Water treatment is complete.
 - d. Systems are flushed, filled, and air purged.
 - e. Strainers are pulled and cleaned.
 - f. Control valves are functioning per the sequence of operation.
 - g. Shutoff and balance valves have been verified to be 100 percent open.
 - h. Pumps are started and proper rotation is verified.
 - i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
 - j. Variable-frequency controllers' startup is complete and safeties are verified.
 - k. Suitable access to balancing devices and equipment is provided.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
 1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.

- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 - 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 - 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 - 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
 - C. Measure air outlets and inlets without making adjustments.
 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
 - D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the contract documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.

3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record final fan-performance data.

3.8 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 1. Open all manual valves for maximum flow.
 2. Check liquid level in expansion tank.
 3. Check makeup water-station pressure gauge for adequate pressure for highest vent.
 4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 6. Set system controls so automatic valves are wide open to heat exchangers.
 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.9 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

- A. Balance the primary circuit flow first.
- B. Balance the secondary circuits after the primary circuits are complete.

- C. Adjust pumps to deliver total design gpm.
 - 1. Measure total water flow.
 - a. Position valves for full flow through coils.
 - b. Measure flow by main flow meter, if installed.
 - c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
 - 2. Measure pump TDH as follows:
 - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
 - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
 - c. Convert pressure to head and correct for differences in gage heights.
 - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
 - 3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

- D. Adjust flow-measuring devices installed in mains and branches to design water flows.
 - 1. Measure flow in main and branch pipes.
 - 2. Adjust main and branch balance valves for design flow.
 - 3. Re-measure each main and branch after all have been adjusted.

- E. Adjust flow-measuring devices installed at terminals for each space to design water flows.
 - 1. Measure flow at terminals.
 - 2. Adjust each terminal to design flow.
 - 3. Re-measure each terminal after it is adjusted.
 - 4. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
 - 5. Perform temperature tests after flows have been balanced.

- F. For systems with pressure-independent valves at terminals:
 - 1. Measure differential pressure and verify that it is within manufacturer's specified range.
 - 2. Perform temperature tests after flows have been verified.

- G. For systems without pressure-independent valves or flow-measuring devices at terminals:
 - 1. Measure and balance coils by either coil pressure drop or temperature method.
 - 2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

- H. Verify final system conditions as follows:
 - 1. Re-measure and confirm that total water flow is within design.
 - 2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.

3. Mark final settings.

I. Verify that memory stops have been set.

3.10 PROCEDURES FOR HEAT EXCHANGERS

A. Adjust water flow to within specified tolerances.

B. Measure inlet and outlet water temperatures.

C. Check settings and operation of safety and relief valves. Record settings.

3.11 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.12 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
6. Capacity: Calculate in tons of cooling.

3.13 PROCEDURES FOR BOILERS

- A. Hydronic Boilers:
 - 1. Measure and record entering- and leaving-water temperatures.
 - 2. Measure and record water flow.
 - 3. Record relief valve pressure setting.

3.14 DUCT LEAKAGE TESTS

- A. Witness the duct pressure testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified tolerances.
- C. Report deficiencies observed.

3.15 CONTROLS VERIFICATION

- A. In conjunction with system balancing, perform the following:
 - 1. Verify temperature control system is operating within the design limitations.
 - 2. Confirm that the sequences of operation are in compliance with Contract Documents.
 - 3. Verify that controllers are calibrated and function as intended.
 - 4. Verify that controller set points are as indicated.
 - 5. Verify the operation of lockout or interlock systems.
 - 6. Verify the operation of valve and damper actuators.
 - 7. Verify that controlled devices are properly installed and connected to correct controller.
 - 8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
 - 9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.
- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.16 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 - 1. Measure and record the operating speed, airflow, and static pressure of each fan.
 - 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 - 3. Check the refrigerant charge.
 - 4. Check the condition of filters.
 - 5. Check the condition of coils.
 - 6. Check the operation of the drain pan and condensate-drain trap.

7. Check bearings and other lubricated parts for proper lubrication.
 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
1. New filters are installed.
 2. Coils are clean and fins combed.
 3. Drain pans are clean.
 4. Fans are clean.
 5. Bearings and other parts are properly lubricated.
 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
 4. Balance each air outlet.

3.17 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
 2. Air Outlets and Inlets: Plus or minus 10 percent.
 3. Heating-Water Flow Rate: Plus or minus 10 percent.
 4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.18 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in

systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.19 **FINAL REPORT**

- A. **General:** Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
 3. Certify validity and accuracy of field data.
 4. Provide 5 paper copies of the final report.
 5. Provide a digital copy of the final report in PDF format on CD-ROM.
- B. **Final Report Contents:** *In addition to certified field-report data, include the following:*
1. Pump curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance; do not include shop drawings and product data.
- C. **General Report Data:** *In addition to form titles and entries, include the following data:*
1. Title page.
 2. Name and address of the TAB contractor.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.

- e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches (mm), and bore.
 - i. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches (mm), and bore.
 - f. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Filter static-pressure differential in inches wg (Pa).
 - f. Preheat-coil static-pressure differential in inches wg (Pa).
 - g. Cooling-coil static-pressure differential in inches wg (Pa).
 - h. Heating-coil static-pressure differential in inches wg (Pa).
 - i. Outdoor airflow in cfm (L/s).
 - j. Return airflow in cfm (L/s).
 - k. Outdoor-air damper position.
 - l. Return-air damper position.

m. Vortex damper position.

F. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches (mm), and bore.
 - h. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches (mm), and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
 - g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Suction static pressure in inches wg (Pa).

3.20 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager.
- B. Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- E. If TAB work fails, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.

F. Prepare test and inspection reports.

3.21 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulation Materials:
 - a. Cellular glass.
 - b. Flexible elastomeric.
 - c. Mineral fiber.
2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied jackets.
9. Tapes.
10. Securements.
11. Corner angles.

B. Related Sections:

1. Division 22 Section "Plumbing Insulation."

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

C. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. **Fire-Test-Response Characteristics:** Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. **Cellular Glass:** Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cell-U-Foam Corporation; Ultra-CUF.
 - b. Pittsburgh Corning Corporation; Foamglas Super K.
 2. Block Insulation: ASTM C 552, Type I.
 3. Special-Shaped Insulation: ASTM C 552, Type III.
 4. Board Insulation: ASTM C 552, Type IV.
 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 6. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
 7. Factory fabricated shapes according to ASTM C 450 and ASTM C 585.

- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.

- H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Owens Corning; All-Service Duct Wrap.

2.2 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; FlameChek.
 - b. Johns Manville; Firetemp Wrap.
 - c. Thermal Ceramics; FireMaster Duct Wrap.
 - d. 3M; Fire Barrier Wrap Products.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

- B. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-96.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-33.
 - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aeroseal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.

2.5 SEALANTS

- A. Joint Sealants:
1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
 - c. Pittsburgh Corning Corporation; Pittseal 444.
 2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-70.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following:
 - a. Childers Products, Division of ITW; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.

3. Color: Color-code jackets based on system. Color as selected by Architect.
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
 5. Factory-fabricated tank heads and tank side panels.
- D. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
 2. Sheet and roll stock ready for shop or field sizing.
 3. Finish and thickness are indicated in field-applied jacket schedules.
 4. Moisture Barrier for Indoor Applications: 1-mil thick, heat-bonded polyethylene and kraft paper.
 5. Moisture Barrier for Outdoor Applications: 3-mil thick, heat-bonded polyethylene and kraft paper.
 6. Factory-Fabricated Fitting Covers:
 - a. Same material, finish, and thickness as jacket.
 - b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - c. Tee covers.
 - d. Flange and union covers.
 - e. End caps.
 - f. Beveled collars.
 - g. Valve covers.
 - h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- E. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.
1. Products: Subject to compliance with requirements, provide the following:
 - a. Polyguard; Alumaguard 60.

2.8 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 0.5-inch wide with closed seal.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
- B. Insulation Pins and Hangers:

1. **Metal, Adhesively Attached, Perforated-Base Insulation Hangers:** Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. **Products:** Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. **Baseplate:** Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. **Spindle Aluminum,** fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. **Adhesive:** Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
2. **Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers:** Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. **Products:** Subject to compliance with requirements, provide one of the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
3. **Self-Sticking-Base Insulation Hangers:** Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. **Products:** Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. **Baseplate:** Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. **Spindle:** Aluminum, fully annealed, 0.106-inch diameter shank, length to suit depth of insulation indicated.
 - d. **Adhesive-backed base** with a peel-off protective cover.

2.9 CORNER ANGLES

- A. **PVC Corner Angles:** 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. **Aluminum Corner Angles:** 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1.5 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at **2 inches** o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.3 PENETRATIONS

- A. **Insulation Installation at Roof Penetrations:** Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.

- B. **Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated):** Install insulation continuously through walls and partitions.

- C. **Insulation Installation at Fire-Rated Wall and Partition Penetrations:** Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - 1. Comply with requirements in Division 07 Section "Joint Sealers" for firestopping and fire-resistive joint sealers.

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

- B. **Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:**
 - 1. Install insulation over fittings, 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. Each piece shall be butted tightly against adjoining piece and bonded 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 and polyolefin, install fitted PVC cover over elbows, tees, strainers, 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.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. 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.
- D. 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 long 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.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 MINERAL-FIBER INSULATION INSTALLATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps

to adjacent insulation section with 0.5-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

- a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.8 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.9 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Joint Sealers."

3.10 FINISHES

- A. Duct, Equipment, and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
 - 1. Flat Acrylic Finish: Two (2) finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited two (2) location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
 - 2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to two location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 - 3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three (3) locations of welded fittings, two (2) locations of threaded strainers, two (2) locations of welded strainers, three (3) locations of threaded valves, and three (3) locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.12 BOILER BREECHING INSULATION SCHEDULE

- A. Round, Exposed Breeching and Connector: High-temperature mineral-fiber blanket, 3 inches thick and 3-lb/cu. ft. nominal density.

3.13 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
 - 4. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
 - 5. Outdoor, concealed supply and return.
 - 6. Outdoor, exposed supply and return.

- B. Items Not Insulated:
 - 1. Fibrous-glass ducts.
 - 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 - 3. Factory-insulated flexible ducts.
 - 4. Factory-insulated plenums and casings.
 - 5. Flexible connectors.
 - 6. Vibration-control devices.
 - 7. Factory-insulated access panels and doors.

3.14 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket, 1.5 inches thick and 1.5-lb/cu. ft. nominal density. Double this thickness on attics or other unconditioned places.

- B. Concealed, Return-Air Duct and Plenum Insulation: Mineral-fiber blanket, 1.5 inches thick and 1.5-lb/cu. ft. nominal density.

- C. Concealed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber blanket 3 inches thick and 3-lb/cu. ft. nominal density.

- D. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

- E. Exposed, Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket, 1.5 inches thick and 1.5-lb/cu. ft. nominal density.

- F. Exposed, Return-Air Duct and Plenum Insulation: Mineral-fiber blanket, 1.5 inches thick and 1.5-lb/cu. ft. nominal density.

- G. Exposed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber blanket, 3 inches thick and 1.5-lb/cu. ft. nominal density.
- H. Exposed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

3.15 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
- C. Heat-Exchanger (Water-to-Water for Heating Service) Insulation: Mineral-fiber pipe and tank, 2 inches thick.
- D. Dual-service heating and cooling pump insulation shall be one of the following:
 - 1. Cellular Glass: 3 inches thick.
 - 2. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
- E. Heating-Hot-Water Pump Insulation: Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
- F. Chilled-water expansion/compression tank insulation shall be the following:
 - 1. Flexible Elastomeric: 1 inch thick.
- G. Dual-service heating and cooling expansion/compression tank insulation shall be the following:
 - 1. Flexible Elastomeric: 1 inch thick.
- H. Heating-Hot-Water Expansion/Compression Tank Insulation: Mineral-Fiber Pipe and Tank: 1 inch thick.
- I. Chilled-water air-separator insulation shall be the following:
 - 1. Flexible Elastomeric: 1 inch thick.
- J. Dual-service heating and cooling air-separator insulation shall be the following:
 - 1. Flexible Elastomeric: 1 inch thick.
- K. Heating-Hot-Water Air-Separator Insulation: Mineral-Fiber Pipe and Tank: 2 inches thick.

3.16 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.17 INDOOR PIPING INSULATION SCHEDULE

- A. Chilled Water, above 40 Deg F: Insulation shall be one of the following:
 - 1. Cellular Glass: 2 inches thick.
 - 2. Flexible Elastomeric: 1 inch thick.

- B. Heating-Hot-Water Supply and Return, 200 Deg F and below: Insulation shall be the following:
 - 1. Cellular Glass: 2 inches thick.

3.18 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

- B. If more than one material is listed, selection from materials listed is Contractor's option.

- C. Piping, Concealed:
 - 1. PVC, Color-Coded by System: 20 mils thick.

- D. Piping, Exposed:
 - 1. PVC, Color-Coded by System: 20 mils thick.

END OF SECTION 230700

SECTION 230923 - DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. The intent of the scope of this specification is to specify the requirements for the replacement of the existing DDC system software, front end system, and controllers for the Mount Vernon Veteran's Home in Mount Vernon, MO.
- B. A new front end control system with color software graphics shall be provided and installed to completely replace the existing system. This new Building DDC system shall be connected to the building ethernet local area network for local access to the system from any connected on-site computer, but it shall not be connected to the internet and shall not be accessible from off-site.
- C. All DDC controllers serving existing equipment shall be replaced with new controllers on a one-for-one basis.
- D. All DDC controllers required by new and/or replaced equipment are not required to be a one-for-one replacement but shall be designed in the best manner to meet the requirements of the equipment and systems that they serve.
- E. All duct-mounted, pipe-mounted, and equipment mounted pressure, temperature, flow sensors, flow switches, transducers, relays, etc. shall be replaced.
- F. All low voltage wiring between controllers and sensors can remain if it is compatible with the new sensors and controllers.
- G. **Contractor shall verify that all systems comply with Mount Vernon Veteran's Home wireless Wander-Guard system.**

1.2 RELATED DOCUMENTS

- A. All work of this Division shall be coordinated and provided by the Building Automation System (BAS) Contractor.
- B. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Division 23 Sections for details.

- C. The work of this Division shall be as required by the Specifications, Point Schedules and Drawings.
- D. If the BAS Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the design team.

1.3 DEFINITIONS

- A. Analog: A continuously variable system or value not having discrete levels. Typically exists within a defined range of limiting values.
- B. Binary: A two-state system where an "ON" condition is represented by one discrete signal level and an "OFF" condition is represented by a second discrete signal level.
- C. Building Automation System (BAS): The total integrated system of fully operational and functional elements, including equipment, software, programming, and associated materials, to be provided by this Division BAS Contractor and to be interfaced to the associated work of other related trades.
- D. BAS Contractor: The Contractor to provide the work of this Division. This Contractor shall be the primary manufacturer, installer, commissioner and ongoing service provider for the BAS work.
- E. Control Sequence: A BAS pre-programmed arrangement of software algorithms, logical computation, target values and limits as required to attain the defined operational control objectives.
- F. Direct Digital Control: The digital algorithms and pre-defined arrangements included in the BAS software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and Integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.
- G. BAS Network: The total digital on-line real-time interconnected configuration of BAS digital processing units, workstations, panels, sub-panels, controllers, devices and associated elements individually known as network nodes. May exist as one or more fully interfaced and integrated sub-networks, LAN, WAN or the like.
- H. Node: A digitally programmable entity existing on the BAS network.

- I. **BAS Integration:** The complete functional and operational interconnection and interfacing of all BAS work elements and nodes in compliance with all applicable codes, standards and ordinances so as to provide a single coherent BAS as required by this Division.

- J. **Provide:** The term “Provide” and its derivatives when used in this Division shall mean to furnish, install in place, connect, calibrate, test, commission, warrant, document and supply the associated required services ready for operation.

- K. **PC:** IBM-compatible Personal Computer from a recognized major manufacturer

- L. **Furnish:** The term “Furnish” and its derivatives when used in this Division shall mean supply at the BAS Contractor’s cost to the designated third party trade contractor for installation. BAS Contractor shall connect furnished items to the BAS, calibrate, test, commission, warrant and document.

- M. **Wiring:** The term “Wiring” and its derivatives when used in this Division shall mean provide the BAS wiring and terminations.

- N. **Install:** The term “Install” and its derivatives when used in this Division shall mean receive at the jobsite and mount.

- O. **Protocol:** The term “protocol” and its derivatives when used in this Division shall mean a defined set of rules and standards governing the on-line exchange of data between BAS network nodes.

- P. **Software:** The term “software” and its derivatives when used in this Division shall mean all of programmed digital processor software, preprogrammed firmware and project specific digital process programming and database entries and definitions as generally understood in the BAS industry for real-time, on-line, integrated BAS configurations.

- Q. The use of words in the singular in these Division documents shall not be considered as limiting when other indications in these documents denote that more than one such item is being referenced.

- R. Headings, paragraph numbers, titles, shading, bolding, underscores, clouds and other symbolic interpretation aids included in the Division documents are for general information only and are to assist in the reading and interpretation of these Documents.

- S. The following abbreviations and acronyms may be used in describing the work of this Division:
 - 1. ADC - Analog to Digital Converter
 - 2. AI - Analog Input

3. AN - Application Node
4. ANSI - American National Standards Institute
5. AO - Analog Output
6. ASCII - American Standard Code for Information Interchange
7. ASHRAE - American Society of Heating, Refrigeration and Air Conditioning Engineers
8. AWG - American Wire Gauge
9. CPU - Central Processing Unit
10. CRT - Cathode Ray Tube
11. CZC - Commercial Zone Control
12. DAC - Digital to Analog Converter
13. DC - Digital Controller
14. DDC - Direct Digital Control
15. DI - Digital Input
16. DO - Digital Output
17. EEPROM - Electronically Erasable Programmable Read Only Memory
18. EMI - Electromagnetic Interference
19. FAS - Fire Alarm Detection and Annunciation System
20. GUI - Graphical User Interface
21. HOA - Hand-Off-Auto
22. ID - Identification
23. IEEE - Institute of Electrical and Electronics Engineers
24. I/O - Input/Output
25. LAN - Local Area Network
26. LCD - Liquid Crystal Display
27. LED - Light Emitting Diode
28. MCC - Motor Control Center
29. NC - Normally Closed
30. NIC - Not In Contract
31. NO - Normally Open
32. OWS - Operator Workstation
33. OAT - Outdoor Air Temperature
34. PC - Personal Computer
35. RAM - Random Access Memory
36. RF - Radio Frequency
37. RFI - Radio Frequency Interference
38. RH - Relative Humidity
39. ROM - Read Only Memory
40. RTD - Resistance Temperature Device
41. SPDT - Single Pole Double Throw
42. SPST - Single Pole Single Throw
43. TBA - To Be Advised
44. TCP/IP - Transmission Control Protocol/Internet Protocol
45. TTD - Thermistor Temperature Device
46. UPS - Uninterruptible Power Supply
47. VAC - Volts, Alternating Current
48. VAV - Variable Air Volume
49. VDC - Volts, Direct Current
50. WAN - Wide Area Network
51. X VGA - Extended Video Graphics Adapter

1.4 **BAS DESCRIPTION**

- A. The Building Automation System (BAS) shall be a complete system designed for scalable implementation from small stand-alone use to large, networked systems. This functionality shall extend into the equipment rooms. Devices residing on the enterprise IT network shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure in the facility. Contractor shall be responsible for coordination with the owner's IT staff to ensure that the BAS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN.

- B. All points of user interface shall be on either local display, standard PCs with appropriate software, a standard Web Browser or a combination of these methods.

- C. Where necessary and as dictated elsewhere in these Specifications, Servers shall be used for the purpose of providing a location for extensive archiving of system configuration data, and historical data such as trend data and operator transactions. All data will be stored in a database.

- D. The work of the single BAS Contractor shall be as defined individually and collectively in all Sections of this Division specification together with the associated Point Sheets and Drawings and the associated interfacing work as referenced in the related documents.

- E. The BAS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned BAS.

- F. Provide a complete, neat and workmanlike installation. Use only manufacturer approved employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.

- G. Manage and coordinate the BAS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.

- H. The BAS as provided shall incorporate, as required the following integrated features, functions and services:
 - 1. Operator information, alarm management and control functions.

2. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
3. Diagnostic monitoring and reporting of BAS functions.
4. Offsite monitoring and management access.
5. Energy management.
6. Standard applications for terminal HVAC systems.

1.5 QUALITY ASSURANCE

A. General

1. The Building Automation System Contractor shall be a manufacturer-approved franchised dealer that is regularly engaged in the engineering, programming, installation and service of total integrated building management systems.
2. The BAS Manufacturer shall be a recognized national manufacturer of BAS.
3. The BAS Contractor shall have a fully staffed branch facility within a 150-mile radius of the job site supplying complete maintenance and support services on a 24-hour, 7-day-a-week basis.
4. As evidence and assurance of the contractor's ability to support the Owner's system with service and parts, the contractor must have been in the BAS business for at least the last five (5) years.
5. The Building Automation System architecture shall consist of the products of a manufacturer regularly engaged in the production of Building Automation Systems, and shall be the manufacturer's latest standard of design at the time of bid.

B. Workplace Safety and Hazardous Materials

1. Provide a safety program in compliance with the Contract Documents.
2. The BAS Contractor shall have a corporately certified comprehensive Safety Certification Manual and a designated Safety Supervisor for the Project.
3. The Contractor and its employees and sub-trades comply with federal, state and local safety regulations.
4. The Contractor shall ensure that all subcontractors and employees have written safety programs in place that covers their scope of work, and that their employees receive the training required by the OSHA having jurisdiction for at least each topic listed in the Safety Certification Manual.
5. Hazards created by the Contractor or its subcontractors shall be eliminated before any further work proceeds.
6. Hazards observed but not created by the Contractor or its subcontractors shall be reported to either the General Contractor or the Owner within the same day. The Contractor shall be required to avoid the hazard area until the hazard has been eliminated.
7. The Contractor shall sign and date a safety certification form prior to any work being performed, stating that the Contractors' company is in full compliance with the Project safety requirements.
8. The Contractor's safety program shall include written policy and arrangements for the handling, storage and management of all hazardous materials to be used in the work in compliance with the requirements of the authority having jurisdiction at the Project site.
9. The Contractor's employees and subcontractor's staff shall have received training as applicable in the use of hazardous materials and shall govern their actions accordingly.

C. Quality Management Program

1. Designate a competent and experienced employee to provide BAS Project Management. The designated Project Manager shall be empowered to make technical, scheduling and related decisions on behalf of the BAS Contractor. At minimum, the Project Manager shall:
 - a. Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.
 - b. Manage the financial aspects of the BAS contract.
 - c. Coordinate as necessary with other trades.
 - d. Be responsible for the work and actions of the BAS workforce on site.

1.6 REFERENCES

A. All work shall conform to the following Codes and Standards, as applicable:

1. National Fire Protection Association (NFPA) Standards.
2. National Electric Code (NEC) and applicable local Electric Code.
3. Underwriters Laboratories (UL) listing and labels.
4. UL 916 Energy Management
5. NFPA 70 - National Electrical Code.
6. NFPA 90A - Standard For The Installation Of Air Conditioning And Ventilating Systems.
7. Factory Mutual (FM).
8. American National Standards Institute (ANSI).
9. National Electric Manufacturer's Association (NEMA).
10. American Society of Mechanical Engineers (ASME).
11. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
12. Air Movement and Control Association (AMCA).
13. Institute of Electrical and Electronic Engineers (IEEE).
14. American Standard Code for Information Interchange (ASCII).
15. Electronics Industries Association (EIA).
16. Occupational Safety and Health Administration (OSHA).
17. American Society for Testing and Materials (ASTM).
18. Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices.
19. Americans Disability Act (ADA)
20. ANSI/EIA 909.1-A-1999 (LonWorks)
21. ANSI/ASHRAE Standard 135-2004 (BACnet)
22. IEEE 802.15.4 ZigBee

B. In the case of conflicts or discrepancies, the more stringent regulation shall apply.

C. All work shall meet the approval of the Authorities Having Jurisdiction at the project site.

1.7 WORK BY OTHERS

- A. The demarcation of work and responsibilities between the BAS Contractor and other related trades shall be as outlined in the BAS RESPONSIBILITY MATRIX

1.8 SUBMITTALS

- A. Shop Drawings, Product Data, and Samples
 1. BAS RESPONSIBILITY MATRIX

BAS RESPONSIBILITY MATRIX	FURNISH	INSTAL L	Low Volt. WIRING/TUBE	LINE POWER
BAS low voltage and communication wiring	BAS	BAS	BAS	N/A
BAS conduits and raceway	BAS	BAS	BAS	26
Automatic dampers	23	23	N/A	N/A
Manual valves	23	23	N/A	N/A
Automatic valves	BAS	23	BAS	N/A
Pipe insertion devices and taps including thermowells, flow and pressure stations.	BAS	23	BAS	26
BAS Current Switches.	BAS	BAS	BAS	N/A
BAS Control Relays	BAS	BAS	BAS	N/A
Power distribution system monitoring interfaces	26	26	BAS	26
Concrete and/or inertia equipment pads and seismic bracing	23	23	N/A	N/A
BAS interface with Chiller controls	BAS	BAS	BAS	BAS
Chiller Controls	23	23	23	26
BAS interface with Boiler controls	BAS	BAS	BAS	BAS
Boiler Sequencer Controls	23	23	23	26
Smoke Detectors	26	26	26	26
Fan Coil Unit controls	BAS	BAS	BAS	26
Unit Heater controls	BAS	BAS	BAS	26
Starters, HOA switches	26	26	N/A	26
Control damper actuators	BAS	BAS	BAS	26

2. The BAS contractor shall submit a list of all shop drawings with submittals dates within 30 days of contract award.
3. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Architect and Engineer for Contract compliance.
4. Allow 15 working days for the review of each package by the Architect and Engineer in the scheduling of the total BAS work.

5. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the BAS Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Owner.
6. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.
7. The BAS Contractor shall correct any errors or omissions noted in the first review.
8. At a minimum, submit the following:
 - a. BAS network architecture diagrams including all nodes and interconnections.
 - b. Systems schematics, sequences and flow diagrams.
 - c. Points schedule for each point in the BAS, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.
 - d. Samples of Graphic Display screen types and associated menus.
 - e. Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.
 - f. Control Damper Schedule including a separate line for each damper provided under this section and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Duct Size, Damper Size, Mounting, and Actuator Type.
 - g. Control Valve Schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Design Pressure, and Actuator Type.
 - h. Details of all BAS interfaces and connections to the work of other trades.
 - i. Product data sheets or marked catalog pages including part number, photo and description for all products including software.

1.9 RECORD DOCUMENTATION

A. Operation and Maintenance Manuals

1. Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Compact Disc media or DVD, and include the following for the BAS provided:
 - a. Table of contents.
 - b. As-built system record drawings. Computer Aided Drawings (CAD) record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
 - c. Manufacturer's product data sheets or catalog pages for all products including software.
 - d. System Operator's manuals.
 - e. Archive copy of all site-specific databases and sequences.
 - f. BAS network diagrams.
 - g. Interfaces to all third-party products and work by other trades.
2. The Operation and Maintenance Manual CD or DVD shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized

table of contents shall provide dynamic links to view and print all product data sheets.
Viewer software shall provide the ability to display, zoom, and search all documents.

- B. On-Line documentation: After completion of all tests and adjustments the contractor shall provide a copy of all as-built information and product data to be installed on a customer designated computer workstation or server.

1.10 WARRANTY

- A. Standard Material and Labor Warranty:
 - 1. Provide a one-year labor and material warranty on the BAS.
 - 2. If within twelve (12) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the BAS Contractor at the cost of the BAS Contractor.
 - 3. Maintain an adequate supply of materials within 100 miles of the Project site such that replacement of key parts and labor support, including programming. Warranty work shall be done during BAS Contractor's normal business hours.

PART 2 - PRODUCTS

2.1 General Description

- A. The Building Automation System (BAS) shall use an open architecture and where applicable support a multi-vendor environment. To accomplish this effectively, the BAS shall not be limited to a single open communication protocol standard, but to also integrate third-party devices and applications via additional protocol and through the latest software standards. The system configuration shall be available for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.
- B. The Building Automation System shall consist of the following:
 - 1. Supervisory Controllers
 - 2. Programmable Controllers (HVAC equipment, etc.)
 - 3. Input, Output Modules
 - 4. Local Display Devices
 - 5. Portable Operator's Terminals – Portable PC's
 - 6. Distributed User Interfaces
 - 7. Network processing, data storage and communications equipment
 - 8. Other components required for a complete and working BAS
- C. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.

- D. The system architectural design shall eliminate dependence upon any single device for alarm generation and control execution. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

- E. Acceptable Systems
 - 1. Honeywell WEBS Control System by Associated Air Products
 - 2. Automated Logic WebCtrl System by Control Service Co.
 - 3. Trane Controls
 - 4. Johnson Controls

2.2 BAS Architecture

- A. Automation Network
 - 1. The automation network shall be configured as a Client/Server network with a web server operating on the Client's LAN/WAN. The web browser interface is extended over the LAN/WAN. Monitoring and control of the BAS is available using the web browser interface.
 - 2. The automation network shall include the option of a PC industry standard of Ethernet TCP/IP. Where used, LAN controller cards shall be standard "off the shelf" products available through normal PC vendor channels.
 - 3. The BAS shall network multiple user interface clients, system controllers and systems supervisors as required for systems operation.
 - 4. The automation network option shall be capable of operating at a communication speed of 100 Mbps.
 - 5. Supervisory Controllers shall reside on the Automation Network
 - 6. The automation network option will be compatible with other enterprise-wide networks. Where indicated, the automation network shall be connected to the enterprise network and share resources with it by way of standard networking devices and practices.

- B. Control Network
 - 1. Supervisory Controllers shall provide management over the control network(s) and shall support the following communications protocols:
 - a. BACnet® Standard (ANSI/ASHRAE Standard 135-) MS/TP and Ethernet/IP
 - b. LONWORKS® enabled devices using the free topology transceiver (FTT-1x).
 - c. Johnson Controls® N2 Open.
 - d. Modbus RTU and Modbus TCP.
 - 2. The Supervisory Controller shall be BTL (BACnet Testing Laboratories) listed as B-BC (BACnet Building Controller) and support the following data link options:
 - a. BACnet Internet Protocol (IP) (Annex J).
 - b. BACnet IP (Annex J) Foreign.
 - c. ISO 8802-3, Ethernet (Clause 7).

3. Control networks shall provide either "Peer-to-Peer," Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.
4. Programmable Controllers shall reside on the control network.
5. A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.
6. The PICS shall be submitted 10 days prior to bidding.

C. Integration

1. Hardwired
 - a. Analog and digital signal values shall be passed from one system to another via hardwired connections.
 - b. There will be one separate physical point on each system for each point to be integrated between the systems.
2. Direct Protocol (Integrator Panel)
 - a. The BAS shall include appropriate hardware equipment and software to allow bi-directional data communications between the BAS system and 3rd party manufacturers' control panels. The BAS shall receive, react to, and return information from multiple building systems, including but not limited to the chillers, boilers, variable frequency drives, power monitoring system, lighting and medical gas.
 - b. All data required by the application shall be mapped into the BAS, and shall be transparent to the operator.
 - c. Point inputs and outputs from the third party controllers shall have real-time interoperability with BAS software features such as: Schedules, Control Software, Energy Management, Custom Process Programming, Alarm Management, Historical Data and Trend Analysis, Totalization, and Local Area Network Communications.
3. BACnet Protocol Integration
 - a. The BACnet over Ethernet and BACnet MS/TP shall comply with the ASHRAE BACnet standard 135-2004.
 - b. A complete Protocol Implementation Conformance Statement (PICS) shall be provided for all BACnet system devices.
 - c. The ability to command, share point object data, change of state (COS) data and schedules between the host and BACnet systems shall be provided.
4. Modbus Protocol Integration
 - a. The BAS shall provide direct connection to Modbus devices without the use of protocol converters.
 - b. All data required by the application shall be mapped into the BAS and shall be transparent to the operator.
 - c. Point inputs and outputs from the Modbus devices shall have real-time interoperability with BAS software features such as: Schedules, Control Software, Energy Management, Custom Process programming, Alarm Management, Historical Data and Trend Analysis, Totalization and local area network communications.

2.3 User Interface

A. Browser Based Operator Interface

1. The system shall be capable of supporting an unlimited number of clients using standard Web browser such as Internet Explorer™ or Mozilla Firefox™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.
2. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the Building Automation System (BAS), shall not be acceptable.
3. The Web browser client shall support at a minimum, the following functions:
 - a. User log-on identification and password shall be required. If an unauthorized user attempts access, notice of access failure shall be displayed. Security using authentication and encryption techniques to prevent unauthorized access shall be implemented.
 - b. HTML programming shall not be required to display system graphics or data on a Web page. Editing of the Web page shall be allowed if the user desires a specific look or format.
 - c. Storage of the graphical screens shall be in the Supervisory Controller or the server, without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
 - d. Real-time values displayed on a web page shall update automatically without requiring a manual “refresh” of the web page.
 - e. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
 - 1) Modify common application objects, such as schedules and setpoints in a graphical manner.
 - 2) Commands binary objects to start and stop.
 - 3) View logs and charts.
 - 4) View alarms.
 - f. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.
4. Alarms
 - a. Alarm feature shall allow user configuration of criteria to create, route, and manage alarms and events. It shall be possible for specific alarms from specific points to be routed to specific alarm recipients. The alarm management portion of the user interface shall, at the minimum, provide the following functions:
 - 1) Allow configuration to generate alarms on any numeric, binary, or data point in the system.
 - 2) Generate alarm records that contain a minimum of a timestamp, original state, acknowledged state, alarm class and priority.
 - 3) Allow the establishment of alarm classes that provide the routing of alarms with similar characteristics to common recipients.
 - 4) Allow a user, with the appropriate security level, to manage alarms - including sorting, acknowledging, and tagging alarms.
5. Reports and Summaries

- a. Reports and Summaries shall be generated and directed to the user interface displays, with subsequent assignment to printers, or disk. As a minimum, the system shall provide the following reports:
 - 1) All points in the BAS
 - 2) All points in each BAS application
 - 3) All points in a specific controller
 - 4) All points in a user-defined group of points
 - 5) All points currently in alarm
 - 6) All BAS schedules
 - 7) All user defined and adjustable variables, schedules, interlocks and the like
 - b. Reports shall be exportable to .pdf, .txt, or .csv formats.
 - c. The system shall allow for the creation of custom reports and queries.
6. Schedules
- a. A graphical display for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following functions shall be provided:
 - 1) Regular schedules
 - 2) Repeating schedules
 - 3) Exception Schedules
 - b. Weekly schedules shall be provided for each group of equipment with a specific time use schedule.
 - c. It shall be possible to define one or more exception schedules for each schedule including references to calendars.
 - d. Monthly calendars shall be provided that allow for simplified scheduling of holidays and special days. Holidays and special days shall be user-selected with the pointing device or keyboard.
7. Password
- a. Multiple-level password access protection shall be provided to allow the system manager to assign user interface control, display, and database manipulation capabilities deemed appropriate for each user based on an assigned password.
 - b. Each user shall have the following: a user name, a password, and access levels.
 - c. The system shall provide the capability to require a password of minimum length and require a combination of characters and numerical or special characters.
 - d. When entering or editing passwords, the system shall not echo the actual characters for display on the monitor.
 - e. The system shall provide unlimited flexibility with access rights. A minimum of four levels of access shall be provided along with the ability to customize the system to provide additional levels.
 - f. A minimum of 100 unique passwords shall be supported.
 - g. Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.
 - h. The system shall automatically generate a report of log-on/log-off and system activity for each user.
 - i. All log data shall be available in .pdf, .txt, and .csv formats.
8. Dynamic Color Graphics
- a. The graphics application program shall be supplied as an integral part of the User Interface.

- b. The graphics applications shall include a create/edit function and a runtime function. The system architecture shall support an unlimited number of graphics documents (graphic definition files) to be generated and executed.
 - c. The graphics shall be able to display real-time data that is acquired, derived, or entered.
 - d. Graphics runtime functions –Each graphic application shall be capable of the following functions:
 - 1) All graphics shall be fully scalable
 - 2) The graphics shall support a maintained aspect ratio.
 - 3) Multiple fonts shall be supported.
 - 4) Unique background shall be assignable on a per graphic basis.
 - e. Operation from graphics – It shall be possible to change values (setpoints) and states in systems controlled equipment within the Web browser interface.
 - f. Graphic editing tool – A graphic editing tool shall be provided that allows for the creation and editing of graphic files. The graphic editor shall be capable of performing/defining all runtime binding.
9. Historical Data Collection
- a. All numeric, binary or data points in the system database shall allow their values to be logged over time (trend log). Each historical record shall include the point's name, a time stamp including time zone, and the point's value.
 - b. The Supervisory Controller shall have the ability to store its historical data records locally and periodically to a remote server on the network (archiving).
 - c. The configuration of the historical data collection shall allow for recording data based on change of value or on a user-defined time interval.
 - d. The configuration of the historical data collection shall allow for the collection process to stop or rollover when capacity has been reached.
 - e. A historical data viewing utility shall be provided with access to all history records. This utility shall allow historical data to be viewed in a table or chart format.
 - f. The history data table view shall allow the user to hide/show columns and to filter data based on time and date. The history data table shall allow exporting to .txt, .csv, or .pdf file formats.
 - g. The historical data chart view shall allow different point histories to be displayed simultaneously, and also provide panning and zooming capabilities.
10. Audit Log
- a. For each log entry, provide the following data;
 - 1) Time and date
 - 2) User ID
 - 3) Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.
11. Database Backup and Storage
- a. The user shall have the ability to backup the Supervisory Controller databases.
- B. Portable Operator Terminal
- 1. The BAS Contractor shall provide a portable operator terminal for programming purposes. The terminal shall be configured as follows:
 - a. Personal Laptop Computer
 - b. 512 MB RAM (minimum) – Windows 2003, Windows 7, Windows XP Professional or Windows Vista

- c. SVGA 1024x768 resolution color display
- d. Complete workstation software packages, including any hardware or software.
- e. Software registration cards for all included software shall be provided to the Owner.
- f. External power supply/battery charger
2. Software
 - a. Portable operator terminals shall support all controllers within the system on a direct-connect communications basis.
 - b. When used to access First or Second Tier controllers, the portable operator terminal shall utilize the standard operator workstation software, as previously defined.
 - c. When used to access Application Specific Controllers, the portable operator terminal shall utilize either the standard operator workstation software, as previously defined, or controller-specific utility software.

2.4 Automation Network

A. Supervisory Server

1. A central server shall be existing or provided. The server shall support all Supervisory Controllers connected to the customer's network whether local or remote.
2. Server Hardware Requirements: The server hardware platform shall have the following requirements:
 - a. The computer shall be an Intel Pentium IV based computer (minimum processing speed of 2.0 GHz with 1 GB RAM minimum, and a 1-gigabyte minimum hard drive). It shall include a 32X CD-ROM drive with write and rewrite capability (R, RW), 1-parallel ports, 2-asynchronous serial ports and 4-USB ports. A minimum 19", 28-dot pitch XVGA (1280 x 960) color monitor with a minimum 80 Hz refresh rate shall also be included. Alternately (at the discretion of the owner) provide a 17" flat panel LCD monitor with comparable resolution.
 - b. The operating system shall be: 32 bit OS- Microsoft Windows XP Professional, Windows 2003 or 2008 Server (if Microsoft IIS is disabled), Vista Business, or Windows 7, with Mozilla Firefox or Internet Explorer 5.0 or later. (64 bit OS – Win64 version of Windows XP Professional or Win 64 version of Windows 7).
 - c. Connection to the BAS network shall be via an Ethernet network interface card, 100 Mbps.
3. Local connections shall be via an Ethernet LAN. Remote connections can be via ISDN, ADSL, T1 or dial-up connection.
4. It shall be possible to provide access to all Supervisory Controllers via a single connection to the server. In this configuration, each Supervisory Controller can be accessed from the Graphical User Interface (GUI) or from a standard Web browser by connecting to the server.
5. The server shall provide the following functions, at a minimum:
 - a. Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system.
 - b. Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any Supervisory Controller in the network, local or remote.
 - c. The server shall include a master clock service for its subsystems and provide time synchronization for all Supervisory Controllers .

- d. The server shall accept time synchronization messages from trusted precision Atomic Clock Internet sites and update its master clock based on this data.
 - e. The server shall provide scheduling for all Supervisory Controllers and their underlying field control devices.
 - f. The server shall provide demand limiting that operates across all Supervisory Controllers. The server must be capable of multiple demand programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shed lists for effective demand control.
 - g. The server shall implement a 16-level Command Prioritization scheme for safe and effective contention resolution of all commands issued to Supervisory Controllers. Systems not employing this prioritization shall not be accepted.
 - h. Each Supervisory Controller supported by the server shall have the ability to archive its log data, alarm data and database to the server, automatically. Archiving options shall be user-defined including archive time and archive frequency.
 - i. The server shall provide central alarm management for all Supervisory Controllers supported by the server. Alarm management shall include:
 - 1) Routing of alarms to display, printer, email and email compatible pagers
 - 2) View and acknowledge of alarms
 - 3) Query alarm logs based on user-defined parameters
6. The server shall provide central management of log data for all Supervisory Controllers supported by the server. Log data shall include process logs, runtime and event counter logs, audit logs and error logs.

B. Supervisory Controller

1. The Supervisory Controller must provide the following hardware features as a minimum:
 - a. Communications
 - 1) One 10/100 Mb Ethernet Port – RJ-45 connection
 - 2) One RS-232 port
 - 3) One RS-485 port (up to 57,600 baud)
 - 4) Optional internal auto-dial/auto-answer 56K modem.
– Use for remote dial-in.
 - 5) Expandable communications ports including LON, RS485, Modem, Wireless Terminal Equipment Control
 - 6) All required protocol drivers are included.
 - b. Optional Inputs/Outputs
 - 1) Four form A SPST relay outputs rated for 24 VAC/VDC @ 500 mA resistive each with individual LED indicators
 - 2) Eight Universal Inputs for 10K NTC, 4-20 mA, 0-10 V, Dry contact
 - 3) Four 0-10v analog outputs.
 - c. Optional Inputs/Outputs
 - 1) Ten form A SPST relay outputs rated for 24 VAC/VDC @ 500 mA resistive each with individual LED indicators
 - 2) Sixteen Universal Inputs for 10K NTC, 4-20 mA, 0-10 V, Dry contact
 - 3) Eight 0-10 V analog outputs.
 - d. Optional Remote Inputs/Outputs
 - 1) Four form A SPST relay outputs rated for 24 VAC/VDC @ 500 mA resistive each with individual LED indicators
 - 2) Eight Universal Inputs for 10K NTC, 4-20 mA, 0-10 V, Dry contact

- 3) Four 0-10v analog outputs.
- 4) Communicates to Supervisory Controller via standard RS-485 connection.
- e. Optional Battery Backup
 - 1) Battery backup provided for all on board functions including I/O
 - 2) Battery is monitored and trickle charged
 - 3) Battery maintains processor operation through power failures for a pre-determined interval, and then writes all data to flash memory, shuts the processor down, and maintains the clock for three months.
- f. Environment
 - 1) Must be capable of operation over a temperature range of 0 °C to 50 °C (32 °F to 122 °F).
 - 2) Must be capable of withstanding storage temperatures of between 0 °C and 60 °C (32 °F to 140 °F).
 - 3) Must be capable of operation over a humidity range of 5% to 95% RH, non-condensing
2. The Supervisory Controller shall be a fully user-programmable device capable of providing all of the capability described in Section 2.3 Part A.
3. Automation network – The Supervisory Controller shall reside on the automation network. Each Supervisory Controller shall support one or more sub-networks of controllers.
4. The Supervisory Controller shall have the capability to communicate directly with Modbus without the use of an additional gateway.
5. The Supervisory Controller shall have the capability to provide secure communications via SSL (Secure Socket Layer).
6. User Interface – Each Supervisory Controller shall have the ability to deliver a web based user interface as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.
7. Power Failure – In the event of the loss of normal power, The Supervisory Controller shall continue to operate for a defined period after which there shall be an orderly shut-down of all programs to prevent the loss of database or operating system software (when using battery backup). Flash memory shall be incorporated for all critical controller configuration data.
 - a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions.
 - b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.
8. Certification – All controllers shall be listed by Underwriters Laboratories (UL).

2.5 DDC System Controllers

- A. Advanced Application General Purpose Programmable Controller
 1. The General Purpose Programmable Controller (PCA) shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol.
 - a. The PCA shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - 1) The PCA shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.

- 2) The PCA shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
- 3) A BACnet Protocol Implementation Conformance Statement shall be provided for the PCA.
- 4) The Conformance Statement shall be submitted 10 days prior to bidding.
2. The PCA shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
3. The PCA shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable.
4. The PCA shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
5. The PCA shall include an integral real-time clock and support time-based tasks which enables these field controllers to monitor and control:
 - a. Schedules
 - b. Calendars
 - c. Alarms
 - d. Trends
6. The PCA can continue time-based monitoring when offline for extended periods of time from a Facility Explorer system network.
7. The PCA can operate as a stand-alone controller in applications that do not require a networked supervisory device or for network applications where it is preferred to have the scheduling, alarming, and/or trending performed locally in the field controllers.
8. The PCA shall include troubleshooting LED indicators to identify the following conditions:
 - a. Power On
 - b. Power Off
 - c. Download or Startup in progress, not ready for normal operation
 - d. No Faults
 - e. Device Fault
 - f. Field Controller Bus - Normal Data Transmission
 - g. Field Controller Bus - No Data Transmission
 - h. Field Controller Bus - No Communication
 - i. Sensor-Actuator Bus - Normal Data Transmission
 - j. Sensor-Actuator Bus - No Data Transmission
 - k. Sensor-Actuator Bus - No Communication
9. The PCA shall accommodate the direct wiring of analog and binary I/O field points.
10. The PCA shall support the following types of inputs and outputs:
 - a. Universal Inputs - shall be configured to monitor any of the following:
 - 1) Analog Input, Voltage Mode
 - 2) Analog Input, Current Mode
 - 3) Analog Input, Resistive Mode
 - 4) Binary Input, Dry Contact Maintained Mode
 - 5) Binary Input, Pulse Counter Mode
 - b. Binary Inputs - shall be configured to monitor either of the following:
 - 1) Dry Contact Maintained Mode

- 2) Pulse Counter Mode
 - c. Analog Outputs - shall be configured to output either of the following
 - 1) Analog Output, Voltage Mode
 - 2) Analog Output, Current Mode
 - d. Binary Outputs - shall output the following:
 - 1) Line-voltage relay outputs
 - 2) 24 VAC Triac
 - e. Configurable Outputs - shall be capable of the following:
 - 1) Analog Output, Voltage Mode
 - 2) Binary Output Mode
11. The PCA shall have the ability to reside on a Field Controller Bus (FC Bus).
 - a. The FC Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
 - b. The FC Bus shall support communications between the PCAs and the Supervisory Controller.
 - c. The FC Bus shall also support communications with the PCA and with the Supervisory Controller.
 - d. The FC Bus shall operate at a maximum distance of 15,000 Ft. between the PCA and the furthest connected device.
 12. The PCA shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).
 - a. The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard Protocol SSPC-135, Clause 9.
 - b. The SA Bus shall support a minimum of 10 devices per trunk.
 - c. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the PCA and the furthest connected device.
 13. The PCA shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the FC Bus or the SA Bus.
 14. The PCA shall support, but not be limited to, the following applications:
 - a. Chilled water/central plant optimization applications including but not limited to:
 - 1) Selection and sequencing of up to eight chillers of different sizes
 - 2) Selection and sequencing of up to eight (each) primary and secondary chilled water pumps of varying pumping capacities
 - 3) Selection and sequencing of up to eight condenser water pumps
 - 4) Selection and sequencing of cooling towers and bypass valve, including single speed, multi-speed, and Vernier control
 - 5) A proven and documented central cooling plant optimization program that incorporates custom equipment efficiency profiles, without rewriting software code, in order to meet the building load using the least amount of energy as calculated.
 - 6) The use of advanced control algorithms that apply equipment specific parameters, including operational limits and efficiency profiles, in order to determine equipment start and runtime preferences
 - 7) Identification of the most efficient equipment combination and automatic control of state and speed of all necessary equipment to balance runtime, optimize timing and sequencing and ensure the efficiency and stability of the central cooling plant

- 8) Control definition for the chiller plant in a single PCA, as supported by available memory and point Input/Output (I/O), or capable of being split across multiple PCAs
- b. Heating central plant applications
- c. Built-up air handling units for special applications
- d. Terminal & package units
- e. Special programs as required for systems control

B. General Purpose Programmable Controllers (PCG)

- 1. The General Purpose Programmable Controller (PCG) shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol.
 - a. The PCG shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - 1) A BACnet Protocol Implementation Conformance Statement shall be provided for the PCG.
 - 2) The Conformance Statement shall be submitted 10 days prior to bidding.
- 2. The PCG shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
- 3. The PCG shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable
- 4. The PCG shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
- 5. The PCG shall include a removable base to allow pre-wiring without the controller.
- 6. The PCG shall include troubleshooting LED indicators to identify the following conditions:
 - a. Power On
 - b. Power Off
 - c. Download or Startup in progress, not ready for normal operation
 - d. No Faults
 - e. Device Fault
 - f. Field Controller Bus - Normal Data Transmission
 - g. Field Controller Bus - No Data Transmission
 - h. Field Controller Bus - No Communication
 - i. Sensor-Actuator Bus - Normal Data Transmission
 - j. Sensor-Actuator Bus - No Data Transmission
 - k. Sensor-Actuator Bus - No Communication
- 7. The PCG shall accommodate the direct wiring of analog and binary I/O field points.
- 8. The PCG shall support the following types of inputs and outputs:
 - a. Universal Inputs - shall be configured to monitor any of the following:
 - 1) Analog Input, Voltage Mode
 - 2) Analog Input, Current Mode
 - 3) Analog Input, Resistive Mode
 - 4) Binary Input, Dry Contact Maintained Mode

- b. Binary Inputs - shall be configured to monitor either of the following:
 - 1) Dry Contact Maintained Mode
 - 2) Pulse Counter Mode
 - c. Analog Outputs - shall be configured to output either of the following
 - 1) Analog Output, Voltage Mode
 - 2) Analog Output, current Mode
 - d. Binary Outputs - shall output the following:
 - 1) 24 VAC Triac
 - e. Configurable Outputs - shall be capable of the following:
 - 1) Analog Output, Voltage Mode
 - 2) Binary Output Mode
9. The PCG shall have the ability to reside on a Field Controller Bus (FC Bus).
- a. The FC Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
 - b. The FC Bus shall support communications between the PCGs and the Supervisory Controller.
 - c. The FC Bus shall also support Expansion I/O (PCX) communications with the PCG and with the Supervisory Controller.
 - d. The FC Bus shall operate at a maximum distance of 15,000 Ft. between the PCG and the furthest connected device.
10. The PCG shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).
- a. The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard Protocol SSPC-135, Clause 9.
 - b. The SA Bus shall support up to 10 devices per trunk.
 - c. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the PCG and the furthest connected device.
11. The PCG shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the FC Bus or the SA Bus.
12. The PCG shall support, but not be limited to, the following:
- a. Chilled water/central plant automation applications including but not limited to:
 - 1) the selection and sequencing of up to 8 chillers of different sizes
 - 2) the selection and sequencing of up to 8 (each) primary and secondary chilled water pumps of varying pump capacities
 - 3) the selection and sequencing of up to 8 condenser water pumps
 - 4) the selection and sequencing of cooling towers and bypass valve, including single speed, multi-speed, and Vernier control
 - 5) a proven and documented central cooling plant optimization program that incorporates custom equipment efficiency profiles, without rewriting software code, in order to meet the building load using the least amount of energy as calculated
 - 6) the use of advanced control algorithms that apply equipment specific parameters, including operational limits and efficiency profiles, in order to determine equipment start and runtime preferences
 - 7) the identification of the most efficient equipment combination and automatic control of state and speed of all necessary equipment to balance runtime, optimize timing and sequencing and ensure the efficiency and stability of the central cooling plant

- 8) the control definition for the chiller plant in a single FX-PCG, as supported by available memory and point Input/Output (I/O), or capable of being split across multiple FX-PCGs
- b. Heating central plant applications
- c. Built-up air handling units for special applications
- d. Terminal and packaged units
- e. Special programs as required for systems control

C. Programmable Controller Expansion I/O Modules (PCX)

1. The Programmable Controller Expansion I/O Module (PCX) provides additional inputs and outputs for use in the PCG.
2. The PCX shall communicate with the PCG over the FC Bus or the SA Bus.
3. The PCX shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - a. A BACnet Protocol Implementation Conformance Statement shall be provided for the PCG.
 - b. The Conformance Statement shall be submitted 10 days prior to bidding.
4. The PCX shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
5. The PCX shall have a minimum of 4 points to a maximum of 17 points.
6. The PCX shall support the following types of inputs and outputs:
 - a. Universal Inputs - shall be configured to monitor any of the following:
 - 1) Analog Input, Voltage Mode
 - 2) Analog Input, Current Mode
 - 3) Analog Input, Resistive Mode
 - 4) Binary Input, Dry Contact Maintained Mode
 - b. Binary Inputs - shall be configured to monitor either of the following:
 - 1) Dry Contact Maintained Mode
 - 2) Pulse Counter Mode
 - c. Analog Outputs - shall be configured to output either of the following:
 - 1) Analog Output, Voltage Mode
 - 2) Analog Output, current Mode
 - d. Binary Outputs - shall output the following:
 - 1) 24 VAC Triac
 - e. Configurable Outputs - shall be capable of the following:
 - 1) Analog Output, Voltage Mode
 - 2) Binary Output Mode
7. The PCX shall include troubleshooting LED indicators to identify the following conditions:
 - a. Power On
 - b. Power Off
 - c. Download or Startup in progress, not ready for normal operation
 - d. No Faults
 - e. Device Fault
 - f. Normal Data Transmission
 - g. No Data Transmission
 - h. No Communication

D. Programmable VAV Box Controller (PCV)

1. The Programmable VAV Box Controller (PCV) shall provide both standalone and networked direct digital control of pressure-independent, variable air volume terminal units. It shall control both single and dual duct applications.
2. The PCV shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - a. A BACnet Protocol Implementation Conformance Statement shall be provided for the PCV.
 - b. The Conformance Statement shall be submitted 10 days prior to bidding.
3. The PCV shall have internal electrical isolation for AC power, DC inputs, and MS/TP communications. An externally mounted isolation transformer shall not be acceptable.
4. The PCV shall be a configurable digital controller with integral differential pressure transducer and damper actuator. All components shall be connected and mounted as a single assembly that can be removed as one piece.
5. The PCV shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
6. The integral damper actuator shall be a fast response stepper motor capable of stroking 90 degrees in 30 seconds for quick damper positioning to speed commissioning and troubleshooting tasks.
7. The controller shall determine airflow by dynamic pressure measurement using an integral dead-ended differential pressure transducer. The transducer shall be maintenance-free and shall not require air filters.
8. Each controller shall have the ability to automatically calibrate the flow sensor to eliminate pressure transducer offset error due to ambient temperature / humidity effects.
9. The controller shall utilize a proportional plus integration (PI) algorithm for the space temperature control loops.
10. Each controller shall continuously, adaptively tune the control algorithms to improve control and controller reliability through reduced actuator duty cycle. In addition, this tuning reduces commissioning costs, and eliminates the maintenance costs of manually re-tuning loops to compensate for seasonal or other load changes.
11. The controller shall provide the ability to download and upload VAV controller configuration files, both locally and via the communications network. Controllers shall be able to be loaded individually or as a group using a zone schedule generated table of controller parameters.
12. Control setpoint changes initiated over the network shall be written to PCV non-volatile memory to prevent loss of setpoint changes and to provide consistent operation in the event of communication failure.
13. The controller firmware shall be flash-upgradeable remotely via the communications bus to minimize costs of feature enhancements.
14. The controller shall provide fail-soft operation if the airflow signal becomes unreliable, by automatically reverting to a pressure-dependent control mode.
15. The controller shall interface with balancer tools that allow automatic recalculation of box flow pickup gain ("K" factor), and the ability to directly command the airflow control loop to the box minimum and maximum airflow setpoints.
16. Controller performance shall be self-documenting via on-board diagnostics. These diagnostics shall consist of control loop performance measurements executing at each control loop's sample interval, which may be used to continuously monitor and document system

performance. The PCV shall calculate exponentially weighted moving averages (EWMA) for each of the following. These metrics shall be available to the end user for efficient management of the VAV terminals.

- a. Absolute temperature loop error
 - b. Signed temperature loop error
 - c. Absolute airflow loop error
 - d. Signed airflow loop error
 - e. Average damper actuator duty cycle
17. The controller shall detect system error conditions to assist in managing the VAV zones. The error conditions shall consist of:
- a. Unreliable space temperature sensor
 - b. Unreliable differential pressure sensor
 - c. Starved box
 - d. Actuator stall
 - e. Insufficient cooling
 - f. Insufficient heating
18. The controller shall provide a flow test function to view damper position vs. flow in a graphical format. The information would alert the user to check damper position. The PCV would also provide a method to calculate actuator duty cycle as an indicator of damper actuator runtime.
19. The controller shall provide a compliant interface for ASHRAE Standard 62-1989 (indoor air quality), and shall be capable of resetting the box minimum airflow based on the percent of outdoor air in the primary air stream.
20. The controller shall comply with ASHRAE Standard 90.1 (energy efficiency) by preventing simultaneous heating and cooling, and where the control strategy requires reset of airflow while in reheat, by modulating the box reheat device fully open prior to increasing the airflow in the heating sequence.
21. Inputs:
- a. Analog inputs with user defined ranges shall monitor the following analog signals, without the addition of equipment outside the terminal controller cabinet:
 - 1) 0-10 VDC Sensors
 - 2) 1000 ohm RTDs
 - 3) NTC Thermistors
 - b. Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input "bouncing."
 - c. For noise immunity, the inputs shall be internally isolated from power, communications, and output circuits.
 - d. Provide side loop application for humidity control.
22. Outputs
- a. Analog outputs shall provide the following control outputs:
 - 1) 0-10 VDC
 - b. Binary outputs shall provide a SPST Triac output rated for 500mA at 24 VAC.
 - c. For noise immunity, the outputs shall be internally isolated from power, communications, and other output circuits.
23. Application Configuration
- a. The PCV shall be configured with a software tool that provides a simple Question/Answer format for developing applications and downloading.
24. Sensor Support

- a. The PCV shall communicate over the Sensor-Actuator Bus (SA Bus) with a Network Sensor.
- b. The PCV shall support an LCD display room sensor.
- c. The PCV shall also support standard room sensors as defined by analog input requirements.
- d. The PCV shall support humidity sensors defined by the AI side loop.

2.6 System Tools

A. Supervisory Controller Toolset

1. Device embedded toolset shall provide the following capabilities in a graphical environment using a standard Web browser:
 - a. Device and point management
 - b. Scheduling, alarming and trending setup
 - c. Creation and binding of graphics
 - d. Time management
 - e. User management
2. Toolset provides additional engineering capabilities including:
 - a. Editable table based point listings.
 - b. Automatically generated graphics for standard applications.

B. Programmable Controller Tool

1. The Programmable Controller Tool shall be capable of programming the Programmable Controllers.
 - a. The Programmable Controller tool shall provide the capability to configure, simulate, and commission all Programmable Controllers.
 - b. The Programmable Controller tool shall allow the application logic to be run in Simulation Mode to verify its sequence of operation.
 - c. The Programmable Controller tool shall contain a library of standard applications to be used for configuration.

2.7 Input Device Characteristics

A. General Requirements

1. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

B. Temperature Sensors

1. General Requirements:
 - a. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
 - b. The temperature sensor shall be of the resistance type, and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.

- c. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

Point Type	Accuracy
Chilled Water	$\pm 0.5 \text{ }^\circ\text{F}, \pm 0.3 \text{ }^\circ\text{C}$
Room Temp	$\pm 0.5 \text{ }^\circ\text{F}, \pm 0.3 \text{ }^\circ\text{C}$.
Duct Temperature	$\pm 0.5 \text{ }^\circ\text{F}, \pm 0.3 \text{ }^\circ\text{C}$.
All Others	$\pm 0.75 \text{ }^\circ\text{F}, \pm 0.4 \text{ }^\circ\text{C}$.

- 2. Room Temperature Sensors
 - a. Room sensors shall be constructed for either surface or wall box mounting.
 - b. Room sensors shall have the following options when specified:
 - 1) Setpoint adjustment providing a +3 degree (adjustable) range
 - 2) Dial adjustment for setpoint value or warmer or cooler requests. The dial shall also initiate temporary occupancy during unoccupied times.
 - 3) A momentary override request push button for activation of after-hours operation
 - 4) Backlit LCD temperature display shall display temperature and setpoint with units.
- 3. Room Command Module
 - a. Room sensors shall be constructed for either surface or wall box mounting.
 - b. Room sensors shall have the following capabilities:
 - 1) Remote Setpoint Adjustment
 - 2) Three Speed Fan Selection
 - 3) Override request push button with LED status for activation of after-hours operation
 - 4) Service connection
- 4. Thermo wells
 - a. When thermo wells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and Greenfield fitting.
 - b. Thermo wells shall be pressure rated and constructed in accordance with the system working pressure.
 - c. Thermo wells and sensors shall be mounted in a threadolet or 1/2-inch NPT saddle and allow easy access to the sensor for repair or replacement.
 - d. Thermo wells shall be constructed of 316 stainless steel.
- 5. Outside Air Sensors
 - a. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
 - b. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
 - c. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.
- 6. Duct Mount Sensors

- a. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.
 - b. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
 - c. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.
7. Averaging Sensors
- a. For ductwork greater in any dimension than 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
 - b. For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.
 - c. Capillary supports at the sides of the duct shall be provided to support the sensing string.
8. Acceptable Manufacturers: Johnson Controls, Setra, Veris.

C. Humidity Sensors

1. The sensor shall be a solid-state type, relative humidity sensor of the Bulk Polymer design. The sensor element shall resist service contamination.
2. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.
3. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH @ 77 degree F unless specified elsewhere.
4. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless steel bushings.
5. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.
6. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.
7. Acceptable Manufacturers: Johnson Controls, Veris Industries, and Mamac.

D. Differential Pressure Transmitters

1. General Air and Water Pressure Transmitter Requirements:
 - a. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
 - b. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
 - c. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.
 - d. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.
2. Low Differential Water Pressure Applications (0" - 20" w.c.)

- a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of flow meter differential pressure or water pressure sensing points.
 - b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
 - 1) .01-20" w.c. input differential pressure range.
 - 2) 4-20 mA output.
 - 3) Maintain accuracy up to 20 to 1 ratio turndown.
 - 4) Reference Accuracy: +0.2% of full span.
 - c. Acceptable Manufacturers: Setra and Mamac.
3. Medium to High Differential Water Pressure Applications (Over 21" w.c.)
- a. The differential pressure transmitter shall meet the low pressure transmitter specifications with the following exceptions:
 - 1) Differential pressure range 10" w.c. to 300 psi.
 - 2) Reference Accuracy: $\pm 1\%$ of full span (includes non-linearity, hysteresis, and repeatability).
 - b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.
 - c. Acceptable Manufacturers: Setra and Mamac.
4. Building Differential Air Pressure Applications (-1" to +1" w.c.)
- a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
 - b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
 - 1) -1.00 to +1.00 w.c. input differential pressure ranges. (Select range appropriate for system application)
 - 2) 4-20 mA output.
 - 3) Maintain accuracy up to 20 to 1 ratio turndown.
 - 4) Reference Accuracy: +0.2% of full span.
 - c. Acceptable Manufacturers: Johnson Controls and Setra.
5. Low Differential Air Pressure Applications (0" to 5" w.c.)
- a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
 - b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
 - 1) (0.00 - 1.00" to 5.00") w.c. input differential pressure ranges. (Select range appropriate for system application.)
 - 2) 4-20 mA output.
 - 3) Maintain accuracy up to 20 to 1 ratio turndown.
 - 4) Reference Accuracy: +0.2% of full span.
 - c. Acceptable Manufacturers: Johnson Controls and Setra.
6. Medium Differential Air Pressure Applications (5" to 21" w.c.)

- a. The pressure transmitter shall be similar to the Low Air Pressure Transmitter, except that the performance specifications are not as severe. Differential pressure transmitters shall be provided that meet the following performance requirements:
 - 1) Zero & span: (c/o F.S./degree. F): .04% including linearity, hysteresis and repeatability.
 - 2) Accuracy: 1% F.S. (best straight line) Static Pressure Effect: 0.5% F.S. (to 100 psig).
 - 3) Thermal Effects: <+.033 F.S./ °F. over 40 °F. to 100 °F. (calibrated at 70°F.).
- b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.
- c. Acceptable manufacturers: Johnson Controls and Setra.

E. Air Flow Monitoring

1. Acceptable Manufactures
 - a. Ebtron (Addendum #3)
2. Electronic Thermal Dispersion Air Flow/Temperature Measuring Device
 - a. Furnish and install airflow/temperature measurement devices as in accordance with plans and equipment schedules.
 - b. Each measurement device shall consist of one or more airfoil sensor probe assemblies and a single microprocessor-based control transmitter. Each airfoil sensor probe assembly will contain one or more independently wired sensor circuits. Multiple sensor circuits shall be equally weighted and averaged by the probe multiplexing unit and communicate digitally to the control transmitter. Pitot arrays and Vortex shedding flow meters are not acceptable.
 - c. Airfoil Sensor Probe Assemblies
 - 1) Each sensor circuit shroud shall be manufactured of a U.L. 94 flame rated, high impact, ABS plastic with a minimum Rockwell Hardness of 109 per ASTM D785 and a thermal deflection value of 200°F.
 - 2) Each sensor circuit shroud shall house two epoxy sealed, thermistor probes to determine airflow rate and ambient temperature. Devices that use "chip" type thermistors or probes that have less than 2 thermistors at each sensing point are not acceptable.
 - 3) Each Airfoil Sensor Probe shall be calibrated at a minimum of 16 airflow rates and have an accuracy of +/-2% of reading over the entire operating airflow range. Each sensor assembly shall be calibrated to standards that are traceable to the National Institute of Standards and Technology (NIST).
 - a) Combined accuracy of all components that make up the air measuring device must meet the performance requirements of this specification throughout the measurement range.
 - 4) The operating temperature range for the airfoil sensor probe assembly shall be -20° F to 160° F. The operating humidity range for the sensor probe assembly shall be 0-99% RH (non-condensing).

- 5) Each temperature sensor shall be calibrated at a minimum of 3 temperatures and have an accuracy of $\pm 0.15^{\circ}$ F over the entire operating temperature range. Each temperature sensor shall be calibrated to standards that are traceable to the National Institute of Standards and Technology (NIST).
 - 6) Each sensor probe assembly shall utilize plenum rated, CAT5 cable with gold plated pins, to digitally communicate data from each airfoil sensing probe multiplexing unit to a remotely mounted control transmitter.
 - 7) Control transmitter shall be compatible with any airfoil sensor probe and not require field matching.
 - 8) To ensure compatibility, the same manufacturer shall provide both the air-flow/temperature measuring probe(s) and control transmitter for each measurement location.
- d. Duct and Plenum Sensor Probe Assemblies
- 1) Sensor housings shall be mounted in an airfoil shaped extruded 6063T5 aluminum probe assembly.
 - 2) The number of sensor housings provided for each location shall be determined by the manufacturer based on the requirements of the application.
 - 3) Probe assemblies shall be mounted using one of the following options:
 - a) Insertion mounted through the side or top of the duct
 - b) Internally mounted inside the duct or plenum
 - c) Standoff mounted inside the plenum
 - 4) The operating airflow range shall be 0 to 2,500 FPM unless otherwise indicated on the plans.
- e. Fan Inlet Sensor Probe Assemblies
- 1) Low profile sensor housings shall follow the contour of the fan inlet bell to reduce pressure drop and affect on fan performance.
 - 2) Sensor housing and mounting bracket shall be manufactured of a one-piece, high impact, ABS material and shall be UL 94 flame rated.
 - 3) Thermistors shall be ceramic-based, glass bead type
 - 4) The operating airflow range shall be 0 to 10,000 FPM unless otherwise indicated on the plans.
- f. Control Transmitters
- 1) The control transmitter shall operate on an internally fused and filtered 24 VAC power supply.
 - 2) The transmitter temperature range shall be -25° F to 140° F and housed in a dust proof indoor enclosure. Control transmitter enclosure shall be installed in a dry location.
 - 3) Communications with the host controls (building automation system) shall be accomplished through one of the following interface options:
 - 4) Analog output signal: Field selectable, fuse protected and isolated, 0-10VDC or 4-20mA (4-wire)
- g. The complete air measuring device shall be RoHS compliant.
3. Mounting: In walls or ceiling with blades horizontal.

4. Finish: Mill aluminum
 5. ACCESSORIES
 - a. Internal mounting Brackets
 - b. Damper standoff mounting brackets.
 - c. Round/Oval duct mounting brackets
 - d. Stainless Steel mounting hardware.
 - e. NEMA4 enclosure
 6. Installation
 - a. Install air flow measuring probes at locations indicated on the drawings and in accordance with manufacturer's installation instructions.
 - b. An authorized factory representative shall coordinate probe placement with the installing contractor, in accordance with the manufacturer's installation recommendations. Representative shall review and approve final placement and operating airflow rates for each measurement location indicated on the plans. A written report shall be submitted to the consulting mechanical engineer if any measurement locations do not meet the manufacturer's placement requirements.
 - c. Install probes with blades running [horizontally] [vertically].
 - d. Do not compress or stretch probes into duct or opening.
 - e. Handle probes using ends.
- F. Underfloor Air Distribution Static Pressure Sensors (Addendum 3)
1. UFAD VAV pressure control system shall be provided with a controller and 4 combination pressure/temperature bleed type airflow sensors per controller. Provide 2 controllers for each UFAD AHU. Controllers shall determine the most critical sensor for each of the 8 sensors connected to a single UFAD AHU.
 2. Acceptable manufacturers: Ebtron model SCN202-T/VAV controller, GTC116-Pc combination airflow/temperature measurement probes, and STA102-B bleed sensors.
- G. Power Monitoring Devices
1. Current Measurement (Amps)
 - a. Current measurement shall be by a combination current transformer and a current transducer. The current transformer shall be sized to reduce the full amperage of the monitored circuit to a maximum 5 Amp signal, which will be converted to a 4-20 mA DDC compatible signal for use by the building automation system.
 - b. Current Transformer – A split core current transformer shall be provided to monitor motor amps.
 - 1) Operating frequency – 50 - 400 Hz.
 - 2) Insulation – 0.6 kV class 10 kV BIL.
 - 3) UL recognized.
 - 4) Five ampere secondary.
 - 5) Select current ration as appropriate for application.
 - 6) Acceptable manufacturers: Veris Industries
 - c. Current Transducer – A current to voltage or current to mA transducer shall be provided. The current transducer shall include:
 - 1) 6X input over amp rating for AC inrushes of up to 120 ampere.
 - 2) Manufactured to UL 1244.
 - 3) Accuracy: +.5%, Ripple +1%.
 - 4) Minimum load resistance 30 kilohm.

- 5) Input 0-20 A.
- 6) Output 4-20 mA.
- 7) Transducer shall be powered by a 24 VDC regulated power supply (24 VDC +5%).
- 8) Acceptable manufacturers: Veris Industries

H. Status and Safety Switches

- 1. General Requirements
 - a. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the BAS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.
- 2. Current Sensing Switches
 - a. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
 - b. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.
 - c. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.
 - d. Acceptable manufacturers: Veris Industries
- 3. Air Filter Status Switches
 - a. Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120 VAC.
 - b. A complete installation kit shall be provided, including: static pressure tops, tubing, fittings, and air filters.
 - c. Provide appropriate scale range and differential adjustment for intended service.
 - d. Acceptable manufacturers: Johnson Controls, Cleveland Controls
- 4. Air Flow Switches
 - a. Differential pressure flow switches shall be bellows actuated mercury switches or snap acting micro-switches with appropriate scale range and differential adjustment for intended service.
 - b. Acceptable manufacturers: Johnson Controls, Cleveland Controls
- 5. Air Pressure Safety Switches
 - a. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120 VAC.
 - b. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.
 - c. Acceptable manufacturers: Johnson Controls, Cleveland Controls
- 6. Water Flow Switches
 - a. Water flow switches shall be equal to the Johnson Controls P74.
- 7. Low Temperature Limit Switches
 - a. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120 VAC.

- b. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
- c. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.
- d. The low temperature limit switch shall be equal to Johnson Controls A70.

2.8 Output Device Characteristics

A. Actuators

- 1. General Requirements
 - a. Damper and valve actuators shall be electronic and/or pneumatic, as specified in the System Description section.
- 2. Electronic Damper Actuators
 - a. Electronic damper actuators shall be direct shaft mount.
 - b. Modulating and two-position actuators shall be provided as required by the sequence of operations. Damper sections shall be sized based on actuator manufacturer's recommendations for face velocity, differential pressure and damper type. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the dampers as required. All actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction and a gear release to allow manual positioning.
 - c. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication. The feedback signal of one damper actuator for each separately controlled damper shall be wired back to a terminal strip in the control panel for troubleshooting purposes.
 - d. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Isolation, smoke, exhaust fan, and other dampers, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan. Two-position actuators, as specified in sequences of operations as "quick acting," shall move full stroke within 20 seconds. All smoke damper actuators shall be quick acting.
 - e. Acceptable manufacturers: Johnson Controls, Mamac.
- 3. Electronic Valve Actuators
 - a. Electronic valve actuators shall be manufactured by the valve manufacturer.
 - b. Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator.
 - c. Modulating and two-position actuators shall be provided as required by the sequence of operations. Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required application. The valve actuator shall be sized based on valve manufacturer's recommendations for

flow and pressure differential. All actuators shall fail in the last position unless specified with mechanical spring return in the sequence of operations. The spring return feature shall permit normally open or normally closed positions of the valves as required. All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.

- d. Modulating actuators shall accept 24 VAC or VDC and 120 VAC power supply and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal, and may be used to parallel other actuators and provide true position indication. The feedback signal of each valve actuator (except terminal valves) shall be wired back to a terminal strip in the control panel for troubleshooting purposes.
- e. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Butterfly isolation and other valves, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop the associated pump or chiller.

B. Control Relays

1. Control Pilot Relays

- a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
- b. Mounting bases shall be snap-mount.
- c. DPDT, 3PDT, or 4PDT relays shall be provided as appropriate for application.
- d. Contacts shall be rated for 10 amps at 120 VAC.
- e. Relays shall have an integral indicator light and check button.
- f. Acceptable manufacturers: Johnson Controls, Lectro

2. Lighting Control Relays

- a. Lighting control relays shall be latching with integral status contacts.
- b. Contacts shall be rated for 20 amps at 277 VAC.
- c. The coil shall be a split low-voltage coil that moves the line voltage contact armature to the ON or OFF latched position.
- d. Lighting control relays shall be controlled by:
 - 1) Pulsed tri-state output –preferred method.
 - 2) Pulsed paired binary outputs.
 - 3) A Binary input to the Building Automation System shall monitor integral status contacts on the lighting control relay. Relay status contacts shall be of the “dry-contact” type.
- e. The relay shall be designed so that power outages do not result in a change-of-state, and so that multiple same state commands will simply maintain the commanded state. Example: Multiple OFF command pulses shall simply keep the contacts in the OFF position.

C. Control Valves

- 1. All automatic control valves shall be fully proportioning and provide near linear heat transfer control. The valves shall be quiet in operation and fail-safe open, closed, or in their last position. All valves shall operate in sequence with another valve when required by the sequence of operations. All control valves shall be sized by the control manufacturer, and shall be guaranteed to meet the heating and cooling loads, as specified. All con-

control valves shall be suitable for the system flow conditions and close against the differential pressures involved. Body pressure rating and connection type (sweat, screwed, or flanged) shall conform to the pipe schedule elsewhere in this Specification.

2. Chilled water control valves shall be modulating plug, ball, and/or butterfly, as required by the specific application. Modulating water valves shall be sized per manufacturer's recommendations for the given application. In general, valves (2 or 3-way) serving variable flow air handling unit coils shall be sized for a pressure drop equal to the actual coil pressure drop, but no less than 5 psi. Valves (3-way) serving constant flow air handling unit coils with secondary circuit pumps shall be sized for a pressure drop equal to 25% the actual coil pressure drop, but no less than 2 psi. Mixing valves (3-way) serving secondary water circuits shall be sized for a pressure drop of no less than 5 psi. Valves for terminal reheat coils shall be sized for a 2 psig pressure drop, but no more than a 5 psi drop.
3. Ball valves shall be used for hot and chilled water applications, water terminal reheat coils, radiant panels, unit heaters, package air conditioning units, and fan coil units except those described hereinafter.
4. Modulating plug water valves of the single-seat type with equal percentage flow characteristics shall be used for all special applications as indicated on the valve schedule. Valve discs shall be composition type. Valve stems shall be stainless steel.
5. Butterfly valves shall be acceptable for modulating large flow applications greater than modulating plug valves, and for all two-position, open/close applications. In-line and/or three-way butterfly valves shall be heavy-duty pattern with a body rating comparable to the pipe rating, replaceable lining suitable for temperature of system, and a stainless steel vane. Valves for modulating service shall be sized and travel limited to 50 degrees of full open. Valves for isolation service shall be the same as the pipe. Valves in the closed position shall be bubble-tight.
6. Acceptable manufacturers: Johnson Controls

D. Electronic Signal Isolation Transducers

1. A signal isolation transducer shall be provided whenever an analog output signal from the BAS is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input signal from a remote system.
2. The signal isolation transducer shall provide ground plane isolation between systems.
3. Signals shall provide optical isolation between systems.
4. Acceptable manufacturers: Advanced Control Technologies

E. External Manual Override Stations

1. External manual override stations shall provide the following:
 - a. An integral HAND/OFF/AUTO switch shall override the controlled device pilot relay.
 - b. A status input to the Building Automation System shall indicate whenever the switch is not in the automatic position.
 - c. A Status LED shall illuminate whenever the output is ON.
 - d. An Override LED shall illuminate whenever the HOA switch is in either the HAND or OFF position.
 - e. Contacts shall be rated for a minimum of 1 ampere at 24 VAC.

F. Electronic/Pneumatic Transducers

1. Electronic to Pneumatic transducers shall provide:
 - a. Output: 3-15 psig.
 - b. Input: 4-20 mA or 0-10 VDC.
 - c. Manual output adjustment.
 - d. Pressure gauge.
 - e. External replaceable supply air filter.
 - f. Acceptable manufacturers: Johnson Controls, Mamac

2.9 Miscellaneous Device Characteristics

A. Local Control Panels

1. All control panels shall be factory constructed, incorporating the BAS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch.
2. In general, the control panels shall consist of the DDC controller(s), display module as specified and indicated on the plans, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. Where specified the display module shall be flush mounted in the panel face unless otherwise noted.
3. All I/O connections on the DDC controller shall be provide via removable or fixed screw terminals.
4. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
5. All wiring shall be neatly installed in plastic trays or tie-wrapped.
6. A convenience 120 VAC duplex receptacle shall be provided in each enclosure, fused on/off power switch, and required transformers.

B. Power Supplies

1. DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75% of the rated capacity of the power supply.
2. Input: 120 VAC +10%, 60Hz.
3. Output: 24 VDC.
4. Line Regulation: +0.05% for 10% line change.
5. Load Regulation: +0.05% for 50% load change.
6. Ripple and Noise: 1 mV rms, 5 mV peak to peak.
7. An appropriately sized fuse and fuse block shall be provided and located next to the power supply.
8. A power disconnect switch shall be provided next to the power supply.

C. Thermostats

1. Electric room thermostats of the heavy-duty type shall be provided for unit heaters, cabinet unit heaters, and ventilation fans, where required. All these items shall be provided with concealed adjustment. Finish of covers for all room-type instruments shall match

and, unless otherwise indicated or specified, covers shall be manufacturer's standard finish.

2.10 Field Devices

A. Network Sensors

1. The Network Sensors (NS) shall have the ability to monitor the following variables as required by the systems sequence of operations:
 - a. Zone CO2
2. The NS shall transmit the information back to the controller on the Sensor-Actuator Bus (SA Bus) using BACnet Standard protocol SSPC-135, Clause 9.
3. The NS shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - a. The NS shall be tested and certified as a BACnet Smart Sensors (B-SS).
 - b. A BACnet Protocol Implementation Conformance Statement shall be provided for the NS.
 - c. The Conformance Statement shall be submitted 10 days prior to bidding.
4. The Network CO2 Zone Sensors shall include the following:
 - a. Available in either surface mount or wall mount
 - b. Available with screw terminals or phone jack

PART 3 - PERFORMANCE AND EXECUTION

3.1 BAS Specific Requirements

A. Graphic Displays

1. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.
2. User shall access the various system schematics via a graphical penetration scheme and/or menu selection. .

B. Custom Reports:

1. Provide custom reports as required for this project:

C. Actuation / Control Type

1. Primary Equipment
 - a. Controls shall be provided by equipment manufacturer as specified herein.
 - b. All damper and valve actuation shall be electric.
2. Air Handling Equipment
 - a. All air handlers shall be controlled with a HVAC-DDC Controller
 - b. All damper and valve actuation shall be electric.
3. Terminal Equipment:
 - a. Terminal Units (VAV, UV, etc.) shall have electric damper and valve actuation.

- b. All Terminal Units shall be controlled with HVAC-DDC Controller)

3.2 Installation Practices

A. BAS Wiring

1. All conduit, wiring, accessories and wiring connections required for the installation of the Building Automation System, as herein specified, shall be provided by the BAS Contractor unless specifically shown on the Electrical Drawings under Division 26 Electrical. All wiring shall comply with the requirements of applicable portions of Division 26 and all local and national electric codes, unless specified otherwise in this section.
2. All BAS wiring materials and installation methods shall comply with BAS manufacturer recommendations.
3. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BAS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BAS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
4. Class 2 Wiring
 - a. All Class 2 (24 VAC or less) wiring shall be installed in conduit unless otherwise specified.
 - b. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.
5. Class 2 signal wiring and 24 VAC power can be run in the same conduit. Power wiring 120 VAC and greater cannot share the same conduit with Class 2 signal wiring.
6. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.

B. BAS Line Voltage Power Source

1. 120-volt AC circuits used for the Building Automation System shall be taken from panel boards and circuit breakers provided by Division 16.
2. Circuits used for the BAS shall be dedicated to the BAS and shall not be used for any other purposes.
3. DDC terminal unit controllers may use AC power from motor power circuits.

C. BAS Raceway

1. All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 1/2".
2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.
3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.

4. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.

D. Penetrations

1. Provide fire stopping for all penetrations used by dedicated BAS conduits and raceways.
2. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
3. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.
4. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

E. BAS Identification Standards

1. Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location.
 - a. Cable types specified in Item A shall be color coded for easy identification and troubleshooting.

F. BAS Panel Installation

1. The BAS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.
2. The BAS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.

G. Input Devices

1. All Input devices shall be installed per the manufacturer recommendation
2. Locate components of the BAS in accessible local control panels wherever possible.

H. HVAC Input Devices – General

1. All Input devices shall be installed per the manufacturer recommendation
2. Locate components of the BAS in accessible local control panels wherever possible.
3. The mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.
4. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.
5. Outside Air Sensors
 - a. Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.
 - b. Sensors shall be installed with a rain proof, perforated cover.
6. Water Differential Pressure Sensors

- a. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.
 - b. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
 - c. The transmitters shall be installed in an accessible location wherever possible.
 7. Medium to High Differential Water Pressure Applications (Over 21" w.c.):
 - a. Air bleed units, bypass valves and compression fittings shall be provided.
 8. Building Differential Air Pressure Applications (-1" to +1" w.c.):
 - a. Transmitter's exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.
 - b. The interior tip shall be inconspicuous and located as shown on the drawings.
 9. Air Flow Measuring Stations:
 - a. Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct.
 - b. Station flanges shall be two inch to three inch to facilitate matching connecting ductwork.
 10. Duct Temperature Sensors:
 - a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
 - b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
 - c. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
 - d. The sensor shall be mounted to suitable supports using factory approved element holders.
 11. Space Sensors:
 - a. Shall be mounted per ADA requirements.
 - b. Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.
 12. Low Temperature Limit Switches:
 - a. Install on the discharge side of the first water or steam coil in the air stream.
 - b. Mount element horizontally across duct in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.
 - c. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.
 13. Air Differential Pressure Status Switches:
 - a. Install with static pressure tips, tubing, fittings, and air filter.
 14. Water Differential Pressure Status Switches:
 - a. Install with shut off valves for isolation.
- I. HVAC Output Devices
1. All output devices shall be installed per the manufacturer's recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, air-flow stations, pressure wells, etc.
 2. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the

- entire stroke. When any pneumatic actuator is sequenced with another device, pilot positioners shall be installed to allow for proper sequencing.
3. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.
 4. Control Valves: Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 psi. The maximum pressure drop for steam applications shall be 7 psi.
 5. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Management System is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems

3.3 Training Services

- A. The BAS contractor shall provide the following training services:
 1. One day of on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the BAS software layout and naming conventions, and a walk through of the facility to identify panel and device locations.

3.4 Commissioning Requirements

- A. Fully commission all aspects of the Building Automation System work.
- B. Acceptance Check Sheet
 1. Prepare a check sheet that includes all points for all functions of the BAS as indicated on the point list included in this specification.
 2. Submit the check sheet to the Engineer for approval
 3. The Engineer will use the check sheet as the basis for acceptance with the BAS Contractor.
 - a. Sample

Systems AHU 1,2,3,4

Point	Description	Type	Units	History	Alarm	Totalize
DA-P	Discharge Static Pressure	AI	In WC	X		
DA-T	Discharge Air Temperature	AI	Degree F	X		
PH-T	Preheat Temperature	AI	Degree F	X		
SF-S	Supply Fan Status	BI	Off On	X	X	X
PH-O	Preheat Output	AO	%	X		
RH-O	Reheat Output	AO	%	X		
CLG-O	Cooling Output	AO	%	X		

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SF-O	Supply Fan Output	AO	%	X
SF-C	Supply Fan Command	BO	Off On	X
PH-LCKO	Preheat Lockout Command	BO	Off On	X
CLG-LCKO	Cooling Lockout Command	BO	Off On	X
RH-LCKO	Reheat Lockout Command	BO	Off On	X
DAT-SP	Discharge Temperature Setpoint	AO	Degree F	X
PHT-SP	Preheat Temperature Setpoint	AO	Degree F	X
DAP-SP	Discharge Static Pressure Setpoint	AO	in WC	X

END OF SECTION 230923

SECTION 230950 - VARIABLE-FREQUENCY DRIVES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes solid-state, pulse-width modulated (PWM), variable frequency controllers (VFDs) for speed control of three-phase, squirrel-cage induction motors.

1.2 SUBMITTALS

- A. Product Data: For each type of VFD.
- B. Shop Drawings: For each VFD.
 - 1. Include wiring diagrams.
- C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.
- B. Comply with NFPA 70.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFDs, minimum clearances between VFDs, and adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: 0 to 40 deg C.
 - 2. Humidity: Less than 90 percent (noncondensing).
 - 3. Altitude: Not exceeding 3300 feet.

1.5 COORDINATION

- A. Coordinate features of VFDs, installed units, and accessory devices with pilot devices and control circuits to which they connect.

- B. Coordinate features, accessories, and functions of each VFD and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
 - 2. Siemens
 - 3. Yaskawa
 - 4. Pre-Approved Manufacturer

2.2 VARIABLE FREQUENCY DRIVES

- A. **Description:** NEMA ICS 2, IGBT, PWM, VFD; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase induction motor by adjusting output voltage and frequency.
 - 1. Provide unit suitable for operation of premium-efficiency motor as defined by NEMA MG 1.
- B. **Design and Rating:** Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- C. **Output Rating:** 3-phase; 6 to 66 Hz, with torque constant as speed changes.
- D. **Unit Operating Requirements:**
 - 1. Input ac voltage tolerance of 208 V, plus or minus 5, or 380 to 500 V, plus or minus 10 percent.
 - 2. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
 - 3. Minimum Efficiency: 96 percent at 60 Hz, full load.
 - 4. Minimum Displacement Primary-Side Power Factor: 96 percent.
 - 5. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
 - 6. Starting Torque: 100 percent of rated torque or as indicated.
 - 7. Speed Regulation: Plus or minus 1 percent.
- E. **Isolated control interface** to allow controller to follow control signal over an 11:1 speed range.
 - 1. Electrical Signal: 4 to 20 mA at 24 V.
- F. **Internal Adjustability Capabilities:**
 - 1. Minimum Speed: 5 to 25 percent of maximum rpm.

2. **Maximum Speed:** 80 to 100 percent of maximum rpm.
3. **Acceleration:** 2 to a minimum of 22 seconds.
4. **Deceleration:** 2 to a minimum of 22 seconds.
5. **Current Limit:** 50 to a minimum of 110 percent of maximum rating.

G. Self-Protection and Reliability Features:

1. **Input transient protection** by means of surge suppressors.
2. **Under- and overvoltage trips;** inverter overtemperature, overload, and overcurrent trips.
3. **Motor Overload Relay:** Adjustable and capable of NEMA ICS 2, Class 10 performance.
4. **Notch filter** to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
5. **Instantaneous line-to-line and line-to-ground overcurrent trips.**
6. **Loss-of-phase protection.**
7. **Reverse-phase protection.**
8. **Short-circuit protection.**
9. **Motor overtemperature fault.**

H. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

I. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.

J. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

K. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

L. Status Lights: Door-mounted LED indicators shall indicate the following conditions:

1. **Power on.**
2. **Run.**
3. **Overvoltage.**
4. **Line fault.**
5. **Overcurrent.**
6. **External fault.**

M. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.

N. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:

1. **Output frequency (Hz).**

2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (VDC).
9. Set-point frequency (Hz).
10. Motor output voltage (V).

O. Control Signal Interface:

1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:
 - a. 0 to 10-V dc.
 - b. 0-20 or 4-20 mA.
 - c. Potentiometer using up/down digital inputs.
 - d. Fixed frequencies using digital inputs.
 - e. RS485.
 - f. Keypad display for local hand operation.
3. Output Signal Interface:
 - a. A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:
 - 1) Output frequency (Hz).
 - 2) Output current (load).
 - 3) DC-link voltage (VDC).
 - 4) Motor torque (percent).
 - 5) Motor speed (rpm).
 - 6) Set-point frequency (Hz).
4. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
 - a. Motor running.
 - b. Set-point speed reached.
 - c. Fault and warning indication (overtemperature or overcurrent).
 - d. PID high- or low-speed limits reached.

- P. Communications: Provide an RS485 interface allowing VFD to be used with an external system within a multidrop LAN configuration. Interface shall allow all parameter settings of VFD to be programmed via BMS control. Provide capability for VFD to retain these settings within the nonvolatile memory.
- Q. Integral Disconnecting Means: NEMA KS 1, nonfusible switch with lockable handle.
- R. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.

2.3 ACCESSORIES

- A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
- B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.
- C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.
- D. Control Relays: Auxiliary and adjustable time-delay relays.
- E. Standard Displays:
 - 1. Output frequency (Hz).
 - 2. Set-point frequency (Hz).
 - 3. Motor current (amperes).
 - 4. DC-link voltage (VDC).
 - 5. Motor torque (percent).
 - 6. Motor speed (rpm).
 - 7. Motor output voltage (V).
- F. Historical Logging Information and Displays:
 - 1. Real-time clock with current time and date.
 - 2. Running log of total power versus time.
 - 3. Total run time.
 - 4. Fault log, maintaining last four faults with time and date stamp for each.
- G. Current-Sensing, Phase-Failure Relays for Bypass Controller: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

2.4 LINE CONDITIONING AND FILTERING

- A. Input Line Conditioning: Based on the manufacturer's harmonic analysis study and report, provide input filtering, as required, to limit total demand (harmonic current) distortion and total harmonic voltage demand at the defined point of common coupling to meet IEEE 519 recommendations.
- B. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2
- C. EMI/RFI Filtering: Coordinate with all owner systems in the existing building to provide proper EMI/RFI filtering.

2.5 BYPASS SYSTEMS

- A. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.
- B. Bypass Mode: Field-selectable automatic or manual, allows local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic-control system feedback.
- C. Bypass Controller: Three-contactor-style bypass allows motor operation via the power converter or the bypass controller with input isolating switch and barrier arranged to isolate the power converter input and output and permit safe testing and troubleshooting of the power converter, both energized and de-energized, while motor is operating in bypass mode.
 - 1. Bypass Contactor: Load-break, NEMA-rated contactor.
 - 2. Input and Output Isolating Contactors: Non-load-break, NEMA-rated contactors.
 - 3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.
- D. Bypass Contactor Configuration: Full-voltage across-the-line type.
 - 1. NORMAL/BYPASS selector switch.
 - 2. HAND/OFF/AUTO selector switch.
 - 3. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFD while the motor is running in the bypass mode.
 - 4. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
 - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
 - b. Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.

5. Control Circuits: 120V ac; obtained from integral CPT, with primary and secondary fuses, with of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.
 - a. CPT Spare Capacity: 100 VA.
6. Overload Relays: NEMA ICS 2.
 - a. Solid-State Overload Relays:
 - 1) Switch or dial selectable for motor-running overload protection.
 - 2) Sensors in each phase.
 - 3) Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
 - 4) Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
 - 5) Analog communication module.
 - b. External overload, reset push button.

2.6 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to VFDs before shipping.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Select features of each VFD to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, controller, and load.
- B. Select horsepower rating of controllers to suit motor controlled.

3.2 INSTALLATION

- A. Install VFDs in locations shown on plans or as required by other sections of these specifications.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

3.3 IDENTIFICATION

- A. Identify VFDs, components, and control wiring according to Division 26 Section "Identification for Electrical Systems."
- B. Operating Instructions: Frame printed operating instructions for VFDs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFD units.

3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between VFDs and remote devices according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect hand-off-automatic switch and other automatic-control devices where applicable.
 - 1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
 - 2. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
 - 1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 - 2. Assist in field testing of equipment including pretesting and adjusting of solid-state controllers.
 - 3. Report results in writing.
- C. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS. 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.

3.6 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

END OF SECTION 230950

SECTION 231123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipes, tubes, and fittings.
 - 2. Piping specialties.
 - 3. Piping and tubing joining materials.
 - 4. Valves.
 - 5. Pressure regulators.

1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
 - 2. Service Regulators: 100 psig minimum unless otherwise indicated.
- B. Natural-Gas System Pressure within Buildings: More than 0.5 psig but not more than 2 psig.
- C. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2 psig, and is reduced to secondary pressure of 0.5 psig or less.
- D. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Submittal: For natural-gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation as required per local authorities.
 - 1. Detail fabrication and assembly of seismic restraints.
 - 2. Design Calculations: Calculate requirements for selecting seismic restraints.
- C. Welding certificates where applicable.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 - 4. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
- B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Parker Hannifin Corporation; Parflex Division.
 - b. Tru-Flex Metal Hose Corp.
 - 2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
 - 3. Coating: PE with flame retardant.
 - a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1) Flame-Spread Index: 25 or less.
 - 2) Smoke-Developed Index: 50 or less.
 - 4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
 - 5. Striker Plates: Steel, designed to protect tubing from penetrations.
 - 6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
 - 7. Operating-Pressure Rating: 5 psig.

- C. Annealed-Temper Copper Tube: Comply with ASTM B 88, Type K.
1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
 2. Flare Fittings: Comply with ASME B16.26 and SAE J513.
 - a. Copper fittings with long nuts.
 - b. Metal-to-metal compression seal without gasket.
 - c. Dryseal threads complying with ASME B1.20.3.
 3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch thick.
- D. PE Pipe: ASTM D 2513, SDR 11.
1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
 2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
 - b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
 - c. Aboveground Portion: PE transition fitting.
 - d. Outlet shall be threaded or suitable for welded connection.
 - e. Tracer wire connection.
 - f. Ultraviolet shield.
 - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
 4. Transition Service-Line Risers: Factory fabricated and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
 - b. Outlet shall be threaded or suitable for welded connection.
 - c. Bridging sleeve over mechanical coupling.
 - d. Factory-connected anode.
 - e. Tracer wire connection.
 - f. Ultraviolet shield.
 - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

2.2 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
 4. Corrugated stainless-steel tubing with polymer coating.
 5. Operating-Pressure Rating: 0.5 psig.
 6. End Fittings: Zinc-coated steel.
 7. Threaded Ends: Comply with ASME B1.20.1.
 8. Maximum Length: 72 inches.

- B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
 - 1. Copper-alloy convenience outlet and matching plug connector.
 - 2. Nitrile seals.
 - 3. Hand operated with automatic shutoff when disconnected.
 - 4. For indoor or outdoor applications.
 - 5. Adjustable, retractable restraining cable.

- C. Y-Pattern Strainers:
 - 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 - 2. End Connections: Threaded ends for NPS 2 and smaller.
 - 3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 - 4. CWP Rating: 125 psig.

- D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.

- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

- A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

- B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
 - 1. CWP Rating: 125 psig.
 - 2. Threaded Ends: Comply with ASME B1.20.1.
 - 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 - 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 - 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
 - 6. Service Mark: Valves 1.25 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

- C. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. Perfection Corporation; a subsidiary of American Meter Company.
 - 2. Body: Bronze, complying with ASTM B 584.
 - 3. Ball: Chrome-plated brass.
 - 4. Stem: Bronze; blowout proof.
 - 5. Seats: Reinforced TFE; blowout proof.
 - 6. Packing: Separate packnut with adjustable-stem packing threaded ends.
 - 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 - 8. CWP Rating: 600 psig.
 - 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 - 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

- D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. Perfection Corporation; a subsidiary of American Meter Company.
 - 2. Body: Bronze, complying with ASTM B 584.
 - 3. Ball: Chrome-plated bronze.
 - 4. Stem: Bronze; blowout proof.
 - 5. Seats: Reinforced TFE; blowout proof.
 - 6. Packing: Threaded-body packnut design with adjustable-stem packing.
 - 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 - 8. CWP Rating: 600 psig.
 - 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 - 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

- E. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. Perfection Corporation; a subsidiary of American Meter Company.
 - 2. Body: Bronze, complying with ASTM B 584.
 - 3. Ball: Chrome-plated bronze.
 - 4. Stem: Bronze; blowout proof.
 - 5. Seats: Reinforced TFE.
 - 6. Packing: Threaded-body packnut design with adjustable-stem packing.

7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Bronze Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lee Brass Company.
 - b. McDonald, A. Y. Mfg. Co.
 - c. Mueller Industries
2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.5 DIELECTRIC UNIONS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Capitol Manufacturing Company.
 2. Hart Industries International, Inc.
 3. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
- B. Minimum Operating-Pressure Rating: 150 psig.
- C. Combination fitting of copper alloy and ferrous materials.
- D. Insulating materials suitable for natural gas.
- E. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.6 SLEEVES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.7 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico Inc.
 - c. Metraflex Company (The).
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
 - 3. Pressure Plates: Carbon steel.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

2.8 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Install fittings for changes in direction and branch connections.
- C. Exterior-Wall Pipe Penetrations: Seal penetrations using steel or cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- D. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required 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.

- E. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."
- F. All exterior gas piping shall be painted with one primer coat and two (2) finish coats.

3.2 INDOOR PIPING INSTALLATION

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas. Where exposed in finished spaces, all piping shall be painted.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access. No running threaded joints or valves shall be installed in a return air plenum.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. **Fire-Barrier Penetrations:** Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Joint Sealers".
- L. Verify final equipment locations for roughing-in.
- M. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

- N. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- O. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- P. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view. No joints will be allowed in concealed locations per code requirements.
- Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- R. Connect branch piping from top or side of horizontal piping.
- S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment.
- T. Do not use natural-gas piping as grounding electrode.
- U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- V. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.3 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install earthquake valves aboveground outside buildings according to listing.

- E. Install anode for metallic valves in underground PE piping.

3.4 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
 - 4. All piping 2 psi or greater shall have welded fittings.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 0.375-inch.
 - 2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 0.375-inch.
 - 3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 0.375-inch.
- B. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 0.375-inch.

2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 0.375-inch.
3. NPS 3/4 and Larger: Maximum span, 96 inches; minimum rod size, 0.375-inch.

3.6 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements. Include all costs, charges, fees incurred by local authorities into bid.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.7 LABELING AND IDENTIFYING

- A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.8 FIELD QUALITY CONTROL

- A. Test, inspect, and purge natural gas according to NFPA 54 and the International Fuel Gas Code and authorities having jurisdiction.
- B. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.9 OUTDOOR PIPING SCHEDULE

- A. Reference piping material schedule on drawings.

3.10 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
 - 1. One-piece, bronze ball valve with bronze trim.
 - 2. Two-piece, full-port, bronze ball valves with bronze trim.
 - 3. Bronze plug valve.

- B. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
 - 1. One-piece, bronze ball valve with bronze trim.
 - 2. Two-piece, full-port, bronze ball valves with bronze trim.
 - 3. Bronze plug valve.

- C. Valves in branch piping for single appliance shall be one of the following:
 - 1. One-piece, bronze ball valve with bronze trim.
 - 2. Two-piece, full-port, bronze ball valves with bronze trim.
 - 3. Bronze plug valve.

END OF SECTION 231123

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following systems:
 - 1. Hot-water heating piping.
 - 2. Chilled-water piping.
 - 3. Condenser-water piping.
 - 4. Condensate-drain piping.
 - 5. Blowdown-drain piping.
 - 6. Safety-valve-inlet and -outlet piping.
 - 7. Chemical Water treatment for hydronic systems (By owner's vendor)

- B. Contractor shall field verify material of existing pipe system and provide all new piping to match the pipe material of the existing system.

1.2 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
 - 1. Hot-Water Heating Piping: 175 psig at 200 deg F (93 deg C).
 - 2. Chilled-Water Piping: 175 psig at 200 deg F.
 - 3. Condenser-Water Piping: 125 psig at 150 deg F.
 - 4. Condensate-Drain Piping: 150 deg F.
 - 5. Blowdown-Drain Piping: 200 deg F.
 - 6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.3 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 2. Air control devices.
 - 3. Chemical treatment.
 - 4. Hydronic specialties.

- B. Field quality-control test reports.

- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 CHEMICAL WATER TREATMENT

- A. Coordinate with Walter Louis Fluid Technologies for all chemicals needed during start-up. The State of Missouri will provide all chemicals needed for start-up through their existing service contract with Walter Louis Fluid Technologies. Walter Louis Fluid Technologies of Quincy, Illinois (217) 223-2017. No chemicals shall be added to any system without their direction.

2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. Wrought-Copper Fittings: ASME B16.22.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. S. P. Fittings; a division of Star Pipe Products.
 - c. Victaulic Company of America.
- E. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.

- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.
- F. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
- G. Grooved Mechanical-Joint Fittings and Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Central Sprinkler Company; a division of Tyco Fire & Building Products.
 - c. National Fittings, Inc.
 - d. S. P. Fittings; a division of Star Pipe Products.
 - e. Victaulic Company of America.
 - 2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - 3. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

2.4 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 0.125-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- E. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions:
 - 1. 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:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.
 - 3. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Couplings:
 - 1. 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:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Calpico, Inc.
 - b. Capitol Manufacturing Company.
 - c. Lochinvar Corporation.
 - d. Watts
 - 3. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

2.6 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."
- C. Bronze, Calibrated-Orifice, Balancing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - b. Flow Design Inc.
 - c. Griswold Controls.
 - d. Taco.
 - 2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 - 3. Ball: Brass or stainless steel.
 - 4. Plug: Resin.
 - 5. Seat: PTFE.
 - 6. End Connections: Threaded or socket.
 - 7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 - 8. Handle Style: Lever, with memory stop to retain set position.
 - 9. CWP Rating: Minimum 125 psig.
 - 10. Maximum Operating Temperature: 250 deg F.
- D. Diaphragm-Operated, Pressure-Reducing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - d. Conbraco Industries, Inc.
 - e. Spence Engineering Company, Inc.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Body: Bronze or brass.
 - 3. Disc: Glass and carbon-filled PTFE.
 - 4. Seat: Brass.
 - 5. Stem Seals: EPDM O-rings.
 - 6. Diaphragm: EPT.
 - 7. Low inlet-pressure check valve.
 - 8. Inlet Strainer: removable without system shutdown.
 - 9. Valve Seat and Stem: Noncorrosive.
 - 10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

2.7 AIR CONTROL DEVICES

- 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. Amtrol, Inc.
 - 2. Armstrong Pumps, Inc.
 - 3. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - 4. Taco.
- C. Manual Air Vents:
 - 1. Body: Bronze.
 - 2. Internal Parts: Nonferrous.
 - 3. Operator: Screwdriver or thumbscrew.
 - 4. Inlet Connection: NPS 1/2.
 - 5. Discharge Connection: NPS 1/8.
 - 6. CWP Rating: 150 psig.
 - 7. Maximum Operating Temperature: 225 deg F.

2.8 HYDRONIC PIPING SPECIALTIES

- A. Y-Pattern Strainers:
 - 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 - 2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
 - 3. Strainer Screen: 60-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
 - 4. CWP Rating: 125 psig.
- B. Stainless-Steel Bellow, Flexible Connectors:
 - 1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
 - 2. End Connections: Threaded or flanged to match equipment connected.
 - 3. Performance: Capable of 3/4-inch misalignment.
 - 4. CWP Rating: 150 psig.
 - 5. Maximum Operating Temperature: 250 deg F.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

- B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

- C. Chilled-water piping, aboveground, NPS 2 and smaller, shall be the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

- D. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

- E. Condenser-water piping, aboveground, NPS 2-1/2 and larger, shall be the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

- F. Condensate-Drain Piping: Type M DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

- G. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

- H. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

3.2 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- B. Install balancing valves at each branch connection to return main.
- C. Install balancing valves in the return pipe of each heating or cooling terminal.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.3 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.

- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using pre-manufactured tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- T. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.

2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 4. Spring hangers to support vertical runs.
 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 0.375-inch.
 2. NPS 1: Maximum span, 7 feet; minimum rod size, 0.375-inch.
 3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 0.375-inch.
 4. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 0.375-inch.
 5. NPS 2: Maximum span, 10 feet; minimum rod size, 0.375-inch.
 6. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 0.5-inch.
 7. NPS 3: Maximum span, 12 feet; minimum rod size, 0.5-inch.
 8. NPS 3-1/2: Maximum span, 13 feet; minimum rod size, 0.5-inch.
 9. NPS 4: Maximum span, 14 feet; minimum rod size, 0.625-inch.
- D. Install hangers for drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 0.375-inch.
 2. NPS 1: Maximum span, 6 feet; minimum rod size, 0.375-inch.
 3. NPS 1-1/4: Maximum span, 7 feet ; minimum rod size, 0.375-inch.
 4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 0.375-inch.
 5. NPS 2: Maximum span, 8 feet ; minimum rod size, 0.375-inch.
 6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 0.5-inch.
 7. NPS 3: Maximum span, 10 feet; minimum rod size, 0.5-inch.
- E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

- E. **Brazed Joints:** Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

- F. **Threaded Joints:** Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. **Damaged Threads:** Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

- G. **Flanged Joints:** Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

- B. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

- C. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.

- D. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
 - 1. Install tank fittings that are shipped loose.
 - 2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

- B. Install control valves in accessible locations close to connected equipment.

- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.8 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

- B. Perform the following tests on hydronic piping:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 - 3. Isolate expansion tanks and determine that hydronic system is full of water.
 - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 - 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 - 6. Prepare written report of testing.

- C. Perform the following before operating the system:
 - 1. Open manual valves fully.
 - 2. Inspect pumps for proper rotation.
 - 3. Set makeup pressure-reducing valves for required system pressure.
 - 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 - 5. Set temperature controls so all coils are calling for full flow.
 - 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 - 7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1 Current Edition.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Coordination Drawings: Plans, drawn to scale, at 0.25-inch scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.

4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Coordination between other trades.

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. At Contractor's option, ductwork may be joined with prefabricated galvanized "Ductmate" sections.

2.2 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. McGill AirFlow LLC.
 - b. SEMCO Incorporated.
 - c. Spiral Manufacturing Co., Inc.
 - d. Lewis & Lambert
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct

Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Fabricate round ducts larger Than 90 inches in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G90.
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum

ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

- G. Tie Rods: Galvanized steel, 0.25-inch minimum diameter for lengths 36 inches or less; 0.375-inch minimum diameter for lengths longer than 36 inches.

2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.
 - 3. Grade: NS.
 - 4. Class: 25.
 - 5. Use: O.
 - 6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- D. Round Duct Joint O-Ring Seals:
 - 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 - 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 - 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless Steel Ducts: Stainless steel complying with ASTM A 492.

- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

- H. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless Steel Ducts: Stainless steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

- C. Install round ducts in maximum practical lengths.

- D. Install ducts with fewest possible joints.

- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to

view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1.5 inches.

- K. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."
- L. All round take-off fittings for ductwork shall be made with Buckley BMD or equal bellmouth fittings. High efficiency takeoffs, Buckley Model 3300D or equal will be allowed where rectangular depth noted on drawings is not 4 inches or greater than the round branch duct size.

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.
- F. All exposed round ductwork and fittings shall be double-walled, galvanized steel, spiral lockseam, with 1 inch fiberglass insulation. Provide perforated inner liner instead of solid inner liner. Outer shell shall be "paint-grip" sheet metal.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.
- B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 10 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1.5 inches from bottom of duct.
- C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
 - 3. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
 - 4. Conditioned Space, Exhaust Ducts: Seal Class B.
 - 5. Conditioned Space, Return-Air Ducts: Seal Class C.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 CONNECTIONS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.8 DUCT SCHEDULE

- A. All ducts shall be constructed for the specific duct pressure class shown on the contract documents or in equipment fan schedule listed as external or total static pressure. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
- B. Supply Ducts:
 - 1. Ducts Connected to Terminal Units:
 - a. Minimum SMACNA Seal Class: A.
 - b. SMACNA Leakage Class for Rectangular: 12.
 - c. SMACNA Leakage Class for Round and Flat Oval: 12.
 - 2. Ducts Connected to Constant-Volume Air-Handling Units:
 - a. Minimum SMACNA Seal Class: A.
 - b. SMACNA Leakage Class for Rectangular: 6.
 - c. SMACNA Leakage Class for Round and Flat Oval: 6.
 - 3. Ducts Connected to Variable-Air-Volume Air-Handling Units:
 - a. Minimum SMACNA Seal Class: A.
 - b. SMACNA Leakage Class for Rectangular: 3.
 - c. SMACNA Leakage Class for Round and Flat Oval: 3.
 - 4. Ducts Connected to Equipment Not Listed Above:
 - a. Minimum SMACNA Seal Class: A.
 - b. SMACNA Leakage Class for Rectangular: 3.
 - c. SMACNA Leakage Class for Round and Flat Oval: 3.
- C. Return Ducts:
 - 1. Ducts Connected to Terminal Units:
 - a. Minimum SMACNA Seal Class: A.
 - b. SMACNA Leakage Class for Rectangular: 12.
 - c. SMACNA Leakage Class for Round and Flat Oval: 12.
 - 2. Ducts Connected to Air-Handling Units:
 - a. Minimum SMACNA Seal Class: A.
 - b. SMACNA Leakage Class for Rectangular: 6.
 - c. SMACNA Leakage Class for Round and Flat Oval: 6.
 - 3. Ducts Connected to Equipment Not Listed Above:
 - a. Minimum SMACNA Seal Class: A.
 - b. SMACNA Leakage Class for Rectangular: 3.

- c. SMACNA Leakage Class for Round and Flat Oval: 3.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
 - b. SMACNA Leakage Class for Rectangular: 12.
 - c. SMACNA Leakage Class for Round and Flat Oval: 6.
2. Ducts Connected to Air-Handling Units:
 - a. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
 - b. SMACNA Leakage Class for Rectangular: 6.
 - c. SMACNA Leakage Class for Round and Flat Oval: 3.
3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
 - a. Exposed to View: Type 304, stainless steel sheet, No. 4 finish.
 - b. Concealed: Carbon-steel sheet 16 gauge welded black iron.
 - c. Welded seams and joints – liquid tight.
 - d. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - e. SMACNA Leakage Class: 3.
4. Ducts Connected to Dishwasher Hoods:
 - a. Type 304, stainless steel sheet.
 - b. Exposed to View: No. 4 finish.
 - c. Concealed: No. 2D finish.
 - d. Welded seams and flanged joints with watertight EPDM gaskets.
 - e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - f. SMACNA Leakage Class: 3.
5. Ducts Connected to Equipment Not Listed Above:
 - a. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - b. SMACNA Leakage Class for Rectangular: 12.
 - c. SMACNA Leakage Class for Round and Flat Oval: 6.

E. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows." (All valves shall be double wall acoustical type).
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

F. Branch Configuration:

1. **Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."**
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Bell mouth or 45 degree high efficiency take off.
2. **Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.**
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Centrifugal roof ventilators.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- C. Operation and maintenance data.

1.3 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. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- C. UL Standard: Power ventilators shall comply with UL 705.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck.
 - 2. Loren Cook Company.
 - 3. Penn Ventilation.

- B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- C. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
 - 1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
- D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
 - 1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 - 4. Fan and motor isolated from exhaust airstream.
- F. Accessories:
 - 1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.
 - 2. Bird Screens: Removable, 0.5-inch mesh, aluminum or brass wire.
 - 3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
 - 4. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
 - 5. Speed Controllers: Provide speed controllers where available for fan motors.
- G. Roof Curbs: Galvanized steel; mitered and welded corners; 1.5-inch-thick, rigid, fiberglass insulation adhered to inside walls; and 1.5-inch wood nailer. Size as required to suit roof opening and fan base.
 - 1. Configuration: Built-in raised cant and mounting flange.
 - 2. Overall Height: 8 inches above roof assembly.
 - 3. Sound Curb: Curb with sound-absorbing insulation matrix.
 - 4. Pitch Mounting: Manufacture curb for roof slope.
 - 5. Metal Liner: Galvanized steel.
 - 6. Mounting Pedestal: Galvanized steel with removable access panel.
 - 7. Vented Curb: Unlined with louvered vents in vertical sides.

2.2 MOTORS

- A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
- B. Enclosure Type: Totally enclosed, fan cooled.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Secure roof-mounting fans to roof curbs with cadmium-plated hardware.
- C. Install units with clearances for service and maintenance.
- D. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."
- E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 10. Shut unit down and reconnect automatic temperature-control operators.
 - 11. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 233423

SECTION 233813 – COMMERCIAL KITCHEN HOODS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes Type I commercial kitchen hoods.

1.2 SUBMITTALS

- A. **Product Data:** For the following:
 - 1. Filters/baffles.
 - 2. Fire-suppression systems.
 - 3. Lighting fixtures.

- B. **Shop Drawings:** Signed and sealed by a qualified professional engineer.
 - 1. Show plan view, elevation view, sections, roughing-in dimensions, service requirements, duct connection sizes, and attachments to other work.
 - 2. Indicate performance, exhaust and makeup air airflow, and pressure loss at actual Project-site elevation.
 - 3. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 4. Wiring Diagrams: Power, signal, and control wiring.
 - 5. Piping Diagrams: Detail fire-suppression piping and components and differentiate between manufacturer-installed and field-installed piping. Show cooking equipment plan and elevation to illustrate fire-suppression nozzle locations.

1.3 QUALITY ASSURANCE

- A. **Welding:** Qualify procedures and personnel according to AWS D1.1/D 1.1M, "Structural Welding Code - Steel," for hangers and supports; and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for joint and seam welding.

- 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.

2.1 HOOD MATERIALS

- A. Stainless-Steel Sheet: ASTM A 666, Type 304.
 - 1. Minimum Thickness: 0.037 inch.
 - 2. Finish: Comply with SSINA's "Finishes for Stainless Steel" for recommendations for applying and designating finishes.
 - a. Finish shall be free from tool and die marks and stretch lines and shall have uniform, directionally textured, polished finish indicated, free of cross scratches. Grain shall run with long dimension of each piece.
 - 3. Exposed Surfaces: ASTM A 480/A 480M, No. 2B finish (bright, cold-rolled, polished).
 - 4. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

- B. Zinc-Coated Steel Shapes: ASTM A 36/A 36M, zinc coated according to ASTM A 123/A 123M requirements.

- C. Sealant: ASTM C 920; Type S, Grade NS, Class 25, Use NT. Elastomeric sealant shall be NSF certified for commercial kitchen hood application. Sealants, when cured and washed, shall comply with requirements in 21 CFR, Section 177.2600, for use in areas that come in contact with food.
 - 1. Color: As selected by Architect from manufacturer's full range.
 - 2. Backer Rod: Closed-cell polyethylene, in diameter larger than joint width.

- D. Sound Dampening: NSF-certified, nonabsorbent, hard-drying, sound-deadening compound for permanent adhesion to metal in minimum 0.125-inch thickness that does not chip, flake, or blister.

- E. Gaskets: NSF certified for end-use application indicated; of resilient rubber, neoprene, or PVC that is nontoxic, stable, odorless, nonabsorbent, and unaffected by exposure to foods and cleaning compounds, and that passes testing according to UL 710.

2.2 GENERAL HOOD FABRICATION REQUIREMENTS

- A. Welding: Use welding rod of same composition as metal being welded. Use methods that minimize distortion and develop strength and corrosion resistance of base metal. Make ductile welds free of mechanical imperfections such as gas holes, pits, or cracks.
 - 1. Welded Butt Joints: Full-penetration welds for full-joint length. Make joints flat, continuous, and homogenous with sheet metal without relying on straps under seams, filling in with solder, or spot welding.
 - 2. Grind exposed welded joints flush with adjoining material and polish to match adjoining surfaces.
 - 3. Where fasteners are welded to underside of equipment, finish reverse side of weld smooth and flush.

4. Coat concealed stainless-steel welded joints with metallic-based paint to prevent corrosion.

- B. For metal butt joints, comply with SMACNA's "Kitchen Equipment Fabrication Guidelines."

- C. Form metal with break bends that are not flaky, scaly, or cracked in appearance; where breaks mar uniform surface appearance of material, remove marks by grinding, polishing, and finishing.

- D. Sheared Metal Edges: Finish free of burrs, fins, and irregular projections.

- E. In food zones, as defined in NSF, fabricate surfaces free from exposed fasteners.

- F. Cap exposed fastener threads, including those inside cabinets, with stainless-steel lock washers and stainless-steel cap (acorn) nuts.

- G. Fabricate pipe slots on equipment with turned-up edges sized to accommodate service and utility lines and mechanical connections.

- H. Fabricate enclosures, including panels, housings, and skirts, to conceal service lines, operating components, and mechanical and electrical devices including those inside cabinets, unless otherwise indicated.

- I. Fabricate seismic restraints according to SMACNA's "Kitchen Equipment Fabrication Guidelines," Appendix 1, "Guidelines for Seismic Restraints of Kitchen Equipment."

- J. Fabricate equipment edges and backsplashes according to SMACNA's "Kitchen Equipment Fabrication Guidelines."

- K. Fabricate enclosure panels to ceiling and wall as follows:
 1. Fabricate panels on all exposed side(s) with same material as hood, and extend from ceiling to top of hood canopy and from canopy to wall.
 2. Wall Offset Spacer: Minimum of 3 inches as noted.
 3. Wall Shelves and Overshelves: Fabricate according to SMACNA's "Kitchen Equipment Fabrication Guidelines," with minimum 0.0625-inch-thick, stainless-steel shelf tops.

2.3 TYPE I EXHAUST HOOD FABRICATION

- 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. Captive-Aire Systems.
 2. Grease Master; a division of Custom Industries, Inc.
 3. Greenheck.
 4. Vent Master; Div. of Garland Commercial Ranges, Ltd.
 5. Absolute Air
- D. Weld all joints exposed to grease with continuous welds, and make filters/baffles or grease extractors and makeup air diffusers easily accessible for cleaning.
1. Fabricate hoods according to NSF 2, "Food Equipment."
 2. Hoods shall be listed and labeled, according to UL 710, by a testing agency acceptable to authorities having jurisdiction.
 3. Hoods shall be designed, fabricated, and installed according to NFPA 96.
 4. Include access panels as required for access to fire dampers and fusible links.
 5. Duct Collars Without Fire Dampers: Minimum 0.0598-inch-thick steel at least 3 inches long, continuously welded to top of hood and at corners.
 6. Duct-Collar with Fire Dampers: Collar and damper shall comply with UL 710 testing and listing required for the entire hood.
 - a. Collar: Minimum 0.0598-inch-thick stainless steel, at least 3 inches long, continuously welded to top of hood and at corners.
 - b. Blades: Minimum 0.1046-inch-thick stainless steel, counterbalanced to remain closed after actuation.
 - c. Blade Pivot and Spring: Stainless steel.
 - d. Fusible Link: Replaceable, 212 deg F rated.
- E. Hood Configuration: Exhaust and makeup air.
1. Makeup air shall be introduced by induction or diffusion inside canopy as detailed. If makeup air is not heated, insulate interior of makeup air plenum with high-density insulation having maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
 2. Makeup air shall be introduced through laminar-flow-type, perforated metal panels on front of hood canopy.
- F. Hood Style: Wall-mounted canopy, Single-island canopy or Double-island canopy as indicated.
- G. Filters/Baffles: Removable, aluminum. Fabricate stainless steel for filter frame and removable collection cup and pitched trough. Exposed surfaces shall be pitched to drain to collection cup. Filters/baffles shall be tested according to UL 1046, "Grease Filters for Exhaust Ducts," by an NRTL acceptable to authorities having jurisdiction.
- H. Lighting Fixtures: Surface-mounted, incandescent fixtures and lamps with lenses sealed vaportight. Wiring shall be installed in conduit on hood exterior.
1. Light switches shall be mounted on front panel of hood canopy or as otherwise noted.
 2. Lighting Fixtures: Incandescent complying with UL 1598.

- I. Comply with requirements in Division 23 Sections "Digital Control System for HVAC".

- J. Hood Controls: Hood mounting control cabinet, factory wired to control groups of adjacent hoods, and fabricated of stainless steel.
 1. Exhaust Fan: On-off switches shall start and stop the exhaust fan. Interlock exhaust fan with makeup air supply fan to operate simultaneously. Interlock exhaust fan with fire-suppression system to operate fan(s) during fire-suppression-agent release and to remain in operation until manually stopped. Include red pilot light to indicate fan operation. Motor starters shall comply with Division 26 Section "Enclosed Controllers."
 2. Exhaust Fan Interlock: Factory wire the exhaust fan starters in a single control cabinet for adjacent hoods to operate together.
 3. High-Temperature Control: Alarm shall sound and cooking equipment shall shut down before hood discharge temperature rises to actuation temperature of fire-suppression system.

2.4 WET-CHEMICAL FIRE-SUPPRESSION SYSTEM

- 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. Ansul Incorporated; a Tyco International Ltd. Company.
 2. Badger Fire Protection.
 3. Kidde Fire Systems.
 4. Pyro Chem.

- C. Description: Engineered distribution piping designed for automatic detection and release or manual release of fire-suppression agent by hood operator. Fire-suppression system shall be listed and labeled for complying with NFPA 17A, "Wet Chemical Extinguishing Systems," by a qualified testing agency acceptable to authorities having jurisdiction.
 1. Steel Pipe, NPS 2 and Smaller: ASTM A 53/A 53M, Type S, Grade A, Schedule 40, plain ends.
 2. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
 3. Piping, fusible links and release mechanism, tank containing the suppression agent, and controls shall be factory installed. Controls shall be in stainless-steel control cabinet mounted on hood. Furnish manual pull station for wall mounting. Exposed piping shall be covered with chrome-plated aluminum tubing. Exposed fittings shall be chrome plated.
 4. Liquid Extinguishing Agent: Noncorrosive, low-pH liquid.
 5. Furnish mechanical-operated gas shutoff valve; refer to Division 23 Section "Facility Natural-Gas Piping."
 6. Furnish electric-operated gas shutoff valve with clearly marked open and closed indicator for field installation.
 7. Fire-suppression system controls shall be integrated with controls for fans, lights, and fuel supply and located in a single cabinet for each group of hoods immediately adjacent.

8. Wiring shall have color-coded, numbered terminal blocks and grounding bar. Spare terminals for fire alarm, optional wiring to start fan with fire alarm, red pilot light to indicate fan operation, and control switches shall all be factory wired in control cabinet with relays or starters. Include spare terminals for fire alarm, and wiring to start fan with fire alarm.
9. Provide electric switch to shut-off electrical power to appliances under hood. A relay shall be provided if the equipment load exceeds the rated capacity of the switch.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Complete field assembly of hoods where required.
 1. Make closed butt and contact joints that do not require filler.
 2. Grind field welds on stainless-steel equipment smooth, and polish to match adjacent finish. Comply with welding requirements in Part 2 "General Hood Fabrication Requirements" Article.
- B. Install hoods and associated services with clearances and access for maintaining, cleaning, and servicing hoods, filters/baffles, grease extractor, and fire-suppression systems according to manufacturer's written instructions and requirements of authorities having jurisdiction.
- C. Make cutouts in hoods where required to run service lines and to make final connections, and seal openings according to UL 1978.
- D. Securely anchor and attach items and accessories to walls, floors, or bases with stainless-steel fasteners, unless otherwise indicated.
- E. Install hoods to operate free from vibration.
- F. Install seismic restraints according to SMACNA's "Kitchen Equipment Fabrication Guidelines," Appendix 1, "Guidelines for Seismic Restraints of Kitchen Equipment."
- G. Install trim strips and similar items requiring fasteners in a bed of sealant. Fasten with stainless-steel fasteners at 48 inches o.c. maximum.
- H. Install sealant in joints between equipment and abutting surfaces with continuous joint backing, unless otherwise indicated. Provide airtight, watertight, vermin-proof, sanitary joints.
- I. Install lamps, with maximum recommended wattage, in equipment with integral lighting.
- J. Set initial temperatures, and calibrate sensors.

- K. Set field-adjustable switches.

- L. Install fire-suppression piping for remote-mounted suppression systems according to NFPA 17A, "Wet Chemical Extinguishing Systems."

3.2 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. Report results in writing.

- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

- C. Tests and Inspections:
 - 1. Test each equipment item for proper operation. Repair or replace equipment that is defective, including units that operate below required capacity or that operate with excessive noise or vibration.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Perform hood performance tests required by authorities having jurisdiction.
 - 4. Perform fire-suppression system performance tests required by authorities having jurisdiction.

- D. Prepare test and inspection reports.

END OF SECTION 233813

SECTION 235216 - CONDENSING BOILERS (ALTERNATE #1)

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes packaged, factory-fabricated and assembled, gas-fired, fire-tube condensing boilers, trim, and accessories for generating hot water.
- B. Work outlined by this specification section shall be performed as part of alternate #1 work if alternate #1 is accepted.

1.2 SUBMITTALS

- A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.
 - 1. Prior to flue vent installation, engineered calculations and drawings must be submitted to Engineer to thoroughly demonstrate that size and configuration conform to recommended size, length and footprint for each submitted boiler.
- B. Efficiency Curves: At a minimum, submit efficiency curves for 100%, 60%, and 5% input firing rates at incoming water temperatures ranging from 60°F to 160°F. Test protocols shall conform to manufacturer's standards and shall be witnessed and reviewed by an independent, third-party group.
- C. Pressure Drop Curve: Submit pressure drop curve for flows ranging from 0 GPM to maximum value of boiler
 - 1. If submitted material is different from that of the design basis, boiler manufacture shall incur all costs associated with reselection of necessary pumps. Possible differences include, but are not limited to, the pump type, pump pad size, electrical characteristics and piping changes.
- D. Shop Drawings: For boilers, boiler trim, and accessories, include:
 - 1. Plans, elevations, sections, details, and attachments to other work.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- E. Source quality-control test reports: Reports shall be included in submittals.
- F. Field quality-control test reports: Reports shall be included in submittals.
- G. Operation and maintenance data: Data to be included in boiler emergency, operation and maintenance manuals.

- H. Warranty: Special warranty specified in this Section.
- I. Other Informational Submittals:
 - 1. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.

1.3 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. I=B=R Performance Compliance: Condensing boilers must be rated in accordance with applicable federal testing methods and verified by AHRI as capable of achieving the energy efficiency and performance ratings as tested within prescribed tolerances.
- C. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.
- D. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."
- E. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N, "Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers."
- F. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Fire-Tube Condensing Boilers:
 - a. The pressure vessel/heat exchanger shall carry a 10-year non-prorated from shipment, limited warranty against any failure due to condensate corrosion, thermal stress, mechanical defects or workmanship.
 - b. Manufacturer labeled control panels are conditionally warranted against failure for (2) two years from shipment.
 - c. All other components, with the exception of the igniter and flame detector, are conditionally guaranteed against any failure for 18 months from shipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide AERCO International, BMK 6000 fuel boiler or a comparable product by one of the following:
1. AERCO International
 2. Lochinvar Crest
 3. Fulton.

2.2 BOILER CONSTRUCTION

- A. Description: Boiler shall be natural gas fired, fully condensing, fire tube design. Power burner shall have full modulation (the minimum firing rate shall not exceed 200,000 BTU/HR input. Boilers that have an input greater than 200,000 BTU/Hr at minimum fire will not be considered) and discharge into a positive pressure vent. Boiler efficiency shall increase with decreasing load (output), while maintaining setpoint. Boiler shall be factory-fabricated, factory-assembled and factory-tested, fire-tube condensing boiler with heat exchanger sealed pressure-tight, built on a steel base, including insulated jacket, flue-gas vent, combustion-air intake connections, water supply, return and condensate drain connections, and controls.
- B. Heat Exchanger: The heat exchanger shall be constructed of 439 stainless steel fire tubes and tubesheets, with a one-pass combustion gas flow design. The fire tubes shall be 5/8" OD, with no less than 0.049" wall thickness. The upper and lower stainless steel tubesheet shall be no less than 0.25" thick. The pressure vessel/heat exchanger shall be welded construction. The heat exchanger shall be ASME stamped for a working pressure not less than 160 psig. Access to the tubesheets and heat exchanger shall be available by burner and exhaust manifold removal. Minimum access opening shall be no less than 10-inch diameter
- C. Pressure Vessel. The pressure vessel shall have a maximum water volume of 110 gallons. The boiler water pressure drop shall not exceed 4.0 psig at 570 gpm. The boiler water connections shall be 6-inch flanged 150-pound, ANSI rated. The pressure vessel shall be constructed of SA53 carbon steel, with a 0.25-inch thick wall and 0.50-inch thick upper head. Inspection openings in the pressure vessel shall be in accordance with ASME Section IV pressure vessel code. The boiler shall be designed so that the thermal efficiency increases as the boiler firing rate decreases.
- D. Modulating Air/Fuel Valve and Burner. The boiler burner shall be capable of a 15-to-1 turndown ratio of the firing rate without loss of combustion efficiency or staging of gas valves. The burner shall produce less than 14 Ng/J or 20 ppm of NOx corrected to 3% excess oxygen when firing on natural gas. The burner shall be metal-fiber mesh covering a stainless steel body with spark ignition and flame rectification. All burner material exposed to the combustion zone shall be of stainless steel construction. There shall be no moving parts within the burner itself. A modulating air/fuel valve shall meter the air and fuel input. The modulating motor must be linked to both the gas valve body and air valve body with a single linkage. The linkage shall not require any field adjustment. A variable frequency drive (VFD), controlled cast aluminum pre-

mix blower shall be used to ensure the optimum mixing of air and fuel between the air/fuel valve and the burner

E. Minimum boiler efficiencies shall be as follows at a 20 degree delta-T:

EWT	100% Fire	50% Fire	5% Fire
160 °F	86%	87%	87%
140 °F	87%	88%	88%
120 °F	88%	89%	89.5%
100 °F	93%	94.6%	95.5%
80 °F	95.7%	96.8%	98.2%

F. Exhaust Manifold: The exhaust manifold shall be of corrosion resistant cast aluminum or 316 stainless steel with an 8-inch diameter flue connection. The exhaust manifold shall have a collecting reservoir and a gravity drain for the elimination of condensation.

G. Blower: The boiler shall include a variable-speed, DC centrifugal fan to operate during the burner firing sequence and pre-purge the combustion chamber.

1. Motors: Blower motors shall comply with requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require a motor to operate in the service factor range above 1.0.

H. Ignition: Ignition shall be via spark ignition with 100 percent main-valve shutoff and electronic flame supervision.

2.3 CONTROLS

A. Refer to Division 23, Section "Instrumentation and Control of HVAC."

B. The boiler control system shall be segregated into three components: "C-More" Control Panel, Power Box and Input/Output Connection Box. The entire system shall be Underwriters Laboratories recognized.

C. The control panel shall consist of six individual circuit boards using state-of-the-art surface-mount technology in a single enclosure. These circuit boards shall include:

1. A display board incorporating LED display to indicate temperature and a vacuum fluorescent display module for all message enunciation
2. A CPU board housing all control functions
3. An electric low-water cutoff board with test and manual reset functions
4. A power supply board
5. An ignition /stepper board incorporating flame safeguard control
6. A connector board. Each board shall be individually field replaceable.

- D. The combustion safeguard/flame monitoring system shall use spark ignition and a rectification-type flame sensor.
- E. The control panel hardware shall support both RS-232 and RS-485 remote communications.
- F. The controls shall annunciate boiler and sensor status and include extensive self-diagnostic capabilities that incorporate a minimum of eight separate status messages and 34 separate fault messages.
- G. The control panel shall incorporate three self-governing features designed to enhance operation in modes where it receives an external control signal by eliminating nuisance faults due to over-temperature, improper external signal or loss of external signal. These features include:
 - 1. Setpoint high limit: Allows for a selectable maximum boiler outlet temperature and acts as temperature limiting governor. Setpoint limit is based on a PID function that automatically limits firing rate to maintain outlet temperature within a 0 to 10 degree selectable band from the desired maximum boiler outlet temperature.
 - 2. Setpoint Low Limit: Allows for a selectable minimum operating temperature.
 - 3. Failsafe Mode: Failsafe mode allows the boiler to switch its mode to operate from an internal setpoint if its external control signal is lost, rather than shut off. This is a selectable mode, enabling the control can to shut off the unit upon loss of external signal, if so desired.
- H. The boiler control system shall incorporate the following additional features for enhanced external system interface:
 - 1. System start temperature feature
 - 2. Pump delay timer
 - 3. Auxiliary start delay timer
 - 4. Auxiliary temperature sensor
 - 5. Analog output feature to enable simple monitoring of temperature setpoint, outlet temperature or fire rate
 - 6. Remote interlock circuit
 - 7. Delayed interlock circuit
 - 8. Fault relay for remote fault alarm
- I. Each boiler shall include an electric, single-seated combination safety shutoff valve/regulator with proof of closure switch in its gas train. Each boiler shall incorporate dual over-temperature protection with manual reset, in accordance with ASME Section IV and CSD-1.
- J. Each boiler shall have an oxygen monitoring system that will measure the oxygen content of the exhaust gases in real-time. Output of O2 information shall be displayed on the C-More control panel.

- K. Each boiler shall have integrated Boiler Sequencing Technology (BST), capable of multi-unit sequencing with lead-lag functionality and parallel operation. The system will incorporate the following capabilities:
1. Efficiently sequence 2-to-8 units on the same system to meet load requirement.
 2. Integrated control and wiring for seamless installation of optional isolation valve. When valves are utilized, the system shall operate one motorized valve per unit as an element of load sequencing. Valves shall close with decreased load as units turn off, minimum of one must always stay open for recirculation.
 3. Automatically rotate lead/lag amongst the units on the chain and monitor run hours per unit and balance load in an effort to equalize unit run hours.
 4. Designated master control, used to display and adjust key system parameters.
 5. Automatic bump-less transfer of master function to next unit on the chain in case of designated master unit failure; master/slave status should be shown on the individual unit displays.
 6. Designated master control, used to display and adjust key system parameters.
- L. For boiler plants greater than 8 units, the Boiler Manufacturer shall supply as part of the boiler package a completely integrated AERCO Control System (ACS) to control all operation and energy input of the multiple boiler heating plant. The ACS shall be comprised of a microprocessor based control utilizing the MODBUS protocol to communicate with the Boilers via the RS-485 port. One ACS controller shall have the ability to operate up to 32 AERCO boilers.
- M. The controller shall have the ability to vary the firing rate and energy input of each individual boiler throughout its full modulating range to maximize the condensing capability and thermal efficiency output of the entire heating plant. The ACS shall control the boiler outlet header temperature within $\pm 2^{\circ}\text{F}$. The controller shall be a PID type controller and uses Ramp Up/Ramp Down control algorithm for accurate temperature control with excellent variable load response. The ACS controller shall provide contact closure for auxiliary equipment such as system pumps and combustion air inlet dampers based upon outdoor air temperature.
1. The ACS shall have the following anti-cycling features:
 - a. Manual designation of lead boiler and last boiler.
 - b. Lead boiler rotation at user-specified time interval.
 - c. Delay the firing/shutting down of boilers when header temperature within a predefined deadband.
- N. When set on Internal Setpoint Mode, temperature control setpoint on the ACS shall be fully field adjustable from 50°F to 190°F in operation. When set on Indoor/Outdoor Reset Mode, the ACS will operate on an adjustable inverse ratio in response to outdoor temperature to control the main header temperature. Reset ratio shall be fully field adjustable from 0.3 to 3.0 in operation. When set on 4ma to 20ma Temperature Control Mode, the ACS will operate the plant to vary header temperature setpoint linearly as an externally applied 4-20 ma signal is supplied.
- O. When set on MODBUS Temperature Control Mode, the ACS will operate the plant to vary header temperature setpoint as an external communication utilizing the MODBUS protocol is

supplied via the RS-232 port. The ACS controller shall have a vacuum fluorescent display for monitoring of all sensors and interlocks. Non-volatile memory backup of all control parameters shall be internally provided as standard. The controller will automatically balance the sequence of operating time on each boiler by a first-on first-off mode and provide for setback and remote alarm contacts. Connection between central ACS system and individual boilers shall be twisted pair low voltage wiring, with the boilers 'daisy-chained' for ease of installation.

2.4 ELECTRICAL POWER

- A. **Controllers, Electrical Devices and Wiring:** Electrical devices and connections are specified in Division 26 sections.
- B. **Single-Point Field Power Connection:** Factory-installed and factory-wired switches, motor controllers, transformers and other electrical devices shall provide a single-point field power connection to the boiler.
- C. **Electrical Characteristics:**
 - 1. Voltage: 460V
 - 2. Phase: Three
 - 3. Frequency: 60 Hz
 - 4. Full-Load Current 20 Amps

2.5 VENTING

- A. The exhaust vent must be UL Listed for use with Category II, III and IV appliances and compatible with operating temperatures up to 230°F, positive pressure, condensing flue gas service. UL-listed vents of Polypropylene and A1 29-4C stainless steel must be used with boilers.
- B. The minimum exhaust vent duct size for each boiler is eight-inch diameter.
- C. **Combustion-Air Intake:** Boilers shall be capable of drawing combustion air from the outdoors via a metal or PVC duct connected between the boiler and the outdoors.
- D. The minimum ducted combustion air duct size for each boiler is eight-inch diameter.
- E. Common vent and common combustion air must be an available option for boiler installation. Consult manufacturer for common vent and combustion air sizing.
- F. Follow guidelines specified in manufacturer's venting guide.

2.6 SOURCE QUALITY CONTROL

- A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions and carbon monoxide in flue gas, and to achieve combustion efficiency. Perform hydrostatic testing.
- B. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.
 - 1. If boilers are not factory assembled and fire-tested, the local vendor is responsible for all field assembly and testing.
- C. Allow Owner access to source quality-control testing of boilers. Notify Architect fourteen days in advance of testing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before boiler installation examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations and piping and electrical connections to verify actual locations, sizes and other conditions affecting boiler performance, maintenance and operations.
 - 1. Final boiler locations indicated on Drawings are approximate, Determine exact locations before roughing-in for piping and electrical connections.
- B. Examine mechanical spaces for suitable conditions where boilers will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

- A. Install boilers level on concrete base. Concrete base is specified in Division 23 Section "Common Work Results for HVAC," and concrete materials and installation requirements are specified in Division 03.
- B. Install gas-fired boilers according to NFPA 54.
- C. Assemble and install boiler trim.
- D. Install electrical devices furnished with boiler but not specified to be factory mounted.
- E. Install control wiring to field-mounted electrical devices.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to boiler to allow service and maintenance.
- C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.
- D. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required.
- E. Connect hot-water piping to supply- and return-boiler tapings with shutoff valve and union or flange at each connection.
- F. Install piping from safety relief valves to nearest floor drain.
- G. Boiler Venting:
 - 1. Install flue venting kit and combustion-air intake.
 - 2. Connect venting full size to boiler connections.
- H. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- I. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL AND START-UP SERVICE

- A. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to perform start-up services and to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.
 - b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Coordinate with Walter Louis Fluid Technologies for all chemicals needed during start-up. The State of Missouri will provide all chemicals needed for start-up through their existing service contract with Walter Louis Fluid Technologies. Walter Louis Fluid Technologies of Quincy, Illinois (217) 223-2017. No chemicals shall be added to any system without their direction.
- E. Occupy Adjustments: When requested within 2 months of date of Substantial Completion, provide on-site assistance adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.
- F. Performance Tests: The boiler manufacturer is expected to provide partial load thermal efficiency curves. These thermal efficiency curves must include at least three separate curves at various BTU input levels. If these curves are not available, it is the responsibility of the boiler manufacturer to complete the following performance tests:
1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
 2. Boilers shall comply with performance requirements indicated as determined by field performance tests. Adjust, modify, or replace equipment to comply.
 3. Perform field performance tests to determine capacity and efficiency of boilers.
 - a. Test for full capacity.
 - b. Test for boiler efficiency at low fire, 20, 40, 60, 80, 100, 80, 60, 40, and 20 percent of full capacity. Determine efficiency at each test point.
 4. Repeat tests until results comply with requirements indicated.
 5. Provide analysis equipment required to determine performance.
 6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.
 7. Notify Engineer in advance of the test dates.
 8. Document test results in a report and submit to Engineer.

END OF SECTION 235216

SECTION 235700 - HEAT EXCHANGERS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes plate heat exchangers.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Coordination Drawings: Equipment room, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Tube-removal space.
 - 2. Structural members to which heat exchangers will be attached.

1.3 QUALITY ASSURANCE

- A. ASME Compliance: Fabricate and label heat exchangers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

PART 2 - PRODUCTS

2.1 GASKETED PLATE HEAT EXCHANGERS

- A. Manufacturers:
 - 1. Alfa Laval Thermal, Inc.
 - 2. API Heat Transfer Inc.
 - 3. Armstrong Pumps, Inc.
 - 4. Diversified Heat Transfer
 - 5. Invensys APV, Inc.
 - 6. ITT Industries; Bell & Gossett.
 - 7. Mueller, Paul Company.
 - 8. Polaris Plate Heat Exchangers.
 - 9. Tranter PHE, Inc.
- B. Configuration: Freestanding assembly consisting of frame support, top and bottom carrying and guide bars, fixed and movable end plates, tie rods, individually removable plates, and one-piece gaskets.

- C. Frame:
 - 1. Capacity to accommodate 20 percent additional plates.
 - 2. Painted carbon steel with provisions for anchoring to support.

- D. Top and Bottom Carrying and Guide Bars: Painted carbon steel, aluminum, or stainless steel.
 - 1. Fabricate attachment of heat-exchanger carrying and guide bars with reinforcement strong enough to resist heat-exchanger movement during a seismic event when heat-exchanger carrying and guide bars are anchored to building structure.

- E. End-Plate Material: Painted carbon steel.

- F. Tie Rods and Nuts: Steel or stainless steel.

- G. Plate Material: 0.024 inch thick before stamping; Type 304 stainless steel.

- H. Gasket Material: EPDM.

- I. Piping Connections:
 - 1. Threaded port for NPS 2 and smaller. For larger sizes, furnish end-plate port with threaded studs suitable for flanged connection.

- J. Enclose plates in a solid aluminum removable shroud.

- K. Capacity and Characteristics:
 - 1. General:
 - a. Heat-Exchanger Surface Area, sq. ft.: 660
 - b. Number of Passes: One.
 - c. Heat Exchanged, Btu/h: 1868
 - 2. Hot Side:
 - a. Fluid: Water.
 - b. Flow Rate, gpm: 620
 - c. Pressure Drop, ft: 20
 - d. Inlet Temperature, Deg F: 52
 - e. Outlet Temperature, Deg F: 46
 - f. Inlet Size, NPS: 4
 - g. Outlet Size, NPS: 4
 - 3. Cold Side:
 - a. Fluid: Water.
 - b. Flow Rate, gpm: 930
 - c. Pressure Drop, ft: 20
 - d. Inlet Temperature, Deg F: 48
 - e. Outlet Temperature, Deg F: 44
 - f. Inlet Size, NPS: 4
 - g. Outlet Size, NPS: 4

PART 3 - EXECUTION

3.1 HEAT-EXCHANGER INSTALLATION

- A. Install gasketed-plate heat exchanger on custom-designed wall supports anchored to structure as indicated on Drawings.
- B. Install metal shroud over installed gasketed-plate heat exchanger according to manufacturer's written instructions.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in other Section 232113 "Hydronic Piping". Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install shutoff valves at heat-exchanger inlet and outlet connections.
- C. Install relief valves on heat-exchanger heated-fluid connection and install pipe relief valves, full size of valve connection, to floor drain.

3.3 START-UP SERVICES

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that pumps are installed and functional.
 - 3. Verify that thermometers and gauges are installed.
 - 4. Verify and record performance of entering and leaving water temperatures.
 - 5. Replace damaged or malfunctioning controls and equipment.
- B. Coordinate with Walter Louis Fluid Technologies for all chemicals needed during start-up. The State of Missouri will provide all chemicals needed for start-up through their existing service contract with Walter Louis Fluid Technologies. Walter Louis Fluid Technologies of Quincy, Illinois (217) 223-2017. No chemicals shall be added to any system without their direction.

END OF SECTION 235700

SECTION 236416 – MAGNETIC BEARING CENTRIFUGAL WATER CHILLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Packaged, water-cooled, electric-motor-driven, magnetic bearing centrifugal chillers.

1.2 PERFORMANCE REQUIREMENTS

- A. Condenser-Fluid Temperature Performance:
1. Startup Condenser-Fluid Temperature: Chiller shall be capable of starting with an entering condenser-fluid temperature of 60 deg F and providing stable operation until the system temperature is elevated to the minimum operating entering condenser-fluid temperature.
 2. Minimum Operating Condenser-Fluid Temperature: Chiller shall be capable of continuous operation over the entire capacity range indicated with an entering condenser-fluid temperature of 65 deg F.
 3. Make factory modifications to standard chiller design if necessary to comply with performance indicated.
- B. Site Altitude: Chiller shall be suitable for altitude at which installed without affecting performance indicated. Make adjustments to affected chiller components to account for site altitude.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings shall include the following:
1. Dimensioned plan and elevation view, including required clearances, and location of all field piping and electrical connections.
 2. Summaries of all auxiliary utility requirements such as: electricity, water, air, etc. Summary shall indicate quality and quantity of each required utility.
 3. Diagram of control system indicating points for field interface and field connection. Diagram shall fully depict field and factory wiring.
 4. Installation and Operating Manuals.
- C. Performance Verification:
1. Provide Chiller performance ratings conforming to and reported in accordance with AHRI-550/590

- a. Capacity in Tons
 - b. Energy Efficiency (KW/Ton)
 - c. Water Pressure Drop (Ft of water head)
 - d. Integrated Part Load Value (IPLV) Efficiency
 - e. Non-Standard Part Load Value (NPLV) Efficiency calculated in accordance with AHRI 550/590 equations
2. Statement of Compliance with ASHRAE 90.1
 3. Part Load Performance: Provide efficiencies at 10% load increments at the following entering condenser water conditions of 85, 80, 75, 70, 65, 60, 55 and minimum possible temperature (degrees F).
- D. Certificates: For certification required in "Quality Assurance" Article.
- E. Startup service reports.
- F. Operation and maintenance data.
- G. Warranty.

1.4 QUALITY ASSURANCE

- A. ARI Certification: Certify chiller according to ARI 550 certification program.
- B. ARI Rating: Rate chiller performance according to requirements in ARI 550/590.
- C. ASHRAE Compliance:
1. ASHRAE 15 for safety code for mechanical refrigeration.
 2. ASHRAE 147 for refrigerant leaks, recovery, and handling and storage requirements.
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.
- E. ASME Compliance: Fabricate and label chillers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, as applicable to chiller design. For chillers charged with R-134a refrigerant, include an ASME U-stamp and nameplate certifying compliance.
- F. Comply with NFPA 70.
- G. Comply with requirements of UL and UL Canada, and include label by a qualified testing agency showing compliance.
- H. Chiller manufacturer plant shall be ISO Certified.
- I. The chiller shall be tested to job conditions at the manufacturer's plant.

1.5 Delivery and Handling

- A. Chillers shall be delivered to the job site completely assembled and charged with refrigerant R134a and be shipped on skids with a weather resistant cover.
- B. Comply with the manufacturer's instructions for rigging and transporting units. Leave protective covers in place until installation.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of chillers that fail in materials or workmanship within specified warranty period.
 - 1. Extended warranties include, but are not limited to, the following:
 - a. Complete chiller including refrigerant charge.
 - b. Parts and labor.
 - c. Loss of refrigerant charge for any reason.
 - 2. Warranty Period: Five (5) years from date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. 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. Daikin Magnitude WME
 - 2. Smardt
 - 3. YORK by Johnson Controls

2.2 MANUFACTURED UNIT

- A. Description: Provide and install as shown on the plans a factory assembled, charged, and tested water-cooled packaged centrifugal chiller. Chillers shall have no more than two oil-free, magnetic bearing, semi-hermetic centrifugal compressors. Each compressor shall have an integrated variable-frequency drive operating in concert with inlet guide vanes for optimized full and part load efficiency. On two-compressor units, the evaporator and condenser refrigerant sides and the expansion valve shall be common and the chiller shall be capable of running on one compressor with the other compressor or any of its auxiliaries inoperable or removed.

2.3 COMPRESSOR-DRIVE ASSEMBLY

- A. Description: Multistage or single stage, variable-displacement, centrifugal-type compressor driven by an electric motor.

1. Provide oil-free compressor technology using a permanent magnet synchronous motor, magnetic bearings, integral variable frequency controller, and digital electronic controls.
- B. Compressor:
1. The unit shall utilize magnetic bearing, oil-free, semihermetic centrifugal compressors. The compressor drive train shall be capable of coming to a controlled, safe stop in the event of a power failure.
 2. The motor shall be of the semi-hermetic type, of sufficient size to efficiently fulfill compressor horsepower requirements. It shall be liquid refrigerant cooled with internal thermal sensing devices in the stator windings. The motor shall be designed for variable frequency drive operation.
 3. The chiller shall be equipped with an integrated Variable Frequency Drive (VFD) to automatically regulate compressor speed in response to cooling load and the compressor pressure lift requirement. Movable inlet guide vanes and variable compressor speed, shall provide unloading. The chiller controls shall coordinate compressor speed and guide vane position to optimize chiller efficiency.
 4. Each compressor circuit shall be equipped with a 5% line reactor to help protect against incoming power surges and help reduce harmonic distortion.
 5. The chiller shall be equipped with a factory-mounted and wired 460V passive harmonic filter guaranteed to meet the IEEE Standard 519 at an I_{sc}/I_L ratio greater than 20.
 6. Each compressor circuit shall be equipped with a 5% line reactor to help protect against incoming power surges and help reduce harmonic distortion.
- C. Vibration Balance: Balance chiller compressor and drive assembly to provide a precision balance that is free of noticeable vibration over the entire operating range.
1. Overspeed Test: 25 percent above design operating speed.
- D. Service: Easily accessible for inspection and service.
1. Compressor's internal components shall be accessible without having to remove compressor-drive assembly from chiller.
 2. Provide lifting lugs or eyebolts attached to casing.
- E. Capacity Control: Modulating, variable-inlet, guide-vane assembly combined with hot-gas bypass, if necessary, to achieve performance indicated.
1. Maintain stable operation that is free of surge, cavitation, and vibration throughout range of operation. Configure to achieve most energy-efficient operation possible.
 2. Operating Range: From 100 to 10 percent of design capacity.
 3. Condenser-Fluid Unloading Requirements over Operating Range: Drop-in entering condenser-fluid temperature of 2.5 deg F for each 10 percent in capacity reduction.
 4. Chillers with variable frequency controllers shall modulate compressor speed with variable-inlet, guide-vane control to achieve optimum energy efficiency.

2.4 REFRIGERATION

- A. Refrigerant:

1. Type: R-134a; ASHRAE 34, Class A1.
 2. Compatibility: Chiller parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
- B. Refrigerant Flow Control: Manufacturer's standard refrigerant flow-control device satisfying performance requirements indicated.
- C. Pressure Relief Device:
1. Comply with requirements in ASHRAE 15 and in applicable portions of ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 2. For Chillers Using R-134a: ASME-rated, spring-loaded, pressure relief valve; single- or multiple-reseating type. Pressure relief valve(s) shall be provided for each heat exchanger. Condenser shall have dual valves with one being redundant and configured to allow either valve to be replaced without loss of refrigerant.
- D. Refrigeration Transfer: Provide service valves and other factory-installed accessories required to facilitate transfer of refrigerant from chiller to a remote refrigerant storage and recycling system. Comply with requirements in ASHRAE 15 and ASHRAE 147.
- E. Positive-Pressure System:
1. During nonoperational periods, positive-pressure system shall automatically maintain a positive pressure for atmosphere in the refrigerant pressure vessel of not less than 0.5 psig (adjustable) up to a pressure that remains within the vessel design pressure limits.
 2. System shall be factory wired and include controller, electric heat, pressure transmitter, or switch.

2.5 EVAPORATOR

- A. Provide sufficient isolation valves and condenser volume to hold the full unit refrigerant charge in the condenser during servicing or provide a separate pumpout system and storage tank sufficient to hold the charge of the largest unit being furnished.
- B. The evaporator and condenser shall be separate vessels of the shell-and-tube type, designed, constructed, tested and stamped according to the requirements of the ASME Code, Section VIII. Regardless of the operating pressure, the refrigerant side of each vessel will bear the ASME stamp indicating compliance with the code and indicating a test pressure of 1.1 times the working pressure, but not less than 100 psig. The tubes shall be individually replaceable and secured to the intermediate supports without rolling or expanding to facilitate replacement if required.
- C. The evaporator shall be flooded type with copper tubes rolled into carbon steel tubesheets. The evaporator shall have left-hand connections when looking at the unit control panel. The evaporator shall have dished heads with valved drain and vent connections. Water connections shall be grooved suitable for Victaulic couplings. The heads shall be carbon steel and the tubesheets shall be carbon steel. The wall copper tubes shall be 0.025 in.

- D. The condenser shall have tubes rolled into carbon steel. The condenser shall have left-hand connections when looking at the unit control panel. The condenser shall have dished heads with valved drain and vent connections. Water connections shall be grooved suitable for Victaulic couplings. The heads shall be carbon steel and the tubesheets shall be carbon steel. The wall copper tubes shall be 0.025 in.
- E. An electronic expansion valve shall control refrigerant flow to the evaporator. Fixed orifice devices or float controls with hot gas bypass are not acceptable because of inefficient control at low load conditions. The liquid line shall have moisture indicating sight glass.
- F. Re-seating type spring loaded pressure relief valves according to ASHRAE-15 safety code shall be furnished. The evaporator shall be provided with single or multiple valves. The condenser shall be provided with dual relief valves equipped with a transfer valve so one relief valve can be removed for testing or replacement without loss of refrigerant or removal of refrigerant from the condenser. Rupture disks are not acceptable. If rupture disks are required on negative pressure units to prevent air and moisture ingress, then factory mounted spring loaded pressure relief valves shall be provided in series with the rupture disks to contain the remaining refrigerant in the event of vessel over-pressurization. The space between the rupture disk and the relief valve shall include a suitable telltale indicator integrated into the chiller control system to alert the operator that a potential safety issue exists in the pressure relief system.
- G. The evaporator vessel, including water heads, suction line, and any other component or part of a component subject to condensing moisture shall be insulated with UL recognized 3/4 inch closed cell insulation. All joints and seams shall be carefully sealed to form a vapor barrier.
- H. Provide factory-mounted and wired, thermal-dispersion water flow switches on each vessel to prevent unit operation with no or low water flow. Paddle and pressure differential type switches are not acceptable due to high rates of failure and false indications from these types of flow indicators.

2.6 INSULATION

- A. Closed-cell, flexible elastomeric thermal insulation complying with ASTM C 534, Type I for tube and Type II for sheet materials.
 - 1. Thickness: 0.75 inch.
- B. Adhesive: As recommended by insulation manufacturer.
- C. All water boxes and nozzles shall be provided with **removable insulation covers** so that they may be field inspected after chiller is installed.
- D. Factory apply insulation over all cold surfaces of chiller capable of forming condensation. Components shall include, but not be limited to, evaporator shell and end tube sheets, refrigerant suction pipe from evaporator to compressor, cold surfaces of compressor, refrigerant-cooled motor, and auxiliary piping.

1. Apply adhesive to 100 percent of insulation contact surface.
2. Before insulating steel surfaces, prepare surfaces for paint, and prime and paint as indicated for other painted components. Do not insulate unpainted steel surfaces.
3. Seal seams and joints to provide a vapor barrier.
4. After adhesive has fully cured, paint exposed surfaces of insulation to match other painted parts.

2.7 ELECTRICAL

- A. Factory installed and wired, and functionally tested at factory before shipment.
- B. Single-point, field-power connection to nonfused disconnect switch. Minimum withstand rating shall be as required by electrical power distribution system, but not less than 65,000 A.
 1. Branch power circuit to each motor, electric heater, dedicated electrical load, and controls.
 - a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
 - b. NEMA AB 1, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit-trip set point.
 2. NEMA ICS 2-rated motor controller for auxiliary motors, hand-off-auto switch, and overcurrent protection for each motor. Provide variable frequency controller for each variable-speed motor furnished.
 3. Control-circuit transformer with primary and secondary side fuses.
- C. Terminal blocks with numbered and color-coded wiring to match wiring diagram. Spare wiring terminal block for connection to external controls or equipment.
- D. Factory-installed wiring outside of enclosures shall be in metal raceway except make terminal connections with not more than a 24-inch length of liquidtight conduit.

2.8 VARIABLE FREQUENCY CONTROLLER

- A. Motor controller shall be factory mounted and wired on the chiller to provide a single-point, field-power termination to the chiller and its auxiliaries.
- B. Description: NEMA ICS 2; listed and labeled as a complete unit and arranged to provide variable speed by adjusting output voltage and frequency.
- C. Enclosure: Unit mounted, NEMA 250, Type 1, with hinged full-front access door with lock and key.
- D. Integral Disconnecting Means: Door-interlocked, NEMA AB 1, instantaneous-trip circuit breaker with lockable handle. Minimum withstand rating shall be as required by electrical power distribution system, but not less than 65,000 A.

- E. Technology: Pulse width modulated (PWM) output with insulated gate bipolar transistors (IGBT); suitable for variable torque loads.
- F. Controller shall consist of a rectifier converter section, a digital/analog driver regulator section, and an inverter output section.
 - 1. Rectifier section shall be a full-wave diode bridge that changes fixed-voltage, fixed-frequency, ac line power to a fixed dc voltage. Silicon controller rectifiers, current source inverters, and paralleling of devices are unacceptable. Rectifier shall be insensitive to phase rotation of the ac line.
 - 2. Regulator shall provide full digital control of frequency and voltage.
 - 3. Inverter section shall change fixed dc voltage to variable-frequency, variable ac voltage, for application to a squirrel-cage motor. Inverter shall produce a sine-coded, pulse width modulated (PWM) output wave form and shall conduct no radio-frequency interference back to the input power supply.
- G. Output Rating: Three phase; with voltage proportional to frequency throughout voltage range.
- H. Operating Requirements:
 - 1. Input AC Voltage Tolerance: 460-V ac, plus 10 percent.
 - 2. Input frequency tolerance of 60 Hz, plus or minus 2 Hz.
 - 3. Capable of driving full load, without derating, under the following conditions:
 - a. Ambient Temperature: 0 to 50 deg C.
 - b. Relative Humidity: Up to 95 percent (noncondensing).
 - c. Altitude: 3300 feet.
 - 4. Minimum Efficiency: 96 percent at 60 Hz, full load.
 - 5. Minimum Displacement Primary-Side Power Factor: 95 percent without harmonic filter, 98 percent with harmonic filter.
 - 6. Overload Capability: 1.05 times the full-load current for 7 seconds.
 - 7. Starting Torque: As required by compressor-drive assembly.
 - 8. Speed Regulation: Plus or minus 1 percent.
 - 9. Isolated control interface to allow controller to follow control signal over a 10:1 speed range.
 - 10. To avoid equipment resonant vibrations, provide critical speed lockout circuitry to allow bands of operating frequency at which controller shall not operate continuously.
 - 11. Capable of being restarted into a motor coasting in either the forward or reverse direction without tripping.
- I. Internal Adjustability Capabilities:
 - 1. Minimum Output Frequency: 6 Hz.
 - 2. Maximum Output Frequency: 60 Hz.
 - 3. Acceleration: 2 seconds to a minimum of 60 seconds.
 - 4. Deceleration: 2 seconds to a minimum of 60 seconds.
 - 5. Current Limit: 30 percent to a minimum of 100 percent of maximum rating.
- J. Self-Protection and Reliability Features: Subjecting the controller to any of the following conditions shall not result in component failure or the need for replacement:

1. Overtemperature.
2. Short circuit at controller output.
3. Ground fault at controller output. Variable frequency controller shall be able to start a grounded motor.
4. Open circuit at controller output.
5. Input undervoltage.
6. Input overvoltage.
7. Loss of input phase.
8. Reverse phase.
9. AC line switching transients.
10. Instantaneous overload, line to line or line to ground.
11. Sustained overload exceeding 100 percent of controller rated current.
12. Starting a rotating motor.

K. Motor Protection: Controller shall protect motor against overvoltage and undervoltage, phase loss, reverse phase, overcurrent, overtemperature, and ground fault.

L. Automatic Reset and Restart: Capable of 3 restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Controller shall be capable of automatic restart on phase-loss and overvoltage and undervoltage trips.

M. Visual Indication: On face of controller enclosure or chiller control enclosure; indicating the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.
7. Motor speed (percent).
8. Fault or alarm status (code).
9. DC-link voltage.
10. Motor output voltage.
11. Input kilovolt amperes.
12. Total power factor.
13. Input kilowatts.
14. Input kilowatt-hours.
15. Three-phase input voltage.
16. Three-phase output voltage.
17. Three-phase input current.
18. Three-phase output current.
19. Three-phase input voltage total harmonic distortion.
20. Three-phase input current total harmonic distortion.
21. Output frequency (Hertz).
22. Elapsed operating time (hours).
23. Diagnostic and service parameters.

- N. Operator Interface: At controller or chiller control panel; with start-stop and auto-manual selector with manual-speed-control potentiometer.
- O. Control Signal Interface:
 - 1. Electric Input Signal Interface: A minimum of two analog inputs (0 to 10 V or 0/4-20 mA) and six programmable digital inputs.
- P. Active Harmonic Distortion Filter: Factory mounted and wired to limit total voltage and current distortion to 5 percent.
- Q. Cooling: Air cooled.
- R. Accessories: Devices shall be factory installed in controller enclosure unless otherwise indicated.
 - 1. Control Relays: Auxiliary and adjustable time-delay relays.
- S. Chiller Capacity Control Interface: Equip chiller with adaptive control logic to automatically adjust the compressor motor speed and the compressor pre-rotation inlet vane position independently to achieve maximum part-load efficiency in response to sensor inputs that are integral to the chiller controls.

2.9 CONTROLS

- A. The unit shall have a microprocessor-based control system consisting of panel interface with display screen and a unit controller.
- B. The screen shall display the unit operating parameters, accept setpoint changes (multi-level password protected) and be capable of resetting faults and alarms. The following parameters shall be displayed on the home screen and also as trend curves on the trend screen:
 - 1. Entering and leaving chilled water temperatures
 - 2. Entering and leaving condenser water temperatures
 - 3. Evaporator saturated refrigerant pressure
 - 4. Condenser saturated refrigerant pressure
 - 5. Percent of 100% speed (per compressor)
 - 6. % of rated load amps for entire unit
- C. In addition to the trended items above, all other important real-time operating parameters shall also be shown on the screen. These items shall be displayed on a chiller graphic showing each component. At a minimum, the following critical areas must be monitored:
 - 1. Compressor actual speed, maximum speed, percent speed
 - 2. Liquid line temperature
 - 3. Chilled water setpoint
 - 4. Compressor and unit state and input and output digital and analog values

- D. A fault history shall be displayed using an easy to decipher, color coded set of messages that are date and time stamped. Time interval scale shall be user selectable as 20 mins, 2 hours, or 8 hours. The alarm history shall be downloadable from the unit's USB port. An operating and maintenance manual specific for the unit shall be viewable on the screen.
- E. All setpoints shall be viewable and changeable (multi-level password protected) on the touch screen and include setpoint description and range of set values.
- F. Automatic corrective action to reduce unnecessary cycling shall be accomplished through preemptive control of low evaporator or high discharge pressure conditions to keep the unit operating through abnormal transient conditions.
- G. The factory mounted controller(s) shall support operation on a network via BACnet® w/RS485 and Ethernet
 - 1. as specified by the successful Building Automation System (BAS) supplier.
- H. The information communicated between the BAS and the factory mounted unit controllers shall include the reading and writing of data to allow unit monitoring, control and alarm notification as specified in the unit sequence of operation and the unit points list.
- I. All communication from the chiller unit controller as specified in the points list shall be via standard BACnet objects. Proprietary BACnet objects shall not be allowed. BACnet communications shall conform to the BACnet protocol (ANSI/ASHRAE135-2001). A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided along with the unit submittal.
- J. The chiller shall be equipped with the capability to restart and reach full load quickly in the event of a power interruption. The compressor shall be capable of restarting within 2 minutes after power is restored and shall reach 80% load within 5 minutes. Chillers not able to restart or load within this time frame shall include a properly sized thermal storage tank to maintain temperature stability in the system.
- K. Trending: Capability to trend analog data of up to five parameters simultaneously over an adjustable period and frequency of polling.

2.10 FINISH

- A. Paint chiller, using manufacturer's standard procedures, except comply with the following minimum requirements:
 - 1. Provide at least one coat of primer with a total dry film thickness of at least 2 mils.
 - 2. Provide at least two coats of epoxy finish with a total dry film thickness of at least 4 mils.
 - 3. Paint surfaces that are to be insulated before applying the insulation.
 - 4. Paint installed insulation to match adjacent uninsulated surfaces.
 - 5. Color of finish coat to be manufacturer's standard.

- B. Provide Owner with quart container of paint used in application of topcoat to use in touchup applications after Project Closeout.

2.11 ACCESSORIES

- A. Flow Switches:
 - 1. Chiller manufacturer shall furnish a switch for each evaporator and condenser and confirm field-mounting location before installation.
 - 2. Thermal Dispersion Flow Switches:
 - a. Provide factory-mounted and wired, thermal-dispersion water flow switches on each vessel to prevent unit operation with no or low water flow. Paddle and pressure differential type switches are not acceptable due to high rates of failure and false indications from these types of flow indicators.
- B. Vibration Isolation:
 - 1. Chiller manufacturer shall furnish vibration isolation for each chiller.
 - 2. Neoprene Pad:
 - a. Two (2) layers of 0.375-inch-thick, ribbed- or waffle-pattern neoprene pads separated by a 16-gauge, stainless-steel plate.

PART 3 - EXECUTION

3.1 CHILLER INSTALLATION

- A. Install chillers on support structure indicated.
- B. Equipment Mounting: Install chiller on existing concrete bases using ASHRAE Type 1 Neoprene Isolators. Comply with manufacturer's requirements for vibration isolation and select isolation pads and deflection requirements to adhere to manufacturer's vibration tolerances.
 - 1. Minimum Deflection: 0.25 inch.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, *instructions, and directions* furnished with items to be embedded.
- C. Maintain manufacturer's recommended clearances for service and maintenance.
- D. Charge chiller with refrigerant and fill with oil if not factory installed.
- E. Install separate devices furnished by manufacturer and not factory installed.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Division 23 Section "Hydronic Piping". Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to chiller to allow service and maintenance.
- C. Evaporator Fluid Connections: Connect to evaporator inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gauge. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with shutoff valve and pressure gauge, and drain connection with valve. Make connections to chiller with a mechanical coupling.
- D. Condenser-Fluid Connections: Connect to condenser inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gauge. Connect to condenser outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with shutoff valve and pressure gauge, and drain connection with valve. Make connections to chiller with a mechanical coupling.
- E. Refrigerant Pressure Relief Device Connections: For chillers installed indoors, extend vent piping to the outdoors without valves or restrictions. Comply with ASHRAE 15. Connect to chiller pressure relief device with flexible connector and dirt leg with drain valve.
- F. For chillers equipped with a purge system, extend purge vent piping to the outdoors. Comply with ASHRAE 15 and ASHRAE 147.
- G. Connect each chiller drain connection with a union and drain pipe, and extend pipe, full size of connection, to floor drain. Provide a shutoff valve at each connection.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that refrigerant charge is sufficient and chiller has been leak tested.
 - 3. Verify that pumps are installed and functional.
 - 4. Verify that thermometers and gauges are installed.
 - 5. Operate chiller for run-in period.
 - 6. Verify that refrigerant pressure relief device is vented outside.
 - 7. Verify proper motor rotation.
 - 8. Verify static deflection of vibration isolators, including deflection during chiller startup and shutdown.
 - 9. Verify and record performance of fluid flow and low-temperature interlocks for evaporator and condenser.
 - 10. Verify and record performance of chiller protection devices.

11. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
- B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assembly, installation, and connection.
- C. Coordinate with Walter Louis Fluid Technologies for all chemicals needed during start-up. The State of Missouri will provide all chemicals needed for start-up through their existing service contract with Walter Louis Fluid Technologies. Walter Louis Fluid Technologies of Quincy, Illinois (217) 223-2017. No chemicals shall be added to any system without their direction.
- D. Prepare test and inspection startup reports.

END OF SECTION 236416

SECTION 237313 – PACKAGED POOL HVAC UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install, as shown in plans and schedule and as specified herein, an indoor swimming pool heat pump dehumidification system. The unit shall be completely factory-assembled, including all internal piping and control wiring. The system shall include a compressor, a pool water condenser, an evaporator coil, an air side condenser reheat coil, a circulating fan, and a micro-processor based control system.
- B. Units shall be manufactured and tested in the U.S.A. and listed by and carry the label of ETL.
- C. It is the intent of this Section of the specification to provide a complete and operable dehumidification system as shown and specified on the plans and Schedule.

1.2 PERFORMANCE REQUIREMENTS

- A. The unit shall control space temperature and relative humidity, and shall provide controlled ventilation. Warm moist air from the natatorium is drawn over an evaporator; and the latent and sensible heat is removed from the air. The heat captured by this process and the heat generated from the compressor power consumption are absorbed by a mechanical refrigeration system. The resulting dryer, cooler air is drawn over a reheat condenser coil and auxiliary heating coil (if provided) by a supply fan. The code required amount of ventilation air is introduced into the dehumidified air after the evaporator and reheat condenser.
- B. The refrigeration system is activated if any of the following occur:
 - 1. Relative humidity rises above set point.
 - 2. Space temperature rises above the set point.
- C. The unit shall monitor space temperature and relative humidity.
- D. The thermal energy absorbed by the refrigeration system is distributed as follows:
 - 1. To maintain the natatorium space temperature.
 - 2. Rejected to Water Cooled Condenser

1.3 SUBMITTALS

- A. Product Data: For each air-handling unit indicated.
 - 1. Unit dimensions and weight.
 - 2. Cabinet material, metal thickness, finishes, insulation, and accessories.

3. Fans:
 - a. Certified fan-performance curves with system operating conditions indicated.
 - b. Certified fan-sound power ratings.
 - c. Fan construction and accessories.
 - d. Motor ratings, electrical characteristics, and motor accessories.
4. Certified coil-performance ratings with system operating conditions indicated.
5. Dampers, including housings, linkages, and operators.
6. Filters with performance characteristics.

B. Source quality-control reports.

C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. 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.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. ASHRAE/IESNA 90.1-2013 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2013, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- D. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Pool Pak or comparable product by one of the following:
 1. DXair.
 2. Dehumidifier Corporation of America.
 3. Desert Aire.
 4. Pool Pak
 5. Dectron

2.2 UNIT CASINGS

- A. The cabinet shall be fabricated out of a minimum of 20 gauge G90 galvanized steel. The unit shall be painted with an electrostatically applied TGIC Polyester coating, with a thickness of 2-3 mils, baked and bonded at 420°F until it forms a hard, textured surface.

- B. Construction shall be modular, consisting of removable panels with permanently affixed fasteners. Base pans shall be formed out of a minimum of 16 gauge G90 galvanized steel with floor mounting support channels. The condensate drain pan under the evaporator shall be TGIC Polyester coated G90 galvanized steel or 316 stainless steel construction. The compressor and controls shall be located in a compartment out of the air stream. Surfaces adjacent to the coil compartment shall be insulated with insulation to prevent condensation.
- C. The unit shall be of vertical design, for minimum footprint. The supply air discharge shall be vertical, from the top or horizontal from the end of the unit cabinet.
- D. Unit shall be designed such that service access is required only from two sides, the return air and control panel sides. The other two sides do not have service clearance.

2.3 COMPRESSOR

- A. The compressor shall be a heavy-duty, fully hermetic, reciprocating or compliant scroll compressor operating at scheduled voltage, phase, and frequency.
- B. The suction gas cooled compressor shall be equipped with thermal overload protection and a crankcase heater to prevent refrigerant migration to the compressor oil during shutdown.
- C. Provide a compressor sound jacket consisting of reinforced vinyl sewn around a 2 pound density fiberglass blanket to provide acoustical attenuation.

2.4 FILTER RACK AND FILTERS

- A. The dehumidification unit shall include a weather tight air filter section with a duct flange and access door for side loading of filters.
- B. The filters shall be totally non-toxic, non-allergenic and not support the growth of bacteria and fungus.
- C. The return air filters, located at the return air inlet, shall be Merv8, 2"-inch thick, laminated polyester construction, replaceable type. The filters shall have a non-migrating tackifier encapsulated between the second and third laminates.
- D. If outside air is ducted to the unit, outside air filters are required but not supplied by PoolPak International.

2.5 REFRIGERANT

- A. The refrigerant shall be R-410A

2.6 FAN

- A. The fan shall be a forward-curved, centrifugal blower. The wheel shall be dynamically balanced and installed on a steel shaft. The blower scroll and housing shall be constructed of cold-rolled steel, coated with an electrostatically applied acrylic enamel paint on G90 galvanized steel.
- B. The fan shall operate at the scheduled supply air CFM, outside air CFM (if equipped with this option) and scheduled external static pressure (ESP).
- C. Fan Motor: The class B winding fan motor shall be belt drive. The motor shall comply with the efficiency requirements of EPACT-92. The belt drive assembly shall include a single "A" or "B" section belt and an adjustable motor sheave or double "B" section belt and non-adjustable motor sheave depending upon motor horsepower for establishing the specified CFM. Single phase motors shall be capacitor start. The fan motor horsepower, voltage and frequency shall be as scheduled.

2.7 EVAPORATOR (DEHUMIDIFICATION) COIL

- A. The coil shall be of adequate face area and rows to remove the specified amount of moisture from the air stream at specified conditions.
- B. Coil shall be Electro-Guard Plus™ corrosion resistant hydrophilic Electro coated fins. Coil shall have a flexible, epoxy polymer, E-coated in a total submersion bath, uniformly applied to all coil surface area without material bridging between fins. A spray on hydrophilic top coat shall be applied immediately after the coil emerged from the E-coat dip tank. Coating process shall ensure complete coil encapsulation and a uniform dry film thickness from 0.5-1.5 mil on all surface areas including fin edges, end plates, structural frames, "u" bends, headers and refrigerant expansion-tube manifolds. Coating surface shall have superior hardness characteristics of 2H per ASTM D3363 and a cross-hatch adhesion of 4B-5B per ASTM B3359. Impact resistance shall be up to 100 in/lb per ASTM D2794. Humidity and water immersion resistance shall be up to a minimum 1000 and 250 hours respectively (ASTM D1735 and ASTM D870). Corrosion durability shall be confirmed through testing to no less than 3,000 hours salt spray per ASTM B117 using scribed aluminum test coupons. The coil shall maintain hydrophilic properties without degradation of the top coat for a minimum of 1000 hours per ASTM G85 Annex 4.
- C. Coil shall have a 10-year (total) extended warranty underwritten by manufacturer. (US and Canada)

2.8 REHEAT COIL

- A. The coil shall be of sufficient size to reject the required amount of total heat.

- B. Coil shall be Electro-Guard™ corrosion resistance Electro coated fins. Coil shall have a flexible, epoxy polymer, E-coated in a total submersion bath, uniformly applied to all coil surface area without material bridging between fins. Coating process shall ensure complete coil encapsulation and a uniform dry film thickness from 0.5-1.5 mil on all surface areas including fin edges, end plates, structural frames, “u” bends and headers. Coating surface shall have superior hardness characteristics of 2H per ASTM D3363 and a cross-hatch adhesion of 4B-5B per ASTM B3359. Impact resistance shall be up to 100 in/lb per ASTM D2794. Humidity and water immersion resistance shall be up to a minimum 1000 and 250 hours respectively (ASTM D1735 and ASTM D870). Corrosion durability shall be confirmed through testing to no less than 3,000 hours salt spray per ASTM B117 using scribed aluminum test coupons.
- C. Coil shall have a 10-year (total) extended warranty underwritten by manufacturer. (US and Canada)

2.9 AUXILIARY HOT WATER HEATING COIL

- A. The hot water coil shall be factory mounted after the air reheat condenser coil. The installing contractor shall install the control valve (by others) and pipe the hot water to the connections on the outside of the unit. The control device for the valve must be interlocked with the terminal strips in the unit.
- B. Coil shall be Electro-Guard™ corrosion resistance Electro coated fins. Coil shall have a flexible, epoxy polymer, E-coated in a total submersion bath, uniformly applied to all coil surface area without material bridging between fins. Coating process shall ensure complete coil encapsulation and a uniform dry film thickness from 0.5-1.5 mil on all surface areas including fin edges, end plates, structural frames, “u” bends and headers. Coating surface shall have superior hardness characteristics of 2H per ASTM D3363 and a cross-hatch adhesion of 4B-5B per ASTM B3359. Impact resistance shall be up to 100 in/lb per ASTM D2794. Humidity and water immersion resistance shall be up to a minimum 1000 and 250 hours respectively (ASTM D1735 and ASTM D870). Corrosion durability shall be confirmed through testing to no less than 3,000 hours salt spray per ASTM B117 using scribed aluminum test coupons.
- C. Coil shall have a 10-year (total) extended warranty underwritten by manufacturer. (US and Canada)

2.10 CONTROL CENTER

- A. The control panel shall have a 4 line, 20 character LCD display, LED annunciators, and a 6 button operator interface. The controller main board shall have all set points and program information stored in nonvolatile memory for protection from power failure.
- B. The control panel shall be wall or unit mounted. It shall be capable of being mounted up to 1000 feet from the unit. All internal circuit boards shall be conformal coated. The control panel shall be connected to the unit by standard six wire RJ-25 phone cord. The control panel shall be capable of being directly connected to the unit for service convenience.

- C. The controller shall be micro-processor based. The following set points shall be programmable at the panel:
 - 1. Space Air Temperature
 - 2. Space Relative Humidity

- D. The following LCD readouts or annunciators shall be provided:
 - 1. Start Up Screen: Power On Screen ; Version No.; Date
 - 2. Setpoints
 - 3. Readouts
 - a. Space Air Temperature
 - b. Space Relative Humidity
 - c. Dewpoint (Space)
 - d. Outside Air Temperature
 - e. Space (Cooling) - (Yes/No)
 - f. Aux. Air Heat - (Yes/No)
 - g. Dehumidify - (Yes/No)
 - h. Economizer - (Yes/No)
 - i. Suction Temperature
 - j. Suction Pressure
 - k. Discharge Pressure
 - 4. Service Parameters Password Protected Including
 - 5. Degree F or Degree C Selections
 - a. Economizer Options
 - b. Deadbands
 - c. Anti Cycle Timer
 - d. Offset Selection
 - e. Fire Trip Action (Open or Close on Alarm)
 - f. Manual Control
 - g. Sensor Offsets
 - 6. Service Diagnostic Codes
 - 7. Service Information Including:
 - a. Surface Temperature
 - b. Dewpoint Temperature
 - c. Network Control - (Yes/No)
 - d. Run Hours for:
 - Compressor
 - Fan
 - A/C
 - Aux. Air Heat
 - Aux. Water Heat
 - 8. Faults – Global
 - a. High Discharge Pressure

- b. Low Suction Pressure
 - c. High Compressor Motor Temperature
 - d. and "Count to Ten" Lockout
9. AC Proof Status – Both Air and Water
10. Purge Mode Including "No Freeze Protection Annunciation while Purge Mode is Active"
(Only with Economizer Option)

2.11 CONTROL SENSORS

- A. The unit shall be provided with the following factory mounted and wired control devices:
- 1. Space Dry Bulb Temperature Sensor (field wired with economizer option)
 - 2. Space Relative Humidity Sensor (field wired with economizer option)
 - 3. Pool Water Temperature Sensor Defrost Controller
 - 4. Defrost Controller
- B. The unit shall be delivered with the following factory supplied sensors to be installed in the field:
- 1. Cold Surface Condensation Prevention Temperature Sensor (Dew Point Reset).
 - 2. Outside Air Dry Bulb Temperature (with economizer option)
- C. An anti-cycle timer shall be provided in the unit control system to prevent short-cycling of the compressor.
- D. Under normal conditions, the unit fan shall operate continuously, to provide air circulation within the pool enclosure.
- E. The compressor shall not operate if the defrost thermostat set point has been reached. Evaporator coil defrost shall be accomplished by the flow of air drawn across the coil by the unit fan.

2.12 Sequence of Operation

- A. Description
- 1. All essential operating and logic controls shall be factory mounted and wired in the unit. Control sequences shall be designed specifically to control swimming pool environmental conditions.
- B. Humidity Control
- 1. When the humidity is above the set point the controller energizes the compressor and directs hot gas to air reheat condenser. If the pool water temperature is below the set point, the recovered heat is directed to the pool water condenser and the air reheat condenser or the auxiliary air-cooling condenser, if so equipped. If the pool water

temperature is at or above the set point, the recovered heat is directed to the air reheat condenser or the auxiliary air cooling condenser, if so equipped.

C. Space Heating

1. When the compressor is running in the dehumidification mode and the pool water temperature is at or above the set point and the space temperature is below the set point, the recovered heat is directed to the air reheat condenser. If the space temperature drops more than 2°F below the set point, the auxiliary space heating system (by others) shall be activated by a dry contact closure from the controller. A further drop in space temperature will activate the second stage of auxiliary heat (if available).

D. Air Conditioning

1. Water Cooled Condenser

- a. In order to achieve space cooling of the natatorium by the rejection of reclaimed heat, the dehumidifier shall be equipped with a water cooled condenser and shall automatically change over from heating to air conditioning as a function of dry bulb cooling demand in the natatorium. The sensible and latent heat in air conditioning mode is rejected to the auxiliary water cooled condenser. This condenser shall be factory-mounted and refrigerant-piped, non-cleanable, with a head pressure controlled water regulating valve.
- b. The condensing water shall be noncorrosive and non-fouling with a temperature range of 45°F to 85°F. The condenser shall be a counter flow, helically wound, coaxial, tube-in-tube heat exchanger for maximum heat transfer from the refrigerant to the condensing water. The water tube shall be constructed of corrosion-resistant cupronickel. The water circuit connections shall be MPT. The heat exchanger shall be UL Listed or CSA Certified.

E. Outside Air

1. The dehumidification unit casing shall include a manual locking damper with duct collar, to permit the introduction of up to 30% outside air to the inlet of the fan, downstream of the evaporator and reheat coil. Damper assembly shall be of heavy-duty construction, designed for industrial applications. The frame and opposing blades shall be fabricated of formed 16 gauge galvanized steel. The shaft shall be 1/2" plated steel hex.
2. The opening shall be on the unit's top or side. Filter rack and filter by others.
3. Preheating of outside air may be required for freeze protection and occupant comfort. An exhaust fan, with a capacity equal to or greater than the amount of outside air brought into the unit shall be furnished and installed by the installing contractor.

F. Economizer (Optional)

1. The economizer shall operate in the space cooling mode when there is no dehumidification requirement. When the outside air temperature is greater than 50°F and more than 5°F below the space temperature set point and the space temperature rises above the set point, the compressor shall be de-energized and a dry contact closure shall be made. Upon closure, outside and exhaust air dampers (by others) shall open and return air dampers (by others) shall close and the exhaust fan (by others) shall be energized. The outside air shall be ducted into the return air plenum (by others).

2. If the space temperature continues to rise and exceeds the space temperature set point by more than two degrees, the dry contact closure shall be opened, reversing the field installed damper positions and de-energizing the exhaust fan and the compressor shall be energized in the air conditioning mode (if so equipped). The compressor shall continue to run until the call for air conditioning is satisfied.
3. The economizer shall also be activated in the air conditioning mode if the auxiliary air conditioning condenser option is not installed or if the compressor is locked out by a fault condition.

G. Fire Trip

1. Upon receipt of a contact closure from a fire control system (by others) a fire trip cycle shall be initiated. Compressor and fan motor shall be de-energized. For units equipped with the optional economizer, the dry contact shall open causing the outside and exhaust air dampers to close and the return air damper to open. Contact action is programmable.

2.13 BACnet MS/TP

- A. The dehumidifier control panel shall be capable of direct connection to a BACnet MS/TP-based Building Automation System. With proper connection to the RS-485 network, the dehumidifier shall appear as a native BACnet device.

2.14 MODBUS (Optional)

- A. The dehumidifier control panel shall be capable of direct connection to a Modbus® based Building Automation System. This will use the Modbus® RTU Protocol on an RS-485 network at speeds of 1200, 2400, 4800, 9600, or 19200 BPS.

2.15 LONWORKS (Optional)

- A. The dehumidifier control panel shall be capable of direct connection to a LonWorks® based Building Automation System. This will use an Echelon® FTT-10A transceiver on a TP/FT-10 channel at a speed of 78.125 KBPS.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Equipment Mounting: Install air-handling unit using elastomeric pads.
 1. Minimum Deflection: 0.25 inch.
 2. Install stainless-steel plate to equally distribute weight over elastomeric pad.

- B. Arrange installation of units to provide access space around air-handling units for service and maintenance.
- C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.
- D. Comply with requirements for piping specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- E. Install piping adjacent to air-handling unit to allow service and maintenance.
- F. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.
- G. Connect condensate drain pans using NPS 1-1/4, ASTM B 88, Type M copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
- H. Hot- and Chilled-Water Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.
- I. Connect duct to air-handling units with flexible connections. Comply with requirements in Division 23 Section "Metal Ducts".

3.2 Functional Factory Test and Verification

- A. The completed unit shall be completely tested for functionality in the factory before shipment. The functional test shall consist of an in-unit test of the controller, inputs, outputs, safeties and the basic sequence of operation. Also, part of the functional test will be verification of the operation of compressor(s), fan(s), and associated electrical components, and if furnished, gas furnaces controls and/or the valve actuators for coils. The functional test shall not be construed as a performance or capacity test. Each unit will have a record of the test certificate prepared documenting the unit serial number which shall be maintained at the factory. Testing of field installed components or the sequence of operation is not a substitute for factory testing. A copy of the functional test report shall be maintained on file and can be furnished upon request.

3.3 Warranty

- A. Manufacturer shall provide a one-year labor and 15-month parts warranty on the entire unit.
- B. Manufacturer shall provide a 5 year extended compressor part warranty.

3.4 Start-Up

- A. All units shall be thoroughly cleaned by the installing contractor in accordance with the manufacturer's instructions prior to being placed into service.
- B. Start-up service shall be provided in accordance with the equipment manufacturer's instructions and must include complete testing of all controls and unit operation. The agency responsible for start-up shall record the refrigeration pressures and electrical operating data. Copies of this data are to be supplied to the owner and manufacturer.
- C. Coordinate with Walter Louis Fluid Technologies for all chemicals needed during start-up. The State of Missouri will provide all chemicals needed for start-up through their existing service contract with Walter Louis Fluid Technologies. Walter Louis Fluid Technologies of Quincy, Illinois (217) 223-2017. No chemicals shall be added to any system without their direction.

END OF SECTION 237313

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Sleeves for raceways and cables.
 2. Sleeve seals.
 3. Grout.
 4. Common electrical installation requirements.

1.2 SPECIFICATION FORM AND DEFINITIONS

- A. Design Engineer, hereinafter abbreviated D/E shall mean the Engineering firm, Malone Finkle Eckhardt & Collins, Inc., Telephone (913) 322-1400. Contact person: Brian Clark.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel.
1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items, unless otherwise noted.

- B. **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.
- C. **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.
- D. **Right of Way:** Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- 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. **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.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. **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.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 0.25-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. **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. Comply with requirements in Division 07 Section "Joint Sealers."
- J. **Roof-Penetration Sleeves:** Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

- K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

- L. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.

- B. 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.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Joint Sealers."

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Sleeves and sleeve seals for cables.
 - 4. Provide 120 Volt, single phase power from a dedicated breaker to the nitrogen generator cabinet.
 - 5. Provide 480 Volt, 3 phase power from a dedicated breaker to the compressor.
 - 6. Provide wiring and terminations between disconnect and nitrogen generator cabinet/compressor.
- B. All products, installation, and testing shall comply with NFPA 70, "National Electrical Code" 2014 Edition, except where modified by this specification section and the contract drawings.
- C. The requirements in this specification only apply to the new or modified system components required by the drawings and these specifications. In other words, it is not the contractor's responsibility to bring existing equipment into compliance with these requirements, unless specifically stated otherwise.

1.2 QUALITY ASSURANCE

- A. All work described by this section shall be conducted by an electrician licensed in the State of Missouri. The electrician shall have been engaged in projects of similar complexity and magnitude for at least the previous 2 years.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Copper Conductors: Comply with NEMA WC 70.
- B. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.
- C. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.

- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

- B. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 3 - EXECUTION

3.1 GENERAL

- A. It is the contractor's responsibility to install all system components in accordance with NFPA 70 2014 Edition and the manufacturer's installation instructions including all recommended practices.

- B. All system components shall be installed in a neat, workmanlike manner.

- C. Upon completion, all system components shall be in 'like-new' condition. If any components are damaged during construction, they shall be replaced with new components.

3.2 MISCELLANEOUS

- A. The circuit disconnecting means for the nitrogen generator shall be permanently labeled "NITROGEN GENERATOR COMPRESSOR".

- B. The circuit disconnecting means for the nitrogen generator shall be secured from unauthorized use.

3.3 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper for feeders smaller than No. 4 AWG; copper for feeders No. 4 AWG and larger. Solid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger. Sizes noted on drawings are for copper.
- B. Branch Circuits: Copper. Solid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Use no conductors smaller than No. 12 gauge unless specifically called for or approved by Design Engineer. Size wire for 120 volt branch Circuits for 3% maximum voltage drop. Size feeder circuits for 2 percent maximum voltage drop. Combined voltage drop of feeders and branch circuits shall not exceed 5 percent maximum.

3.4 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway.
- B. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- C. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- E. Branch Circuits, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- F. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- G. Class 2 Control Circuits: Type THHN-THWN, in raceway Power-limited cable, concealed in building finishes.

3.5 INSTALLATION OF CONDUCTORS AND CABLES

- A. Run conductors in conduit continuous between outlets and junction boxes with no splices or taps pulled into conduits.

- B. Neatly route, tie and support conductors terminating at switchboards, motor control centers, panelboards, sound equipment, etc., with Thomas & Betts Ty-Rap cable ties and clamps or equivalent by Electrovert or Panduit.
- C. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- D. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- E. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- F. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- G. Support cables according to Division 26 Sections "Hangers and Supports for Electrical Systems."
- H. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."
- I. 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.
- J. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Make circuit conductor splices with Buchanan B-Cap nylon insulated connectors or equivalent by Ideal or 3M.
 - 2. Make fixture and device taps with Scotchlock self-stripping electrical tap connectors.
 - 3. Terminate solid conductors at equipment terminal strips and other similar terminal point with insulated solderless terminal connectors. Terminate all stranded conductor terminal points with insulated solderless terminal connectors. Provide Thomas & Betts Sta-Kon insulated terminals and connectors or equivalent by API/AMP Blackburn, Buchanan or Scotchlock.
 - 4. Where a total of six or more control and feeder conductors terminate in a multiple device panel or enclosure that has no built-in terminal blocks, provide mounting channel and see-thru covers. Equivalent terminal blocks by General Electric, Square D or Westinghouse.
 - 5. Wrap conductor taps and connections requiring additional insulation with a minimum of three (3) overlapped layers of 3M Scotch vinyl plastic electrical tape No. 88 or equivalent.
- K. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

- L. No wiring or conduit shall be placed in the concrete slab.

3.6 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Joint Sealers."
- B. 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.
- C. 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.
- D. Cut sleeves to length for mounting flush with both wall surfaces.
- E. Extend sleeves installed in floors 2 inches above finished floor level.
- F. Size pipe sleeves to provide 0.25-inch annular clear space between sleeve and cable unless sleeve seal is to be installed.
- G. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealers."
- I. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- J. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.7 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.8 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Joint Sealers."

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment. Provide a grounding system as required by the National Electric Code (NEC) and local authorities.

1.2 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. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 0.25-inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1.625 inches wide and 0.0625-inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1.625 inches wide and 0.0625-inch thick.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel 0.75-inch by 10 feet in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid or stranded conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 3/0 AWG minimum. Bury at least 24 inches below grade.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three (3) bands of green and two bands of yellow.
- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits (exterior only) and (dimming circuits).
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Metal-clad cable runs.

8. **Computer and Rack-Mounted Electronic Equipment Circuits:** Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
 9. **Connect system neutral ground and equipment ground system to common ground bus.**
- B. **Air-Duct Equipment Circuits:** Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- C. **Water Heater:** Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- D. **Isolated Grounding Receptacle Circuits:** Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- E. **Isolated Equipment Enclosure Circuits:** For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- F. **Signal and Communication Equipment:** For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
1. **Service and Central Equipment Locations and Wiring Closets:** Terminate grounding conductor on a 0.25-inch by 2-inch by 12-inch grounding bus.
 2. **Terminal Cabinets:** Terminate grounding conductor on cabinet grounding terminal.
- G. **Metal and Wood Poles Supporting Outdoor Lighting Fixtures:** Install grounding electrode rod and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- H. **Ground secondary services at supply side of each individual secondary disconnecting means and at related transformers in accordance with NEC.** Provide each service disconnect enclosure with neutral disconnecting means which interconnect with insulated neutral and uninsulated equipment ground sub to establish system common ground point. Neutral disconnecting links shall be located so that low voltage neutral bar with interior secondary neutrals can be isolated from common ground bus and service entrance conductors.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. For grounding electrode system, install at least three (3) rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor. Rods shall be interconnected by a minimum 3/0 bare copper conductor brazed to each ground rod below grade.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on building side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
- B. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 5 ohms.
 2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm.
- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.2 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.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70.

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. Cooper B-Line, Inc.; a division of Cooper Industries.
 - b. Thomas & Betts Corporation.
 - c. Unistrut; Tyco International, Ltd.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 5. Channel Dimensions: Selected for applicable load criteria.

- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. 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.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. 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. 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) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Available Manufacturers: 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) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Hilti Inc.
 - 3) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 4) 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.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

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. Support vertical and horizontal conduit runs at intervals not greater than 10 feet, within 3 feet of any bend and at every outlet or junction box. Where plastic conduit is used, follow E/M's recommended hangar spacing.
- C. *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 0.25-inch in diameter.*
- D. *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.
- E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1.5-inch 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, EMT, 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 pounds.*
- 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. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 7. To Light Steel: Sheet metal screws.
 8. 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.
- 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.
- D. All conduit raceways and cable trays where exposed in finish space shall be painted to match attached surface or material.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. See Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior duct banks and manholes, and underground hand-holes, boxes, and utility construction.

1.2 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, details, and attachments to other work.

1.3 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. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: Hot dipped galvanized with clear lacquer finish complying with ANSI C80.1.
- B. EMT: Thin wall with electro-galvanized and clear lacquer finish complying with ANSI C80.3.
- C. Fittings for Conduit (Including all Types and Flexible and Liquid tight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 - 2. Fittings for EMT: Steel, compression type.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. ENT: NEMA TC 13.
- B. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

2.3 METAL WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1 or 3R, as indicated.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Flanged-and-gasketed type.
- E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Thomas & Betts Corporation.
 - b. Walker Systems, Inc.; Wiremold Company (The).
 - c. Wiremold Company (The); Electrical Sales Division.
- B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors.
 - 1. 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:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Butler Manufacturing Company; Walker Division.
 - b. Hubbell Incorporated; Wiring Device-Kellems Division.
 - c. Lamson & Sessions; Carlon Electrical Products.

- d. Panduit Corp.
- e. Walker Systems, Inc.; Wiremold Company (The).
- f. Wiremold Company (The); Electrical Sales Division.

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- C. Metal Floor Boxes: Cast metal, fully adjustable, rectangular.
- D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- E. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.
- F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic finished inside with radio-frequency-resistant paint.
- G. Cabinets:
 - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 - 1. Exposed Conduit: Rigid steel conduit
 - 2. Concealed Conduit, Aboveground: Rigid steel conduit.
 - 3. Underground Conduit: RNC, Type EPC-80-PVC, direct buried.
 - 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Comply with the following indoor applications, unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT.

2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Electrical rooms.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Damp or Wet Locations: Rigid steel conduit.
 6. Raceways for Optical Fiber or Communications Cable: EMT.
 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
- C. EMT Conduit shall be provided for the following application where cable is installed in occupied area without ceiling or cable tray, and in walls to above ceiling:
1. Data and telephone wiring
 2. Intercom
 3. Fire Alarm
 4. Security System
 5. Cable TV
 6. DDC control wiring
- D. Minimum Raceway Size: 0.75-inch trade size.
- E. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 2. Setscrew fittings shall not be allowed.
- F. Short runs of flexible conduit may be used where permitted by code. Lengths greater than 6 feet require prior approval by engineer.
- G. Plastic conduit shall not be used above grade for any purpose.

3.2 INSTALLATION

- A. 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.
- B. 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.
- C. Complete raceway installation before starting conductor installation. Provide insulated throat fittings prior to conductor installation. Failure to do so may result in re-pulling of wiring.

- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated. Install exposed conduit parallel or at right angles to building lines. Install all conduit in neat, workman like manner.
- H. Make conduit connection to motors and equipment on resilient mounts with liquid-tight flexible conduit.
- I. Where conduits cross building expansion joints, provide expansion fittings as required.
- J. Raceways Embedded in Slabs:
 - 1. 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.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Change from ENT to rigid steel conduit, before rising above the floor.
- K. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- L. Install pull wires in empty raceways. 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 wire.
- M. All below grade non-metallic conduit shall be provided with tracer wire.
- N. Raceways for Optical Fiber and Communications Cable: Install as follows:
 - 1. 0.75-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
 - 2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
 - 3. Install with a maximum of two (2) 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- O. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a

blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where otherwise required by NFPA 70.
- P. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- Q. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
- R. Set metal floor boxes level and flush with finished floor surface.

3.3 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Joint Sealers".

END OF SECTION 260533

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Identification for raceways.
 2. Identification of power and control cables.
 3. Identification for conductors.
 4. Underground-line warning tape.
 5. Warning labels and signs.
 6. Instruction signs.
 7. Equipment identification labels.
 8. Miscellaneous identification products.

1.2 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
1. Black letters on an orange field.
 2. Legend: Indicate voltage and system service type.
- C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

- E. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Colors for Raceways Carrying Circuits at 600 V and Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- C. 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.
- D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. 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.
- C. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

- D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. 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.
- C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- D. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.5 FLOOR MARKING TAPE

- A. 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.6 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 - 1. Underground electrical and communications utility lines. Recommended by manufacturer for the method of installation and suitable to identify and locate
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
 - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
 - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.

3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

2.7 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70.
- 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:
 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 2. 0.25-inch grommets in corners for mounting.
 3. Nominal size, 7 by 10 inches.
- D. 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: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.8 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 0.625-inch thick for signs up to 20 sq. inches and 0.125-inch thick for larger sizes.
 1. Engraved legend with black letters on white face.
 2. Punched or drilled for mechanical fasteners.
 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 0.375-inch.
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 0.375-inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.9 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 0.375-inch. Overlay shall provide a weatherproof and UV-resistant seal for label.
- B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 0.375-inch.
- C. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Apply identification devices to surfaces that require finish after completing finish work.
- C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

- F. **Underground-Line Warning Tape:** During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- G. **Painted Identification:** Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. **Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground:** Install labels at 30-foot maximum intervals.
- B. **Accessible Raceways and Cables within Buildings:** Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. **Emergency Power.**
 - 2. **Power.**
 - 3. **UPS.**
- C. **Power-Circuit Conductor Identification, 600 V or Less:** For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. **Color-Coding for Phase and Voltage Level Identification, 600 V or Less:** Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. **Colors for 208/120-V Circuits:**
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. **Colors for 480/277-V Circuits:**
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - d. **Field-Applied, Color-Coding Conductor Tape:** Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. **Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.**
- E. **Auxiliary Electrical Systems Conductor Identification:** Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
1. Limit use of underground-line warning tape to direct-buried cables.
 2. Install underground-line warning tape for both direct-buried cables and cables in non-metallic raceway.
- G. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
1. Comply with 29 CFR 1910.145.
 2. Identify system voltage with black letters on an orange background.
 3. Apply to exterior of door, cover, or other access.
 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
- I. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:

TYPE 1: Laminated phenolic plastic with black Gothic-condensed lettering by Seaton or Wilco.

TYPE 2: Self-sticking 0.5-inch wide flexible nylon tape with high gloss surface and typed smearproof, chemical/solvent resistant lettering by Brady or Dymo.

TYPE 3: Self-sticking polyester sign with wording and size conforming to ANSI Standard Z35.1 - 1964 and OSHA 19.0.144iii(2) Specifications, by Brady or as approved.

TYPE 4: Self-sticking flexible vinyl with oil resistant adhesive for -20 degrees to 300 degrees F. temperatures by Brady or as approved.

- a. Provide switchboards with Type 1 signs 2.5 inches x 12 inches indicating switchboards designation and electrical characteristics as noted on drawings. Provide switchboards sections operating at different voltages with Type I sign 2 inches by 8 inches indicating electrical characteristics of section. Provide each switchboard device with Type 1 sign 1.25 inches by 5 inches indicating load served.
- b. Provide distribution panelboards with Type 1 signs 2 inches by 8 inches indicating panel designation and electrical characteristics. Provide branch devices with Type 1 sign 1 inch by 4 inches indicating load served.
- c. Provide lighting and power panelboards with Type 1 sign 1.25 inches by 6 inches indicating panel designation, electrical characteristics, and source of power. Source of power indication shall indicate source panel designation and switch or breaker number. Mount inside of panel door on circuit breaker trim flange just below breakers.
- d. Provide disconnect switches, time switches, lighting contactors, motor starters and controllers with Type 1 sign 1.25 inches by 6 inches indicating equipment served, electrical characteristics, and source of power,
- e. Provide feeders and branch circuit home runs with Type 4 wire marker indicating circuit number and power source. Provide feeders phase identification letter at each terminal point in addition to its circuit number.
- f. Provide Type 2 tape at feeder terminal lugs to switchboards and panelboards. Tape shall indicate conduit size, conductor type and AWG size. Tape shall be located to be easily read with conductors installed.

END OF SECTION 260553

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
1. Receptacles, receptacles with integral GFCI, and associated device plates.
 2. Wall-box motion sensors.
 3. Snap switches and wall-box dimmers.
 4. Wall-switch and exterior occupancy sensors.
 5. Communications outlets.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.3 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. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 3. Leviton Mfg. Company Inc. (Leviton).
 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5351 (single), 5352 (duplex).
 - b. Hubbell; HBL5351 (single), CR5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 HOSPITAL GRADE RECEPTACLES

- A. Hospital Grade Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 8362 (duplex).
 - b. Hubbell; HBL8300 (duplex).
 - c. Leviton; 8300 (duplex).
 - d. Pass & Seymour; 8300 (duplex).
 - 2. All devices on emergency power shall be red in color.

2.4 HOSPITAL GRADE ISOLATED GROUND RECEPTACLES

- A. Hospital Grade Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; IG 8362.
 - b. Hubbell; IG 5300.
 - c. Leviton; 8300-IG
 - 2. Devices shall be orange in color.

2.5 GFCI RECEPTACLES

- A. General Description: Straight blade, feed and non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; GF20.
 - b. Pass & Seymour; 2084.
 - c. Leviton; 8399

2.6 HOSPITAL GRADE GFCI RECEPTACLES

- A. General Description: Straight blade, feed and non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; VGFH20.
 - b. Hubbell; GF 83600 ALA.
 - c. Leviton; 8898-HG
 - 2. All devices on emergency power shall be red in color.

2.7 CLOCK hanger and wall mounted tv outlet

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Leviton 5361-CH.
 - 2. Hubbell HBK5235.

2.8 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.

- B. Switches, 120/277 V, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
 - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

- C. Pilot Light Switches, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221PL for 120 V and 277 V.
 - b. Hubbell; HPL1221PL for 120 V and 277 V.
 - c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
 - d. Pass & Seymour; PS20AC1-PLR for 120 V.
 - 3. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

2.9 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
- C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
 - 1. 600 W; dimmers shall require no derating when ganged with other devices. Illuminated when "OFF." Equal to Leviton IPI06-ILZ.
 - 2. 1000W; dimmers shall require no derating when ganged with other devices. Equal to Leviton IPI10-ILZ.
- D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.
 - 1. 1000W; dimmers shall require no derating when ganged with other devices. Equal to Leviton IPX10-ILZ.
- E. Contractors shall supply power extenders as needed for additional load capacity as needed by circuiting.

2.10 OCCUPANCY SENSORS – Reference lighting section

2.11 COMMUNICATIONS OUTLETS

- A. Telephone Outlet:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 3560-6.
 - b. Leviton; 40649.
 - 3. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1 complying with Category 5e. Comply with UL 1863.
- B. Combination TV and Telephone Outlet:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 3562.
 - b. Leviton; 40595.

3. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e; and one (1) Type F coaxial cable connector.

2.12 WALL PLATES

- A. Single and combination types to match corresponding wiring devices. Devices shall be stainless steel or nylon in color as selected by Architect.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: 0.035-inch- thick, satin-finished stainless steel.
 3. Material for Unfinished Spaces: Galvanized steel.
 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant.

2.13 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
 2. Wiring Devices Connected to Emergency Power System: [Red].
 3. TVSS Devices: Blue.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted or required by ADA AG-2010 to be mounted at a different height.
- B. Comply with ADA AG-2010 Sections 308 and 309 for mounting heights, maximum height of any device shall not be higher than 48" AFF.
- C. Coordination with Other Trades:
 1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 4. Install wiring devices after all wall preparation, including painting, is complete.

D. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailling existing conductors is permitted provided the outlet box is large enough.

E. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

F. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

G. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

H. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

I. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Test Instruments: Use instruments that comply with UL 1436.
 - 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

- B. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Cartridge fuses rated 600-V ac and less for use in control circuits enclosed switches and motor-control centers.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. 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.
- B. Comply with NEMA FU 1 for cartridge fuses.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Edison Fuse, Inc.
 - 3. Ferraz Shawmut, Inc.
 - 4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.1 FUSE APPLICATIONS

- A. Service Entrance: Class RK, time delay unless otherwise scheduled.
- B. Feeders: Class RK5, time delay unless otherwise indicated.
- C. Motor Branch Circuits: Class RK5, time delay.
- D. Other Branch Circuits: Class RK5, time delay unless otherwise indicated.
- E. Control Circuits: Class CC, time delay.

3.2 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.3 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block and holder.

3.4 SPARE FUSES

- A. Furnish Owner with spare fuses of each size and type installed on job as follows:
 - 1. 601 amps or larger Three (3) of each size and type
 - 2. 600 amps or less 10% with minimum of three (3) of each size and type.

END OF SECTION 262813

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. Shunt trip switches.
 - 5. Molded-case circuit breakers (MCCBs).
 - 6. Enclosures.

1.2 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

- D. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. 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.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products 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. Type GD, General Duty, Single Throw, 240-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with cartridge fuse interiors to accommodate indicated fuses, lockable handle with capability to accept two (2) padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three (3) padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three (3) padlocks, and interlocked with cover in closed position.
- E. 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. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 4. Lugs: Suitable for number, size, and conductor material.
 - 5. 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:
 - 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. **Type GD, General Duty, Single Throw, 600 A and Smaller:** UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two (2) padlocks, and interlocked with cover in closed position.

- C. **Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller:** UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three (3) padlocks, and interlocked with cover in closed position.

- D. **Type HD, Heavy Duty, Double Throw, 600-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.

- E. **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: Suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

- A. **Manufacturers:** Subject to compliance with requirements, provide products 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. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long- and short-time time adjustments.
 - 4. Ground-fault pickup level, time delay, and I^2t response.

- E. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

- F. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: 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.
 - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-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.
 - 5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 - 6. Auxiliary Contacts: One (1) SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 - 7. Alarm Switch: One (1) NO contact that operates only when circuit breaker has tripped.

2.4 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. Kitchen or Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 - 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Common Work Results for Electrical Systems."

- C. *Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.*
- D. Install fuses in fusible devices.
- E. Comply with NECA 1.

3.2 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.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. 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.
- C. 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.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262816

SECTION 262913 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the following enclosed controllers rated 600 V and less:
 - 1. Full-voltage manual.
 - 2. Full-voltage magnetic.

1.2 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.

1.3 SUBMITTALS

- A. Product Data: For each type of enclosed controller.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Seismic Qualification Certificates: For enclosed controllers, accessories, and components, from manufacturer.

1.4 QUALITY ASSURANCE

- A. 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.

- B. Comply with NFPA 70.
- C. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 - 2. Configuration: Nonreversing.
 - 3. Surface mounting.
 - 4. Pilot light.
- C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 - 2. Configuration: Nonreversing.
 - 3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
 - 4. Surface mounting.
 - 5. Pilot light.
- D. Integral Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

- b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
- c. Rockwell Automation, Inc.; Allen-Bradley brand.
- d. Siemens Energy & Automation, Inc.
- e. Square D; a brand of Schneider Electric.
2. Configuration: Nonreversing.
3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters and sensors in each phase, matched to nameplate full-load current of actual protected motor and having appropriate adjustment for duty cycle; external reset push button; bimetallic type.
4. Surface mounting.
5. Pilot light.

E. Magnetic Controllers: Full voltage, across the line, electrically held.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
2. Configuration: Nonreversing.
3. Contactor Coils: Pressure-encapsulated type.
 - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
5. Control Circuits: 24-V ac; with control power source of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
6. Melting Alloy Overload Relays:
 - a. Inverse-time-current characteristic.
 - b. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
7. Bimetallic Overload Relays:
 - a. Inverse-time-current characteristic.
 - b. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
8. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor running overload protection.
 - b. Sensors in each phase.
 - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
9. External overload reset push button.

F. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

- b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
2. Nonfusible Disconnecting Means:
- a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

2.2 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
- 1. Dry and Clean Indoor Locations: Type 1.
 - 2. Outdoor Locations: Type 3R.
 - 3. Other Wet or Damp Indoor Locations: Type 4.
 - 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

2.3 ACCESSORIES

- A. Push Buttons, Pilot Lights, and Selector Switches: NEMA ICS 5; heavy-duty type; factory installed in controller enclosure cover unless otherwise indicated.
- B. Control Relays: Auxiliary and adjustable time-delay relays.
- C. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height, and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- 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 control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- D. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- E. Comply with NECA 1.

3.2 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified 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 nameplate.
 - 3. Label each enclosure-mounted control and pilot device.

3.3 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices and facility's central control system. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
 - 2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
 3. Test continuity of each circuit.
 4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect before starting the motor(s).
 5. Test each motor for proper phase rotation.
 6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed controllers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Set field-adjustable switches and overload-relay pickup and trip ranges.
- B. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six (6) times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cool down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect before increasing settings.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 262913

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Exit signs.
 - 2. Interior solid-state luminaires that use LED technology.
 - 3. Lighting fixture supports.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include emergency lighting units, including batteries and chargers.
 - 5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
 - 6. Include data on LED driver including total system wattage, power factor and total harmonic distortion.

7. Photometric data and adjustment factors based on laboratory tests.
 - a. **Manufacturers' Certified Data:** Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - b. **Testing Agency Certified Data:** For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
 8. Wiring diagrams for power, control, and signal wiring.
 9. Photoelectric relays.
 10. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
- B. **Shop Drawings:** For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
- C. **Product Schedule:** For luminaires and lamps. Use same designations indicated on Drawings.
- D. **Field quality-control test reports.**

1.5 INFORMATIONAL SUBMITTALS

- A. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. **Product Certificates:** For each type of luminaire.
- C. **Product Test Reports:** For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.
- D. **Sample warranty.**

1.6 CLOSEOUT SUBMITTALS

- A. **Operation and Maintenance Data:** For luminaires and lighting systems to include in operation and maintenance manuals.
 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: Five for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Drivers: One for every 50 of each type and rating installed. Furnish at least one of each type.
 - 4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- E. Mockups: For interior lighting luminaires in room or module mockups, complete with power and control connections.
 - 1. Obtain Architect's approval of luminaires in mockups before starting installations.
 - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: The design for each lighting fixture is based on the product named in the schedule. Subject to compliance with requirements, provide either the named product or an approved equivalent product specified in the schedule with the specific manufacturer and light fixture series that has been approved. Other manufacturers or other series from a listed manufacturer will not be considered.
 - 1. Cooper
 - 2. Lithonia
 - 3. Williams

2.2 LUMINAIRE REQUIREMENTS

- A. 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.
- B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. Recessed Fixtures: Comply with NEMA LE 4.
- E. Bulb shape complying with ANSI C79.1.
- F. Lamp base complying with ANSI C81.61 or IEC 60061-1.
- G. CRI of minimum 80.
- H. CCT of 4100 K.
- I. Rated lamp life of minimum 35,000 hours.
- J. Nominal Operating Voltage: as indicated on the drawings.
- K. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

- L. Dimming applications – dimmable from 100 percent to 0 percent of maximum light output.

2.3 MATERIALS

A. LED Driver

- 1. Internal to luminaire unless noted otherwise.
- 2. Power Factor: 0.90 or higher
- 3. Total Harmonic Distortion: less than 10 percent

B. Metal Parts:

- 1. Free of burrs and sharp corners and edges.
- 2. Sheet metal components shall be steel unless otherwise indicated.
- 3. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position.

D. Diffusers and Globes:

- 1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- 2. Glass: Annealed crystal glass unless otherwise indicated.
- 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels 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 characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI for all luminaires.

2.4 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Twin-Stem Hangers: Two (2), 0.5-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gauge.
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.

3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaire Support:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

G. Ceiling-Mounted Luminaire Support:

1. Ceiling mount with minimum two 5/32-inch- diameter aircraft cable supports with adjustable length.
2. Ceiling mount with hook mount.

H. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing, rod or wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

I. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

- J. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119



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