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Delaware Army National Guard
Regional Training Institute-Phase I, Bethany Beach, DE
PN 100010
Delaware Purchase Order 76074

ISSUED FOR CONSTRUCTION

Burns & McDonnell Project Nos. 62134/62222

DOCUMENT 000107 – CERTIFICATION PAGE

CERTIFICATION(S)



ADVERTISEMENT FOR BIDS

Sealed bids for **DEARNG Contract No. 10-2010, Bethany Beach Training Site – Regional Training Institute (RTI)**, will be received by the Delaware Army National Guard at the Security Officers desk in the Main Lobby of the Joint Force Headquarters, Sherwood Park II, First Regiment Road, Wilmington, Delaware, 19808-2191, **until 2:00 PM local time on Friday, June 21, 2013**, at which time they will be publicly opened and read aloud in the Conference Room. Bidder bears the risk of late delivery. Any bids received after the stated time will be returned unopened.

Project involves the demolition of existing buildings within construction foot print, and the construction of one, approximately 14,000 SF, single story training building located at the Delaware Army National Guard, Bethany Beach Training Site. Project includes HVAC, electrical, carpentry, masonry and all other associated work with new construction.

Attention is called to construction schedule in the Contract Documents.

A MANDATORY Pre-Bid Meeting will be held on Wednesday, **May 22, 2013, at 11:00 AM** at the Delaware Army National Guard, Bethany Beach Training Site, Building 115 (Multipurpose Room) 163 Scannell Boulevard, Bethany Beach, Delaware 19930 (all contractors to meet at the entrance to the North Gate off Route 1 adjacent to the helicopter) for the purpose of establishing the listing of subcontractors and to answer questions. Representatives of each party to any Joint Venture must attend this meeting. **ATTENDANCE OF THIS MEETING IS A PREREQUISITE FOR BIDDING ON THIS CONTRACT.**

Sealed bids shall be addressed to the Delaware Army National Guard, Joint Force Headquarters, First Regiment Road, Wilmington, DE, 19808-2191; ATTENTION: CPT Eugene W. Bledsoe. The outer envelope should clearly indicate: **DEARNG CONTRACT NO. 10-2010 – BETHANY BEACH TRAINING SITE – Regional Training Institute - SEALED BID – DO NOT OPEN.**

Contract Documents may be obtained at the Pre-Bid Meeting. Documents will only be available on CD and may be obtained upon receipt of \$25/disc, non-refundable. To obtain documents earlier, you may call the office of the architect, Burns & McDonnell, 9400 Ward Parkway, Kansas City, MO, 64114 (phone: 816-349-6785). Checks are to be made payable to **“Burns & McDonnell.”**

Construction Documents will be available for review at the offices of Delaware Contractors Association, and the Associated Builders and Contractors, Delaware.

Minority Business Enterprises (MBE), Disadvantaged Business Enterprises (DBE) and Women-Owned Business Enterprises (WBE) will be afforded full opportunity to submit

bids on this contract and will not be subject to discrimination on the basis of race, color, national origin or sex in consideration of this award. Each bid must be accompanied by a bid security equivalent to ten percent of the bid amount and all additive alternates. The successful bidder must post a performance bond and payment bond in a sum equal to 100 percent of the contract price upon execution of the contract. The Owner reserves the right to reject any or all bids and to waive any informalities therein. The Owner may extend the time and place for the opening of the bids from that described in the advertisement, with not less than two calendar days notice by certified delivery, facsimile machine or other electronic means to those bidders receiving plans.

END OF ADVERTISEMENT FOR BIDS

This advertisement for bids to be posted on the State of Delaware Procurement Portal website found at **mymarketplace.delaware.gov**

INSTRUCTIONS TO BIDDERS

TABLE OF ARTICLES

1. DEFINITIONS
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3. BIDDING DOCUMENTS
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6. POST-BID INFORMATION
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ARTICLE 1: GENERAL

1.1 DEFINITIONS

1.1.1 Whenever the following terms are used, their intent and meaning shall be interpreted as follows:

1.2 STATE: The State of Delaware.

1.3 AGENCY: Contracting State Agency as noted on cover sheet.

1.4 DESIGNATED OFFICIAL: The agent authorized to act for the Agency.

1.5 BIDDING DOCUMENTS: Bidding Documents include the Bidding Requirements and the proposed Contract Documents. The Bidding Requirements consist of the Advertisement for Bid, Invitation to Bid, Instructions to Bidders, Supplementary Instructions to Bidders (if any), General Conditions, Supplementary General Conditions, General Requirements, Special Provisions (if any), the Bid Form (including the Non-collusion Statement), and other sample bidding and contract forms. The proposed Contract Documents consist of the form of Agreement between the Owner and Contractor, as well as the Drawings, Specifications (Project Manual) and all Addenda issued prior to execution of the Contract.

1.6 CONTRACT DOCUMENTS: The Contract Documents consist of the, Instructions to Bidders, Supplementary Instructions to Bidders (if any), General Conditions, Supplementary General Conditions, General Requirements, Special Provisions (if any), the form of agreement between the Owner and the Contractor, Drawings (if any), Specifications (Project Manual), and all addenda.

1.7 AGREEMENT: The form of the Agreement shall be AIA Document A101, Standard Form of Agreement between Owner and Contractor where the basis of payment is a STIPULATED SUM. In the case of conflict between the instructions contained therein and the General Requirements herein, these General Requirements shall prevail.

1.8 GENERAL REQUIREMENTS (or CONDITIONS): General Requirements (or conditions) are instructions pertaining to the Bidding Documents and to contracts in general. They contain, in summary, requirements of laws of the State; policies of the Agency and instructions to bidders.

1.9 SPECIAL PROVISIONS: Special Provisions are specific conditions or requirements peculiar to the bidding documents and to the contract under consideration and are supplemental to the General Requirements. Should the Special Provisions conflict with the General Requirements, the Special Provisions shall prevail.

1.10 ADDENDA: Written or graphic instruments issued by the Owner/Architect prior to the execution of the contract which modify or interpret the Bidding Documents by additions, deletions, clarifications or corrections.

1.11 BIDDER OR VENDOR: A person or entity who formally submits a Bid for the material or Work contemplated, acting directly or through a duly authorized representative who meets the requirements set forth in the Bidding Documents.

1.12 SUB-BIDDER: A person or entity who submits a Bid to a Bidder for materials or labor, or both for a portion of the Work.

- 1.13 BID: A complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.
- 1.14 BASE BID: The sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added or from which Work may be deleted for sums stated in Alternate Bids (if any are required to be stated in the bid).
- 1.15 OPTION BID (or OPTION): An amount stated in the Bid, where applicable, to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents is accepted.
- 1.16 UNIT PRICE: An amount stated in the Bid, where applicable, as a price per unit of measurement for materials, equipment or services or a portion of the Work as described in the Bidding Documents.
- 1.17 SURETY: The corporate body which is bound with and for the Contract, or which is liable, and which engages to be responsible for the Contractor's payments of all debts pertaining to and for his acceptable performance of the Work for which he has contracted.
- 1.18 BIDDER'S DEPOSIT: The security designated in the Bid to be furnished by the Bidder as a guaranty of good faith to enter into a contract with the Agency if the Work to be performed or the material or equipment to be furnished is awarded to him.
- 1.19 CONTRACT: The written agreement covering the furnishing and delivery of material or work to be performed.
- 1.20 CONTRACTOR: Any individual, firm or corporation with whom a contract is made by the Agency.
- 1.21 SUBCONTRACTOR: An individual, partnership or corporation which has a direct contract with a contractor to furnish labor and materials at the job site, or to perform construction labor and furnish material in connection with such labor at the job site.
- 1.22 CONTRACT BOND: The approved form of security furnished by the contractor and his surety as a guaranty of good faith on the part of the contractor to execute the work in accordance with the terms of the contract.

ARTICLE 2: BIDDER'S REPRESENTATIONS

- 2.1 PRE-BID MEETING
- 2.1.1 A pre-bid meeting for this project will be held at the time and place designated. Attendance at this meeting is a pre-requisite for submitting a Bid, unless this requirement is specifically waived elsewhere in the Bid Documents.
- 2.2 By submitting a Bid, the Bidder represents that:
- 2.2.1 The Bidder has read and understands the Bidding Documents and that the Bid is made in accordance therewith.
- 2.2.2 The Bidder has visited the site, become familiar with existing conditions under which the Work is to be performed, and has correlated the Bidder's his personal observations with the requirements of the proposed Contract Documents.

2.2.3 The Bid is based upon the materials, equipment, and systems required by the Bidding Documents without exception.

2.3 JOINT VENTURE REQUIREMENTS

2.3.1 For Public Works Contracts, each Joint Venturer shall be qualified and capable to complete the Work with their own forces.

2.3.2 Included with the Bid submission, and as a requirement to bid, a copy of the executed Joint Venture Agreement shall be submitted and signed by all Joint Venturers involved.

2.3.3 All required Bid Bonds, Performance Bonds, Material and Labor Payment Bonds must be executed by both Joint Venturers and be placed in both of their names.

2.3.4 All required insurance certificates shall name both Joint Venturers.

2.3.5 Both Joint Venturers shall sign the Bid Form and shall submit a valid Delaware Business License Number with their Bid or shall state that the process of application for a Delaware Business License has been initiated.

2.3.6 Both Joint Venturers shall include their Federal E.I. Number with the Bid.

2.3.7 In the event of a mandatory Pre-bid Meeting, each Joint Venturer shall have a representative in attendance.

2.3.8 Due to exceptional circumstances and for good cause shown, one or more of these provisions may be waived at the discretion of the State.

2.4 ASSIGNMENT OF ANTITRUST CLAIMS

2.4.1 As consideration for the award and execution by the Owner of this contract, the Contractor hereby grants, conveys, sells, assigns and transfers to the State of Delaware all of its right, title and interests in and to all known or unknown causes of action it presently has or may now or hereafter acquire under the antitrust laws of the United States and the State of Delaware, relating to the particular goods or services purchased or acquired by the Owner pursuant to this contract.

ARTICLE 3: BIDDING DOCUMENTS

3.1 COPIES OF BID DOCUMENTS

3.1.1 Bidders may obtain complete sets of the Bidding Documents from the Architectural/Engineering firm designated in the Advertisement or Invitation to Bid in the number and for the deposit sum, if any, stated therein.

3.1.2 Bidders shall use complete sets of Bidding Documents for preparation of Bids. The issuing Agency nor the Architect assumes no responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

3.1.3 Any errors, inconsistencies or omissions discovered shall be reported to the Architect immediately.

3.1.4 The Agency and Architect may make copies of the Bidding Documents available on the above terms for the purpose of obtaining Bids on the Work. No license or grant of use is conferred by issuance of copies of the Bidding Documents.

3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

3.2.1 The Bidder shall carefully study and compare the Bidding Documents with each other, and with other work being bid concurrently or presently under construction to the extent that it relates to the Work for which the Bid is submitted, shall examine the site and local conditions, and shall report any errors, inconsistencies, or ambiguities discovered to the Architect.

3.2.2 Bidders or Sub-bidders requiring clarification or interpretation of the Bidding Documents shall make a written request to the Architect at least seven days prior to the date for receipt of Bids. Interpretations, corrections and changes to the Bidding Documents will be made by written Addendum. Interpretations, corrections, or changes to the Bidding Documents made in any other manner shall not be binding.

3.2.3 The apparent silence of the specifications as to any detail, or the apparent omission from it of detailed description concerning any point, shall be regarded as meaning that only the best commercial practice is to prevail and only material and workmanship of the first quality are to be used. Proof of specification compliance will be the responsibility of the Bidder.

3.2.4 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for all permits, labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work.

3.2.5 The Owner will bear the costs for all impact and user fees associated with the project.

3.3 SUBSTITUTIONS

3.3.1 The materials, products and equipment described in the Bidding Documents establish a standard of quality, required function, dimension, and appearance to be met by any proposed substitution. The specification of a particular manufacturer or model number is not intended to be proprietary in any way. Substitutions of products for those named will be considered, providing that the Vendor certifies that the function, quality, and performance characteristics of the material offered is equal or superior to that specified. It shall be the Bidder's responsibility to assure that the proposed substitution will not affect the intent of the design, and to make any installation modifications required to accommodate the substitution.

3.3.2 Requests for substitutions shall be made in writing to the Architect at least ten days prior to the date of the Bid Opening. Such requests shall include a complete description of the proposed substitution, drawings, performance and test data, explanation of required installation modifications due the substitution, and any other information necessary for an evaluation. The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval shall be final. The Architect is to notify Owner prior to any approvals.

3.3.3 If the Architect approves a substitution prior to the receipt of Bids, such approval shall be set forth in an Addendum. Approvals made in any other manner shall not be binding.

3.3.4 The Architect shall have no obligation to consider any substitutions after the Contract award.

3.4 ADDENDA

- 3.4.1 Addenda will be mailed or delivered to all who are known by the Architect to have received a complete set of the Bidding Documents.
- 3.4.2 Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.
- 3.4.3 No Addenda will be issued later than 4 days prior to the date for receipt of Bids except an Addendum withdrawing the request for Bids or one which extends the time or changes the location for the opening of bids.
- 3.4.4 Each bidder shall ascertain prior to submitting his Bid that they have received all Addenda issued, and shall acknowledge their receipt in their Bid in the appropriate space. Not acknowledging an issued Addenda could be grounds for determining a bid to be non-responsive.

ARTICLE 4: BIDDING PROCEDURES**4.1 PREPARATION OF BIDS**

- 4.1.1 Submit the bids on the Bid Forms included with the Bidding Documents.
- 4.1.2 Submit the original Bid Form for each bid. Bid Forms may be removed from the project manual for this purpose.
- 4.1.3 Execute all blanks on the Bid Form in a non-erasable medium (typewriter or manually in ink).
- 4.1.4 Where so indicated by the makeup on the Bid Form, express sums in both words and figures, in case of discrepancy between the two, the written amount shall govern.
- 4.1.5 Interlineations, alterations or erasures must be initialed by the signer of the Bid.
- 4.1.6 **BID ALL REQUESTED ALTERNATES AND UNIT PRICES, IF ANY.** If there is no change in the Base Bid for an Alternate, enter "No Change". The Contractor is responsible for verifying that they have received all addenda issued during the bidding period. Work required by Addenda shall automatically become part of the Contract.
- 4.1.7 Make no additional stipulations on the Bid Form and do not qualify the Bid in any other manner.
- 4.1.8 Each copy of the Bid shall include the legal name of the Bidder and a statement whether the Bidder is a sole proprietor, a partnership, a corporation, or any legal entity, and each copy shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further give the state of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current Power of Attorney attached, certifying agent's authority to bind the Bidder.
- 4.1.9 Bidder shall complete the Non-Collusion Statement form included with the Bid Forms and include it with their Bid.
- 4.1.10 In the construction of all Public Works projects for the State of Delaware or any agency thereof, preference in employment of laborers, workers or mechanics shall be given to bona fide legal citizens of the State who have established citizenship by residence of at least 90 days in the State.

4.2 BID SECURITY

4.2.1 All bids shall be accompanied by a deposit of either a good and sufficient bond to the agency for the benefit of the agency, with corporate surety authorized to do business in this State, the form of the bond and the surety to be approved by the agency, or a security of the bidder assigned to the agency, for a sum equal to at least 10% of the bid plus all add alternates, or in lieu of the bid bond a security deposit in the form of a certified check, bank treasurer's check, cashier's check, money order, or other prior approved secured deposit assigned to the State. The bid bond need not be for a specific sum, but may be stated to be for a sum equal to 10% of the bid plus all add alternates to which it relates and not to exceed a certain stated sum, if said sum is equal to at least 10% of the bid. The Bid Bond form used shall be the standard OMB form (attached).

4.2.2 The Agency has the right to retain the bid security of Bidders to whom an award is being considered until either a formal contract has been executed and bonds have been furnished or the specified time has elapsed so the Bids may be withdrawn or all Bids have been rejected.

4.2.3 In the event of any successful Bidder refusing or neglecting to execute a formal contract and bond within 20 days of the awarding of the contract, the bid bond or security deposited by the successful bidder shall be forfeited.

4.3 SUBCONTRACTOR LIST

4.3.1 As required by Delaware Code, Title 29, section 6962(d)(10)b, each Bidder shall submit with their Bid a completed List of Sub-Contractors included with the Bid Form. NAME ONLY ONE SUBCONTRACTOR FOR EACH TRADE. A Bid will be considered non-responsive unless the completed list is included.

4.3.2 Provide the Name and Address for each listed subcontractor. Addresses by City, Town or Locality, plus State, will be acceptable.

4.3.3 It is the responsibility of the Contractor to ensure that their Subcontractors are in compliance with the provisions of this law. Also, if a Contractor elects to list themselves as a Subcontractor for any category, they must specifically name themselves on the Bid Form and be able to document their capability to act as Subcontractor in that category in accordance with this law.

4.4 EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS

4.4.1 During the performance of this contract, the contractor agrees as follows:

- A. The Contractor will not discriminate against any employee or applicant for employment because of race, creed, color, sex or national origin. The Contractor will take affirmative action to ensure the applicants are employed, and that employees are treated during employment, without regard to their race, creed, color, sex or national origin. Such action shall include, but not be limited to, the following: Employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places available to employees and applicants for employment notices to be provided by the contracting agency setting forth this nondiscrimination clause.

- B. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, color, sex or national origin."

4.5 PREVAILING WAGE REQUIREMENT

4.5.1 Wage Provisions: In accordance with Delaware Code, Title 29, Section 6960, renovation projects whose total cost shall exceed \$15,000, and \$100,000 for new construction, the minimum wage rates for various classes of laborers and mechanics shall be as determined by the Department of Labor, Division of Industrial Affairs of the State of Delaware.

4.5.2 The prevailing wage shall be the wage paid to a majority of employees performing similar work as reported in the Department's annual prevailing wage survey or in the absence of a majority, the average paid to all employees reported.

4.5.3 The employer shall pay all mechanics and labors employed directly upon the site of work, unconditionally and not less often than once a week and without subsequent deduction or rebate on any account, the full amounts accrued at time of payment, computed at wage rates not less than those stated in the specifications, regardless of any contractual relationship which may be alleged to exist between the employer and such laborers and mechanics.

4.5.4 The scale of the wages to be paid shall be posted by the employer in a prominent and easily accessible place at the site of the work.

4.5.5 Every contract based upon these specifications shall contain a stipulation that sworn payroll information, as required by the Department of Labor, be furnished weekly. The Department of Labor shall keep and maintain the sworn payroll information for a period of 6 months from the last day of the work week covered by the payroll.

4.6 SUBMISSION OF BIDS

4.6.1 Enclose the Bid, the Bid Security, and any other documents required to be submitted with the Bid in a sealed opaque envelope. Address the envelope to the party receiving the Bids. Identify with the project name, project number, and the Bidder's name and address. If the Bid is sent by mail, enclose the sealed envelope in a separate mailing envelope with the notation "BID ENCLOSED" on the face thereof. The State is not responsible for the opening of bids prior to bid opening date and time that are not properly marked.

4.6.2 Deposit Bids at the designated location prior to the time and date for receipt of bids indicated in the Advertisement for Bids. Bids received after the time and date for receipt of bids will be marked "LATE BID" and returned.

4.6.3 Bidder assumes full responsibility for timely delivery at location designated for receipt of bids.

4.6.4 Oral, telephonic or telegraphic bids are invalid and will not receive consideration.

4.6.5 Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids, provided that they are then fully in compliance with these Instructions to Bidders.

4.7 MODIFICATION OR WITHDRAW OF BIDS

4.7.1 Prior to the closing date for receipt of Bids, a Bidder may withdraw a Bid by personal request and by showing proper identification to the Architect. A request for withdraw by letter or fax,

if the Architect is notified in writing prior to receipt of fax, is acceptable. A fax directing a modification in the bid price will render the Bid informal, causing it to be ineligible for consideration of award. Telephone directives for modification of the bid price shall not be permitted and will have no bearing on the submitted proposal in any manner.

4.7.2 Bidders submitting Bids that are late shall be notified as soon as practicable and the bid shall be returned.

4.7.3 A Bid may not be modified, withdrawn or canceled by the Bidder during a thirty (30) day period following the time and date designated for the receipt and opening of Bids, and Bidder so agrees in submitting their Bid. Bids shall be binding for 30 days after the date of the Bid opening.

ARTICLE 5: CONSIDERATION OF BIDS

5.1 OPENING/REJECTION OF BIDS

5.1.1 Unless otherwise stated, Bids received on time will be publicly opened and will be read aloud. An abstract of the Bids will be made available to Bidders.

5.1.2 The Agency shall have the right to reject any and all Bids. A Bid not accompanied by a required Bid Security or by other data required by the Bidding Documents, or a Bid which is in any way incomplete or irregular is subject to rejection.

5.1.3 If the Bids are rejected, it will be done within thirty (30) calendar day of the Bid opening.

5.2 COMPARISON OF BIDS

5.2.1 After the Bids have been opened and read, the bid prices will be compared and the result of such comparisons will be made available to the public. Comparisons of the Bids may be based on the Base Bid plus desired Alternates. The Agency shall have the right to accept Alternates in any order or combination.

5.2.2 The Agency reserves the right to waive technicalities, to reject any or all Bids, or any portion thereof, to advertise for new Bids, to proceed to do the Work otherwise, or to abandon the Work, if in the judgment of the Agency or its agent(s), it is in the best interest of the State.

5.2.3 An increase or decrease in the quantity for any item is not sufficient grounds for an increase or decrease in the Unit Price.

5.2.4 The prices quoted are to be those for which the material will be furnished F.O.B. Job Site and include all charges that may be imposed during the period of the Contract.

5.2.5 No qualifying letter or statements in or attached to the Bid, or separate discounts will be considered in determining the low Bid except as may be otherwise herein noted. Cash or separate discounts should be computed and incorporated into Unit Bid Price(s).

5.3 DISQUALIFICATION OF BIDDERS

5.3.1 An agency shall determine that each Bidder on any Public Works Contract is responsible before awarding the Contract. Factors to be considered in determining the responsibility of a Bidder include:

A. The Bidder's financial, physical, personnel or other resources including Subcontracts;

- B. The Bidder's record of performance on past public or private construction projects, including, but not limited to, defaults and/or final adjudication or admission of violations of the Prevailing Wage Laws in Delaware or any other state;
- C. The Bidder's written safety plan;
- D. Whether the Bidder is qualified legally to contract with the State;
- E. Whether the Bidder supplied all necessary information concerning its responsibility; and,
- F. Any other specific criteria for a particular procurement, which an agency may establish; provided however, that, the criteria be set forth in the Invitation to Bid and is otherwise in conformity with State and/or Federal law.

5.3.2 If an agency determines that a Bidder is nonresponsive and/or nonresponsible, the determination shall be in writing and set forth the basis for the determination. A copy of the determination shall be sent to the affected Bidder within five (5) working days of said determination.

5.3.3 In addition, any one or more of the following causes may be considered as sufficient for the disqualification of a Bidder and the rejection of their Bid or Bids.

5.3.3.1 More than one Bid for the same Contract from an individual, firm or corporation under the same or different names.

5.3.3.2 Evidence of collusion among Bidders.

5.3.3.3 Unsatisfactory performance record as evidenced by past experience.

5.3.3.4 If the Unit Prices are obviously unbalanced either in excess or below reasonable cost analysis values.

5.3.3.5 If there are any unauthorized additions, interlineation, conditional or alternate bids or irregularities of any kind which may tend to make the Bid incomplete, indefinite or ambiguous as to its meaning.

5.3.3.6 If the Bid is not accompanied by the required Bid Security and other data required by the Bidding Documents.

5.3.3.7 If any exceptions or qualifications of the Bid are noted on the Bid Form.

5.4 ACCEPTANCE OF BID AND AWARD OF CONTRACT

5.4.1 A formal Contract shall be executed with the successful Bidder within twenty (20) calendar days after the award of the Contract.

5.4.2 Per Section 6962(d)(13) a., Title 29, Delaware Code, "The contracting agency shall award any public works contract within thirty (30) days of the bid opening to the lowest responsive and responsible Bidder, unless the Agency elects to award on the basis of

best value, in which case the election to award on the basis of best value shall be stated in the Invitation To Bid.”

- 5.4.3 Each Bid on any Public Works Contract must be deemed responsive by the Agency to be considered for award. A responsive Bid shall conform in all material respects to the requirements and criteria set forth in the Contract Documents and specifications.
- 5.4.4 The Agency shall have the right to accept Alternates in any order or combination, and to determine the low Bidder on the basis of the sum of the Base Bid, plus accepted Alternates.
- 5.4.5 The successful Bidder shall execute a formal contract, submit the required Insurance Certificate, and furnish good and sufficient bonds, unless specifically waived in the General Requirements, in accordance with the General Requirement, within twenty (20) days of official notice of contract award. Bonds shall be for the benefit of the Agency with surety in the amount of 100% of the total contract award. Said Bonds shall be conditioned upon the faithful performance of the contract. Bonds shall remain in affect for period of one year after the date of substantial completion.
- 5.4.6 If the successful Bidder fails to execute the required Contract and Bond, as aforesaid, within twenty (20) calendar days after the date of official Notice of the Award of the Contract, their Bid guaranty shall immediately be taken and become the property of the State for the benefit of the Agency as liquidated damages, and not as a forfeiture or as a penalty. Award will then be made to the next lowest qualified Bidder of the Work or readvertised, as the Agency may decide.
- 5.4.7 Prior to receiving an award, the successful Bidder shall furnish to the Agency proof of State of Delaware Business Licensure. If the Bidder does not currently have a Business License, they may obtain an application by writing to: Division of Revenue, Carvel State Office Building, 820 French Street, Wilmington, DE 19899. A copy of the letter written to the Division of Revenue, sent with your Bid will be adequate proof for your firm to be considered for award until such time as you receive your license.
- 5.4.8 The Bid Security shall be returned to the successful Bidder upon the execution of the formal contract. The Bid Securities of unsuccessful bidders shall be returned within thirty (30) calendar days after the opening of the Bids.

ARTICLE 6: POST-BID INFORMATION

- 6.1 CONTRACTOR'S QUALIFICATION STATEMENT
- 6.1.1 Bidders to whom award of a Contract is under consideration shall, if requested by the Agency, submit a properly executed AIA Document A305, Contractor's Qualification Statement, unless such a statement has been previously required and submitted.
- 6.2 BUSINESS DESIGNATION FORM
- 6.2.1 Successful bidder shall be required to accurately complete an Office of Management and Budget Business Designation Form for Subcontractors.

ARTICLE 7: PERFORMANCE BOND AND PAYMENT BOND

- 7.1 BOND REQUIREMENTS

- 7.1.1 The cost of furnishing the required Bonds, that are stipulated in the Bidding Documents, shall be included in the Bid.
- 7.1.2 If the Bidder is required by the Agency to secure a bond from other than the Bidder's usual sources, changes in cost will be adjusted as provide in the Contract Documents.
- 7.1.3 The Performance and Payment Bond forms used shall be the standard OMB forms (attached).
- 7.2 TIME OF DELIVERY AND FORM OF BONDS
 - 7.2.1 The bonds shall be dated on or after the date of the Contract.
 - 7.2.2 The Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix a certified and current copy of the power of attorney.

ARTICLE 8: FORM OF AGREEMENT BETWEEN AGENCY AND CONTRACTOR

- 8.1 Unless otherwise required in the Bidding Documents, the Agreement for the Work will be written on AIA Document A101, Standard Form of Agreement Between Owner and Contractor Where the Basis of Payment is a Stipulated Sum.

END OF INSTRUCTIONS TO BIDDERS

GENERAL REQUIREMENTS

TABLE OF ARTICLES

1. GENERAL PROVISIONS
2. OWNER
3. CONTRACTOR
4. ADMINISTRATION OF THE CONTRACT
5. SUBCONTRACTORS
6. CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS
7. CHANGES IN THE WORK
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9. PAYMENTS AND COMPLETION
10. PROTECTION OF PERSONS AND PROPERTY
11. INSURANCE AND BONDS
12. UNCOVERING AND CORRECTION OF WORK
13. MISCELLANEOUS PROVISIONS
14. TERMINATION OR SUSPENSION OF THE CONTRACT

ARTICLE 1: GENERAL**1.1 CONTRACT DOCUMENTS**

1.1.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary and what is required by one shall be as binding as if required by all. Performance by the Contractor shall be required to an extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the intended results.

1.1.2 Work including material purchases shall not begin until the Contractor is in receipt of a bonafide State of Delaware Purchase Order. Any work performed or material purchases prior to the issuance of the Purchase Order is done at the Contractor's own risk and cost.

1.2 EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS

1.2.1 For Public Works Projects financed in whole or in part by state appropriation the Contractor agrees that during the performance of this contract:

1. The Contractor will not discriminate against any employee or applicant for employment because of race, creed, color, sex or national origin. The Contractor will take positive steps to ensure that applicants are employed and that employees are treated during employment without regard to their race, creed, color, sex or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places available to employees and applicants for employment notices to be provided by the contracting agency setting forth this nondiscrimination clause.
2. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, color, sex or national origin."

ARTICLE 2: OWNER

(NO ADDITIONAL GENERAL REQUIREMENTS – SEE SUPPLEMENTARY GENERAL CONDITIONS)

ARTICLE 3: CONTRACTOR

3.1 Schedule of Values: The successful Bidder shall within twenty (20) days after receiving notice to proceed with the work, furnish to the Owner a complete schedule of values on the various items comprising the work.

3.2 Subcontracts: Upon approval of Subcontractors, the Contractor shall award their Subcontracts as soon as possible after the signing of their own contract and see that all material, their own and those of their Subcontractors, are promptly ordered so that the work will not be delayed by failure of materials to arrive on time.

- 3.3 Before commencing any work or construction, the General Contractor is to consult with the Owner as to matters in connection with access to the site and the allocation of Ground Areas for the various features of hauling, storage, etc.
- 3.4 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions.
- 3.5 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Contract. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.
- 3.6 The Contractor warrants to the Owner that materials and equipment furnished will be new and of good quality, unless otherwise permitted, and that the work will be free from defects and in conformance with the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved, may be considered defective. If required by the Owner, the Contractor shall furnish evidence as to the kind and quality of materials and equipment provided.
- 3.7 Unless otherwise provided, the Contractor shall pay all sales, consumer, use and other similar taxes, and shall secure and pay for required permits, fees, licenses, and inspections necessary for proper execution of the Work.
- 3.8 The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations, and lawful orders of public authorities bearing on performance of the Work. The Contractor shall promptly notify the Owner if the Drawings and Specifications are observed to be at variance therewith.
- 3.9 The Contractor shall be responsible to the Owner for the acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons performing portions of the Work under contract with the Contractor.
- 3.10 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work the Contractor shall remove from and about the Project all waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials. The Contractor shall be responsible for returning all damaged areas to their original conditions.
- 3.11 STATE LICENSE AND TAX REQUIREMENTS
- 3.11.1 Each Contractor and Subcontractor shall be licensed to do business in the State of Delaware and shall pay all fees and taxes due under State laws. In conformance with Section 2503, Chapter 25, Title 30, Delaware Code, "the Contractor shall furnish the Delaware Department of Finance within ten (10) days after entering into any contract with a contractor or subcontractor not a resident of this State, a statement of total value of such contract or contracts together with the names and addresses of the contracting parties."
- 3.12. The Contractor shall comply with all requirements set forth in Section 6962, Chapter 69, Title 29 of the Delaware Code.

ARTICLE 4: ADMINISTRATION OF THE CONTRACT

- 4.1 CONTRACT SURETY

4.1.1 PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND

4.1.2 All bonds will be required as follows unless specifically waived elsewhere in the Bidding Documents.

4.1.3 Contents of Performance Bonds – The bond shall be in the form approved by the Office of Management and Budget. The bond shall be conditioned upon the faithful compliance and performance by the successful bidder of each and every term and condition of the contract and the proposal, plans, specifications, and bid documents thereof. Each term and condition shall be met at the time and in the manner prescribed by the Contract, Bid documents and the specifications, including the payment in full to every person furnishing material or performing labor in the performance of the Contract, of all sums of money due the person for such labor and material. (The bond shall also contain the successful bidder's guarantee to indemnify and save harmless the State and the agency from all costs, damages and expenses growing out of or by reason of the Contract in accordance with the Contract.)

4.1.4 Invoking a Performance Bond – The agency may, when it considers that the interest of the State so require, cause judgement to be confessed upon the bond.

4.1.5 Within twenty (20) days after the date of notice of award of contract, the Bidder to whom the award is made shall furnish a Performance Bond and Labor and Material Payment Bond, each equal to the full amount of the Contract price to guarantee the faithful performance of all terms, covenants and conditions of the same. The bonds are to be issued by an acceptable Bonding Company licensed to do business in the State of Delaware and shall be issued in duplicate.

4.1.6 Performance and Payment Bonds shall be maintained in full force (warranty bond) for a period of two (2) years after the date of the Certificate for Final Payment. The Performance Bond shall guarantee the satisfactory completion of the Project and that the Contractor will make good any faults or defects in his work which may develop during the period of said guarantees as a result of improper or defective workmanship, material or apparatus, whether furnished by themselves or their Sub-Contractors. The Payment Bond shall guarantee that the Contractor shall pay in full all persons, firms or corporations who furnish labor or material or both labor and material for, or on account of, the work included herein. The bonds shall be paid for by this Contractor. The Owner shall have the right to demand that the proof parties signing the bonds are duly authorized to do so.

4.2 FAILURE TO COMPLY WITH CONTRACT

4.2.1 If any firm entering into a contract with the State, or Agency that neglects or refuses to perform or fails to comply with the terms thereof, the Agency which signed the Contract may terminate the Contract and proceed to award a new contract in accordance with this Chapter 69, Title 29 of the Delaware Code or may require the Surety on the Performance Bond to complete the Contract in accordance with the terms of the Performance Bond. Nothing herein shall preclude the Agency from pursuing additional remedies as otherwise provided by law.

4.3 CONTRACT INSURANCE AND CONTRACT LIABILITY

4.3.1 In addition to the bond requirements stated in the Bid Documents, each successful Bidder shall purchase adequate insurance for the performance of the Contract and, by submission of a Bid, agrees to indemnify and save harmless and to defend all legal or equitable actions brought against the State, any Agency, officer and/or employee of the

State, for and from all claims of liability which is or may be the result of the successful Bidder's actions during the performance of the Contract.

4.3.2 The purchase or nonpurchase of such insurance or the involvement of the successful Bidder in any legal or equitable defense of any action brought against the successful Bidder based upon work performed pursuant to the Contract will not waive any defense which the State, its agencies and their respective officers, employees and agents might otherwise have against such claims, specifically including the defense of sovereign immunity, where applicable, and by the terms of this section, the State and all agencies, officers and employees thereof shall not be financially responsible for the consequences of work performed, pursuant to said contract.

4.4 RIGHT TO AUDIT RECORDS

4.4.1 The Owner shall have the right to audit the books and records of a Contractor or any Subcontractor under any Contract or Subcontract to the extent that the books and records relate to the performance of the Contract or Subcontract.

4.4.2 Said books and records shall be maintained by the Contractor for a period of seven (7) years from the date of final payment under the Prime Contract and by the Subcontractor for a period of seven (7) years from the date of final payment under the Subcontract.

ARTICLE 5: SUBCONTRACTORS

5.1 SUBCONTRACTING REQUIREMENTS

5.1.1 All contracts for the construction, reconstruction, alteration or repair of any public building (not a road, street or highway) shall be subject to the following provisions:

1. A contract shall be awarded only to a Bidder whose Bid is accompanied by a statement containing, for each Subcontractor category, the name and address (city or town and State only – street number and P.O. Box addresses not required) of the subcontractor whose services the Bidder intends to use in performing the Work and providing the material for such Subcontractor category.
2. A Bid will not be accepted nor will an award of any Contract be made to any Bidder which, as the Prime Contractor, has listed itself as the Subcontractor for any Subcontractor unless:
 - A. It has been established to the satisfaction of the awarding Agency that the Bidder has customarily performed the specialty work of such Subcontractor category by artisans regularly employed by the Bidder's firm;
 - B. That the Bidder is duly licensed by the State to engage in such specialty work, if the State requires licenses; and
 - C. That the Bidder is recognized in the industry as a bona fide Subcontractor or Contractor in such specialty work and Subcontractor category.

5.1.2 The decision of the awarding Agency as to whether a Bidder who list itself as the Subcontractor for a Subcontractor category shall be final and binding upon all Bidders, and no action of any nature shall lie against any awarding agency or its employees or officers because of its decision in this regard.

- 5.1.3 After such a Contract has been awarded, the successful Bidder shall not substitute another Subcontractor for any Subcontractor whose name was set forth in the statement which accompanied the Bid without the written consent of the awarding Agency.
- 5.1.4 No Agency shall consent to any substitution of Subcontractors unless the Agency is satisfied that the Subcontractor whose name is on the Bidders accompanying statement:
- A. Is unqualified to perform the work required;
 - B. Has failed to execute a timely reasonable Subcontract;
 - C. Has defaulted in the performance on the portion of the work covered by the Subcontract; or
 - D. Is no longer engaged in such business.

5.2 PENALTY FOR SUBSTITUTION OF SUBCONTRACTORS

- 5.2.1 Should the Contractor fail to utilize any or all of the Subcontractors in the Contractor's Bid statement in the performance of the Work on the public bidding, the Contractor shall be penalized in the amount of (project specific amount*). The Agency may determine to deduct payments of the penalty from the Contractor or have the amount paid directly to the Agency. Any penalty amount assessed against the Contractor may be remitted or refunded, in whole or in part, by the Agency awarding the Contract, only if it is established to the satisfaction of the Agency that the Subcontractor in question has defaulted or is no longer engaged in such business. No claim for the remission or refund of any penalty shall be granted unless an application is filed within one year after the liability of the successful Bidder accrues. All penalty amounts assessed and not refunded or remitted to the contractor shall be reverted to the State.

*one (1) percent of contract amount not to exceed \$10,000

5.3 ASBESTOS ABATEMENT

- 5.3.1 The selection of any Contractor to perform asbestos abatement for State-funded projects shall be approved by the Office of Management and Budget, Division of Facilities Management pursuant to Chapter 78 of Title 16.

5.4 STANDARDS OF CONSTRUCTION FOR THE PROTECTION OF THE PHYSICALLY HANDICAPPED

- 5.4.1 All Contracts shall conform with the standard established by the Delaware Architectural Accessibility Board unless otherwise exempted by the Board.

5.5 CONTRACT PERFORMANCE

- 5.5.1 Any firm entering into a Public Works Contract that neglects or refuses to perform or fails to comply with its terms, the Agency may terminate the Contract and proceed to award a new Contract or may require the Surety on the Performance Bond to complete the Contract in accordance with the terms of the Performance Bond.

ARTICLE 6: CONSTRUCTION BY OWNER OR SEPARATE CONTRACTORS

6.1 The Owner reserves the right to simultaneously perform other construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other Projects at the same site.

6.2 The Contractor shall afford the Owner and other Contractors reasonable opportunity for access and storage of materials and equipment, and for the performance of their activities, and shall connect and coordinate their activities with other forces as required by the Contract Documents.

ARTICLE 7: CHANGES IN THE WORK

7.1 The Owner, without invalidating the Contract, may order changes in the Work consisting of Additions, Deletions, Modifications or Substitutions, with the Contract Sum and Contract completion date being adjusted accordingly. Such changes in the Work shall be authorized by written Change Order signed by the Professional, as the duly authorized agent, the Contractor and the Owner.

7.2 The Contract Sum and Contract Completion Date shall be adjusted only by a fully executed Change Order.

7.3 The additional cost, or credit to the Owner resulting from a change in the Work shall be by mutual agreement of the Owner, Contractor and the Architect. In all cases, this cost or credit shall be based on the 'DPE' wages required and the "invoice price" of the materials/equipment needed.

7.3.1 "DPE" shall be defined to mean "direct personnel expense". Direct payroll expense includes direct salary plus customary fringe benefits (prevailing wage rates) and documented statutory costs such as workman's compensation insurance, Social Security/Medicare, and unemployment insurance (a maximum multiplier of 1.35 times DPE).

7.3.2 "Invoice price" of materials/equipment shall be defined to mean the actual cost of materials and/or equipment that is paid by the Contractor, (or subcontractor), to a material distributor, direct factory vendor, store, material provider, or equipment leasing entity. Rates for equipment that is leased and/or owned by the Contractor or subcontractor(s) shall not exceed those listed in the latest version of the "Means Building Construction Cost Data" publication.

7.3.3 In addition to the above, the General Contractor is allowed a fifteen percent (15%) markup for overhead and profit for additional work performed by the General Contractor's own forces. For additional subcontractor work, the Subcontractor is allowed a fifteen (15) percent overhead and profit on change order work above and beyond the direct costs stated previously. To this amount, the General Contractor will be allowed a mark-up not exceeding seven and one half percent (7.5%) on the subcontractors work. These mark-ups shall include all costs including, but not limited to: overhead, profit, bonds, insurance, supervision, etc. No markup is permitted on the work of the subcontractors subcontractor. No additional costs shall be allowed for changes related to the Contractor's onsite superintendent/staff, or project manager, unless a change in the work changes the project duration and is identified by the CPM schedule. There will be no other costs associated with the change order.

ARTICLE 8: TIME

- 8.1 Time limits, if any, are as stated in the Project Manual. By executing the Agreement, the Contractor confirms that the stipulated limits are reasonable, and that the Work will be completed within the anticipated time frame.
- 8.2 If progress of the Work is delayed at any time by changes ordered by the Owner, by labor disputes, fire, unusual delay in deliveries, abnormal adverse weather conditions, unavoidable casualties or other causes beyond the Contractor's control, the Contract Time shall be extended for such reasonable time as the Owner may determine.
- 8.3 Any extension of time beyond the date fixed for completion of the construction and acceptance of any part of the Work called for by the Contract, or the occupancy of the building by the Owner, in whole or in part, previous to the completion shall not be deemed a waiver by the Owner of his right to annul or terminate the Contract for abandonment or delay in the matter provided for, nor relieve the Contractor of full responsibility.
- 8.4 SUSPENSION AND DEBARMENT
- 8.4.1 Per Section 6962(d)(14), Title 29, Delaware Code, "Any Contractor who fails to perform a public works contract or complete a public works project within the time schedule established by the Agency in the Invitation To Bid, may be subject to Suspension or Debarment for one or more of the following reasons: a) failure to supply the adequate labor supply ratio for the project; b) inadequate financial resources; or, c) poor performance on the Project."
- 8.4.2 "Upon such failure for any of the above stated reasons, the Agency that contracted for the public works project may petition the Director of the Office of Management and Budget for Suspension or Debarment of the Contractor. The Agency shall send a copy of the petition to the Contractor within three (3) working days of filing with the Director. If the Director concludes that the petition has merit, the Director shall schedule and hold a hearing to determine whether to suspend the Contractor, debar the Contractor or deny the petition. The Agency shall have the burden of proving, by a preponderance of the evidence, that the Contractor failed to perform or complete the public works project within the time schedule established by the Agency and failed to do so for one or more of the following reasons: a) failure to supply the adequate labor supply ratio for the project; b) inadequate financial resources; or, c) poor performance on the project. Upon a finding in favor of the Agency, the Director may suspend a Contractor from Bidding on any project funded, in whole or in part, with public funds for up to 1 year for a first offense, up to 3 years for a second offense and permanently debar the Contractor for a third offense. The Director shall issue a written decision and shall send a copy to the Contractor and the Agency. Such decision may be appealed to the Superior Court within thirty (30) days for a review on the record."
- 8.5 RETAINAGE
- 8.5.1 Per Section 6962(d)(5) a.3, Title 29, Delaware Code: The Agency may at the beginning of each public works project establish a time schedule for the completion of the project. If the project is delayed beyond the completion date due to the Contractor's failure to meet their responsibilities, the Agency may forfeit, at its discretion, all or part of the Contractor's retainage.
- 8.5.2 This forfeiture of retainage also applies to the timely completion of the punchlist. A punchlist will only be prepared upon the mutual agreement of the Owner, Architect and Contractor. Once the punchlist is prepared, all three parties will by mutual agreement, establish a schedule for its completion. Should completion of the punchlist be delayed beyond the established date due to the Contractor's failure to meet their responsibilities,

the Agency may hold permanently, at its discretion, all or part of the Contractor's retainage.

ARTICLE 9: PAYMENTS AND COMPLETION

9.1 APPLICATION FOR PAYMENT

9.1.1 Applications for payment shall be made upon AIA Document G702. There will be a five percent (5%) retainage on all Contractor's monthly invoices until completion of the project. This retainage may become payable upon receipt of all required closeout documentation, provided all other requirements of the Contract Documents have been met.

9.1.2 A date will be fixed for the taking of the monthly account of work done. Upon receipt of Contractor's itemized application for payment, such application will be audited, modified, if found necessary, and approved for the amount. Statement shall be submitted to the Owner.

9.1.3 Section 6516, Title 29 of the Delaware Code annualized interest is not to exceed 12% per annum beginning thirty (30) days after the "presentment" (as opposed to the date) of the invoice.

9.2 PARTIAL PAYMENTS

9.2.1 Any public works Contract executed by any Agency may provide for partial payments at the option of the Owner with respect to materials placed along or upon the sites or stored at secured locations, which are suitable for use in the performance of the contract.

9.2.2 When approved by the agency, partial payment may include the values of tested and acceptable materials of a nonperishable or noncontaminative nature which have been produced or furnished for incorporation as a permanent part of the work yet to be completed, provided acceptable provisions have been made for storage.

9.2.2.1 Any allowance made for materials on hand will not exceed the delivered cost of the materials as verified by invoices furnished by the Contractor, nor will it exceed the contract bid price for the material complete in place.

9.2.3 If requested by the Agency, receipted bills from all Contractors, Subcontractors, and material, men, etc., for the previous payment must accompany each application for payment. Following such a request, no payment will be made until these receipted bills have been received by the Owner.

9.3 SUBSTANTIAL COMPLETION

9.3.1 When the building has been made suitable for occupancy, but still requires small items of miscellaneous work, the Owner will determine the date when the project has been substantially completed.

9.3.2 If, after the Work has been substantially completed, full completion thereof is materially delayed through no fault of the Contractor, and without terminating the Contract, the Owner may make payment of the balance due for the portion of the Work fully completed and

accepted. Such payment shall be made under the terms and conditions governing final payment that it shall not constitute a waiver of claims.

- 9.3.3 On projects where commissioning is included, the commissioning work as defined in the specifications must be complete prior to the issuance of substantial completion.

9.4 FINAL PAYMENT

- 9.4.1 Final payment, including the five percent (5%) retainage if determined appropriate, shall be made within thirty (30) days after the Work is fully completed and the Contract fully performed and provided that the Contractor has submitted the following closeout documentation (in addition to any other documentation required elsewhere in the Contract Documents):

- 9.4.1.1 Evidence satisfactory to the Owner that all payrolls, material bills, and other indebtedness connected with the work have been paid,

- 9.4.1.2 An acceptable RELEASE OF LIENS,

- 9.4.1.3 Copies of all applicable warranties,

- 9.4.1.4 As-built drawings,

- 9.4.1.5 Operations and Maintenance Manuals,

- 9.4.1.6 Instruction Manuals,

- 9.4.1.7 Consent of Surety to final payment.

- 9.4.1.8 The Owner reserves the right to retain payments, or parts thereof, for its protection until the foregoing conditions have been complied with, defective work corrected and all unsatisfactory conditions remedied.

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

- 10.1 The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract. The Contractor shall take all reasonable precautions to prevent damage, injury or loss to: workers, persons nearby who may be affected, the Work, materials and equipment to be incorporated, and existing property at the site or adjacent thereto. The Contractor shall give notices and comply with applicable laws ordinances, rules regulations, and lawful orders of public authorities bearing on the safety of persons and property and their protection from injury, damage, or loss. The Contractor shall promptly remedy damage and loss to property at the site caused in whole or in part by the Contractor, a Subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable.

- 10.2 The Contractor shall notify the Owner in the event any existing hazardous material such as lead, PCBs, asbestos, etc. is encountered on the project. The Owner will arrange with a qualified specialist for the identification, testing, removal, handling and protection against exposure or environmental pollution, to comply with applicable regulation laws and ordinances. The Contractor and Architect will not be required to participate in or to perform

this operation. Upon completion of this work, the Owner will notify the Contractor and Architect in writing the area has been cleared and approved by the authorities in order for the work to proceed. The Contractor shall attach documentation from the authorities of said approval.

- 10.3 As required in the Hazardous Chemical Information Act of June 1984, all vendors supplying any materials that may be defined as hazardous, must provide Material Safety Data Sheets for those products. Any chemical product should be considered hazardous if it has a warning caution on the label relating to a potential physical or health hazard, if it is known to be present in the work place, and if employees may be exposed under normal conditions or in any foreseeable emergency situation. Material Safety Data Sheets must be provided directly to the Owner along with the shipping slips that include those products.
- 10.4 The Contractor shall certify to the Owner that materials incorporated into the Work are free of all asbestos. This certification may be in the form of Material Safety Data Sheet (MSDS) provided by the product manufacturer for the materials used in construction, as specified or as provided by the Contractor.

ARTICLE 11: INSURANCE AND BONDS

- 11.1 The Contractor shall carry all insurance required by law, such as Unemployment Insurance, etc. The Contractor shall carry such insurance coverage as they desire on their own property such as a field office, storage sheds or other structures erected upon the project site that belong to them and for their own use. The Subcontractors involved with this project shall carry whatever insurance protection they consider necessary to cover the loss of any of their personal property, etc.
- 11.2 Upon being awarded the Contract, the Contractor shall obtain a minimum of two (2) copies of all required insurance certificates called for herein, and submit one (1) copy of each certificate, to the Owner, within 20 days of contract award.
- 11.3 Bodily Injury Liability and Property Damage Liability Insurance shall, in addition to the coverage included herein, include coverage for injury to or destruction of any property arising out of the collapse of or structural injury to any building or structure due to demolition work and evidence of these coverages shall be filed with and approved by the Owner.
- 11.4 The Contractor's Property Damage Liability Insurance shall, in addition to the coverage noted herein, include coverage on all real and personal property in their care, custody and control damaged in any way by the Contractor or their Subcontractors during the entire construction period on this project.
- 11.5 Builders Risk (including Standard Extended Coverage Insurance) on the existing building during the entire construction period, shall not be provided by the Contractor under this contract. The Owner shall insure the existing building and all of its contents and all this new alteration work under this contract during entire construction period for the full insurable value of the entire work at the site. Note, however, that the Contractor and their Subcontractors shall be responsible for insuring building materials (installed and stored) and their tools and equipment whenever in use on the project, against fire damage, theft, vandalism, etc.
- 11.6 Certificates of the insurance company or companies stating the amount and type of coverage, terms of policies, etc., shall be furnished to the Owner, within 20 days of contract award.
- 11.7 The Contractor shall, at their own expense, (in addition to the above) carry the following forms of insurance:

11.7.1 Contractor's Contractual Liability Insurance

Minimum coverage to be:

Bodily Injury	\$ 500,000	for each person
	\$1,000,000	for each occurrence
	\$1,000,000	aggregate
Property Damage	\$ 500,000	for each occurrence
	\$1,000,000	aggregate

11.7.2 Contractor's Protective Liability Insurance

Minimum coverage to be:

Bodily Injury	\$ 500,000	for each person
	\$1,000,000	for each occurrence
	\$1,000,000	aggregate
Property Damage	\$ 500,000	for each occurrence
	\$500,000	aggregate

11.7.3 Automobile Liability Insurance

Minimum coverage to be:

Bodily Injury	\$1,000,000	for each person
	\$1,000,000	for each occurrence
Property Damage	\$ 500,000	per accident

11.7.4 Prime Contractor's and Subcontractors' policies shall include contingent and contractual liability coverage in the same minimum amounts as 11.7.1 above.

11.7.5 Workmen's Compensation (including Employer's Liability):

11.7.5.1 Minimum Limit on employer's liability to be as required by law.

11.7.5.2 Minimum Limit for all employees working at one site.

11.7.6 Certificates of Insurance must be filed with the Owner guaranteeing fifteen (15) days prior notice of cancellation, non-renewal, or any change in coverages and limits of liability shown as included on certificates.

11.7.7 Social Security Liability

- 11.7.7.1 With respect to all persons at any time employed by or on the payroll of the Contractor or performing any work for or on their behalf, or in connection with or arising out of the Contractor's business, the Contractor shall accept full and exclusive liability for the payment of any and all contributions or taxes or unemployment insurance, or old age retirement benefits, pensions or annuities now or hereafter imposed by the Government of the United States and the State or political subdivision thereof, whether the same be measured by wages, salaries or other remuneration paid to such persons or otherwise.
- 11.7.7.2 Upon request, the Contractor shall furnish Owner such information on payrolls or employment records as may be necessary to enable it to fully comply with the law imposing the aforesaid contributions or taxes.
- 11.7.7.3 If the Owner is required by law to and does pay any and/or all of the aforesaid contributions or taxes, the Contractor shall forthwith reimburse the Owner for the entire amount so paid by the Owner.

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

- 12.1 The Contractor shall promptly correct Work rejected by the Owner or failing to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed or completed, and shall correct any Work found to be not in accordance with the requirements of the Contract Documents within a period of one year from the date of Substantial Completion, or by terms of an applicable special warranty required by the Contract Documents. The provisions of this Article apply to work done by Subcontractors as well as to Work done by direct employees of the Contractor.
- 12.2 At any time during the progress of the work, or in any case where the nature of the defects shall be such that it is not expedient to have them corrected, the Owner, at their option, shall have the right to deduct such sum, or sums, of money from the amount of the contract as they consider justified to adjust the difference in value between the defective work and that required under contract including any damage to the structure.

ARTICLE 13: MISCELLANEOUS PROVISIONS

- 13.1 CUTTING AND PATCHING
- 13.1.1 The Contractor shall be responsible for all cutting and patching. The Contractor shall coordinate the work of the various trades involved.
- 13.2 DIMENSIONS
- 13.2.1 All dimensions shown shall be verified by the Contractor by actual measurements at the project site. Any discrepancies between the drawings and specifications and the existing conditions shall be referred to the Owner for adjustment before any work affected thereby has been performed.
- 13.3 LABORATORY TESTS
- 13.3.1 Any specified laboratory tests of material and finished articles to be incorporated in the work shall be made by bureaus, laboratories or agencies approved by the Owner and reports of such tests shall be submitted to the Owner. The cost of the testing shall be paid for by the Contractor.
- 13.3.2 The Contractor shall furnish all sample materials required for these tests and shall deliver same without charge to the testing laboratory or other designated agency when and where directed by the Owner.

13.4 ARCHAEOLOGICAL EVIDENCE

13.4.1 Whenever, in the course of construction, any archaeological evidence is encountered on the surface or below the surface of the ground, the Contractor shall notify the authorities of the Delaware Archaeological Board and suspend work in the immediate area for a reasonable time to permit those authorities, or persons designated by them, to examine the area and ensure the proper removal of the archaeological evidence for suitable preservation in the State Museum.

13.5 GLASS REPLACEMENT AND CLEANING

13.5.1 The General Contractor shall replace without expense to the Owner all glass broken during the construction of the project. If job conditions warrant, at completion of the job the General Contractor shall have all glass cleaned and polished.

13.6 WARRANTY

13.6.1 For a period of two (2) years from the date of substantial completion, as evidenced by the date of final acceptance of the work, the contractor warrants that work performed under this contract conforms to the contract requirements and is free of any defect of equipment, material or workmanship performed by the contractor or any of his subcontractors or suppliers. However, manufacturer's warranties and guarantees, if for a period longer than two (2) years, shall take precedence over the above warranties. The contractor shall remedy, at his own expense, any such failure to conform or any such defect. The protection of this warranty shall be included in the Contractor's Performance Bond.

13.7 REPORTING

Contractor who is awarded contract must report contract amounts awarded to all listed subcontractors. All contractors must identify if they are considered a minority or women owned business, and, if so, are they registered with the State of Delaware, Office of Minority and Women Owned Business Enterprise.

13.8 BUY AMERICAN ACT

Section 810 of Article VIII (included elsewhere in this Project Manual) requires compliance with the Buy American Act (41 U.S.C. 10.) The Buy American Act gives preference to domestic end products and domestic construction material. To verify compliance with this Section, Contractor is required to provide proof, acceptable to the Owner, that all major equipment and material installed on the project was manufactured in the United States.

ARTICLE 14: TERMINATION OF CONTRACT

14.1 If the Contractor defaults or persistently fails or neglects to carry out the Work in accordance with the Contract Documents or fails to perform a provision of the Contract, the Owner, after seven days written notice to the Contractor, may make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due the Contractor. Alternatively, at the Owner's option, and the Owner may terminate the Contract and take possession of the site and of all materials, equipment, tools, and machinery thereon owned by the Contractor and may finish the Work by whatever method the Owner may deem expedient. If the costs of finishing the Work exceed any unpaid compensation due the Contractor, the Contractor shall pay the difference to the Owner.

- 14.2 "If the continuation of this Agreement is contingent upon the appropriation of adequate state, or federal funds, this Agreement may be terminated on the date beginning on the first fiscal year for which funds are not appropriated or at the exhaustion of the appropriation. The Owner may terminate this Agreement by providing written notice to the parties of such non-appropriation. All payment obligations of the Owner will cease upon the date of termination. Notwithstanding the foregoing, the Owner agrees that it will use its best efforts to obtain approval of necessary funds to continue the Agreement by taking appropriate action to request adequate funds to continue the Agreement."

END OF GENERAL REQUIREMENTS

STANDARD
GENERAL CONDITIONS
OF THE
CONSTRUCTION CONTRACT

The General Conditions of this Contract are as stated in the American Institute of Architects Document AIA A201 (2007 Edition) titled General Conditions of the Contract for Construction and is part of this project manual as if herein written in full.

Copies of the Document are available through the Owner.

DRAFT AIA® Document A101™ - 2007

Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

AGREEMENT made as of the « » day of « » in the year « »
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address and other information)

«»«»Delaware Army National Guard
«»«»First Regiment Road
«»«»Wilmington, DE 19808-2191
« »

and the Contractor:
(Name, legal status, address and other information)

« »« »
« »
« »
« »

for the following Project:
(Name, location and detailed description)

«Regional Training Institute-Phase 1»
«Bethany Beach, DE
»
« »

The Architect:
(Name, legal status, address and other information)

« »« »
« »
« »
« »

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS:
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

AIA Document A201™-2007, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

ELECTRONIC COPYING of any portion of this AIA® Document to another electronic file is prohibited and constitutes a violation of copyright laws as set forth in the footer of this document.

TABLE OF ARTICLES

- 1 THE CONTRACT DOCUMENTS
- 2 THE WORK OF THIS CONTRACT
- 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION
- 4 CONTRACT SUM
- 5 PAYMENTS
- 6 DISPUTE RESOLUTION
- 7 TERMINATION OR SUSPENSION
- 8 MISCELLANEOUS PROVISIONS
- 9 ENUMERATION OF CONTRACT DOCUMENTS
- 10 INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be the date of this Agreement unless a different date is stated below or provision is made for the date to be fixed in a notice to proceed issued by the Owner.

(Insert the date of commencement if it differs from the date of this Agreement or, if applicable, state that the date will be fixed in a notice to proceed.)

« »

If, prior to the commencement of the Work, the Owner requires time to file mortgages and other security interests, the Owner's time requirement shall be as follows:

« »

§ 3.2 The Contract Time shall be measured from the date of commencement.

§ 3.3 The Contractor shall achieve Substantial Completion of the entire Work not later than « » (« ») days from the date of commencement, or as follows:

(Insert number of calendar days. Alternatively, a calendar date may be used when coordinated with the date of commencement. If appropriate, insert requirements for earlier Substantial Completion of certain portions of the Work.)

« »

Portion of Work

Substantial Completion Date

, subject to adjustments of this Contract Time as provided in the Contract Documents.

(Insert provisions, if any, for liquidated damages relating to failure to achieve Substantial Completion on time or for bonus payments for early completion of the Work.)

« »

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be « » (\$ « »), subject to additions and deductions as provided in the Contract Documents.

§ 4.2 The Contract Sum is based upon the following alternates, if any, which are described in the Contract Documents and are hereby accepted by the Owner:

(State the numbers or other identification of accepted alternates. If the bidding or proposal documents permit the Owner to accept other alternates subsequent to the execution of this Agreement, attach a schedule of such other alternates showing the amount for each and the date when that amount expires.)

« »

§ 4.3 Unit prices, if any:

(Identify and state the unit price; state quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price Per Unit (\$0.00)

§ 4.4 Allowances included in the Contract Sum, if any:

(Identify allowance and state exclusions, if any, from the allowance price.)

Item	Price

ARTICLE 5 PAYMENTS

§ 5.1 PROGRESS PAYMENTS

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

« »

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the « » day of a month, the Owner shall make payment of the certified amount to the Contractor not later than the « » day of the « » month. If an Application for Payment is received by the Architect after the application date fixed above, payment shall be made by the Owner not later than « » (« ») days after the Architect receives the Application for Payment. *(Federal, state or local laws may require payment within a certain period of time.)*

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form and supported by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 Subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

- .1 Take that portion of the Contract Sum properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the Contract Sum allocated to that portion of the Work in the schedule of values, less retainage of « » percent (« » %). Pending final determination of cost to the Owner of changes in the Work, amounts not in dispute shall be included as provided in Section 7.3.9 of AIA Document A201™–2007, General Conditions of the Contract for Construction;
- .2 Add that portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction (or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing), less retainage of « » percent (« » %);
- .3 Subtract the aggregate of previous payments made by the Owner; and
- .4 Subtract amounts, if any, for which the Architect has withheld or nullified a Certificate for Payment as provided in Section 9.5 of AIA Document A201–2007.

§ 5.1.7 The progress payment amount determined in accordance with Section 5.1.6 shall be further modified under the following circumstances:

- .1 Add, upon Substantial Completion of the Work, a sum sufficient to increase the total payments to the full amount of the Contract Sum, less such amounts as the Architect shall determine for incomplete Work, retainage applicable to such work and unsettled claims; and
(Section 9.8.5 of AIA Document A201–2007 requires release of applicable retainage upon Substantial Completion of Work with consent of surety, if any.)
- .2 Add, if final completion of the Work is thereafter materially delayed through no fault of the Contractor, any additional amounts payable in accordance with Section 9.10.3 of AIA Document A201–2007.

§ 5.1.8 Reduction or limitation of retainage, if any, shall be as follows:

(If it is intended, prior to Substantial Completion of the entire Work, to reduce or limit the retainage resulting from the percentages inserted in Sections 5.1.6.1 and 5.1.6.2 above, and this is not explained elsewhere in the Contract Documents, insert here provisions for such reduction or limitation.)

« »

§ 5.1.9 Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.2 FINAL PAYMENT

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

- .1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Section 12.2.2 of AIA Document A201–2007, and to satisfy other requirements, if any, which extend beyond final payment; and
- .2 a final Certificate for Payment has been issued by the Architect.

§ 5.2.2 The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect's final Certificate for Payment, or as follows:

« »

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 INITIAL DECISION MAKER

The Architect will serve as Initial Decision Maker pursuant to Section 15.2 of AIA Document A201–2007, unless the parties appoint below another individual, not a party to this Agreement, to serve as Initial Decision Maker. *(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)*

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§ 6.2 BINDING DISPUTE RESOLUTION

For any Claim subject to, but not resolved by, mediation pursuant to Section 15.3 of AIA Document A201–2007, the method of binding dispute resolution shall be as follows: *(Check the appropriate box. If the Owner and Contractor do not select a method of binding dispute resolution below, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.)*

- Arbitration pursuant to Section 15.4 of AIA Document A201–2007
 - Litigation in a court of competent jurisdiction
 - Other *(Specify)*
- << >>

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2007.

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2007.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2007 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

(Insert rate of interest agreed upon, if any.)

<< >> % << >>

§ 8.3 The Owner’s representative:
(Name, address and other information)

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§ 8.4 The Contractor’s representative:
(Name, address and other information)

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§ 8.5 Neither the Owner's nor the Contractor's representative shall be changed without ten days written notice to the other party.

§ 8.6 Other provisions:

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ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 The Contract Documents, except for Modifications issued after execution of this Agreement, are enumerated in the sections below.

§ 9.1.1 The Agreement is this executed AIA Document A101-2007, Standard Form of Agreement Between Owner and Contractor.

§ 9.1.2 The General Conditions are AIA Document A201-2007, General Conditions of the Contract for Construction.

§ 9.1.3 The Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

§ 9.1.4 The Specifications:

(Either list the Specifications here or refer to an exhibit attached to this Agreement.)

<< >>

Section	Title	Date	Pages

§ 9.1.5 The Drawings:

(Either list the Drawings here or refer to an exhibit attached to this Agreement.)

<< >>

Number	Title	Date

§ 9.1.6 The Addenda, if any:

Number	Date	Pages

Portions of Addenda relating to bidding requirements are not part of the Contract Documents unless the bidding requirements are also enumerated in this Article 9.

§ 9.1.7 Additional documents, if any, forming part of the Contract Documents:

- .1 AIA Document E201™-2007, Digital Data Protocol Exhibit, if completed by the parties, or the following:

<< >>

- 2 Other documents, if any, listed below:
(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201–2007 provides that bidding requirements such as advertisement or invitation to bid, Instructions to Bidders, sample forms and the Contractor’s bid are not part of the Contract Documents unless enumerated in this Agreement. They should be listed here only if intended to be part of the Contract Documents.)

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ARTICLE 10 INSURANCE AND BONDS

The Contractor shall purchase and maintain insurance and provide bonds as set forth in Article 11 of AIA Document A201–2007.

(State bonding requirements, if any, and limits of liability for insurance required in Article 11 of AIA Document A201–2007.)

Type of insurance or bond	Limit of liability or bond amount (\$0.00)

This Agreement entered into as of the day and year first written above.

OWNER (Signature)

<< >><< >>

(Printed name and title)

CONTRACTOR (Signature)

<< >><< >>

(Printed name and title)

SUPPLEMENTARY GENERAL CONDITIONS A201-2007

The following supplements modify the "General Conditions of the Contract for Construction," AIA Document A201-2007. Where a portion of the General Conditions is modified or deleted by the Supplementary Conditions, the unaltered portions of the General Conditions shall remain in effect.

TABLE OF ARTICLES

1. GENERAL PROVISIONS
2. OWNER
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ARTICLE 1: GENERAL PROVISIONS

1.1 BASIC DEFINITIONS

1.1.1 THE CONTRACT DOCUMENTS

Delete the last sentence in its entirety and replace with the following:

“The Contract Documents also include Advertisement for Bid, Instructions to Bidder, sample forms, the Bid Form, the Contractor’s completed Bid and the Award Letter.”

Add the following Paragraph:

1.1.2 In the event of conflict or discrepancies among the Contract Documents, the Documents prepared by the State of Delaware, Delaware Army National Guard, shall take precedence over all other documents.

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

Add the following Paragraphs:

1.2.4 In the case of an inconsistency between the Drawings and the Specifications, or within either document not clarified by addendum, the better quality or greater quantity of work shall be provided in accordance with the Architect’s interpretation.

1.2.5 The word “PROVIDE” as used in the Contract Documents shall mean “FURNISH AND INSTALL” and shall include, without limitation, all labor, materials, equipment, transportation, services and other items required to complete the Work.

1.2.6 The word “PRODUCT” as used in the Contract Documents means all materials, systems and equipment.

1.5 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS OF SERVICE

Delete Paragraph 1.5.1 in its entirety and replace with the following:

“All pre-design studies, drawings, specifications and other documents, including those in electronic form, prepared by the Architect under this Agreement are, and shall remain, the property of the Owner whether the Project for which they are made is executed or not. Such documents may be used by the Owner to construct one or more like Projects without the approval of, or additional compensation to, the Architect. The Contractor, Subcontractors, Sub-subcontractors and Material or Equipment Suppliers are authorized to use and reproduce applicable portions of the Drawings, Specifications and other documents prepared by the Architect and the Architect’s consultants appropriate to and for use in the execution of their Work under the Contract Documents. They are not to be used by the Contractor or any Subcontractor, Sub-subcontractor or Material and Equipment Supplier on other Projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and Architect’s consultants.

The Architect shall not be liable for injury or damage resulting from the re-use of drawings and specifications if the Architect is not involved in the re-use Project. Prior to re-use of construction documents for a Project in which the Architect is not also involved, the Owner will remove from such documents all identification of the original Architect, including name, address and professional seal or stamp.”

Delete Paragraph 1.5.2 in its entirety.

ARTICLE 2: OWNER

2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

To Subparagraph 2.2.3 – Add the following sentence:

“The Contractor, at their expense shall bear the costs to accurately identify the location of all underground utilities in the area of their excavation and shall bear all cost for any repairs required, out of failure to accurately identify said utilities.”

Delete Subparagraph 2.2.5 in its entirety and substitute the following:

2.2.5 The Contractor shall be furnished free of charge up to five (5) sets of the Drawings and Project Manuals. Additional sets will be furnished at the cost of reproduction, postage and handling.

ARTICLE 3: CONTRACTOR

3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

Amend Paragraph 3.2.2 to state that any errors, inconsistencies or omissions discovered shall be reported to the Architect and Owner immediately.

Delete the third sentence in Paragraph 3.2.3.

3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

Add the following Paragraphs:

3.3.2.1 The Contractor shall immediately remove from the Work, whenever requested to do so by the Owner, any person who is considered by the Owner or Architect to be incompetent or disposed to be so disorderly, or who for any reason is not satisfactory to the Owner, and that person shall not again be employed on the Work without the consent of the Owner or the Architect.

3.3.4 The Contractor must provide suitable storage facilities at the Site for the proper protection and safe storage of their materials. Consult the Owner and the Architect before storing any materials.

3.3.5 When any room is used as a shop, storeroom, office, etc., by the Contractor or Subcontractor(s) during the construction of the Work, the Contractor making use of these areas will be held responsible for any repairs, patching or cleaning arising from such use.

3.4 LABOR AND MATERIALS

Add the Following Paragraphs:

3.4.4 Before starting the Work, each Contractor shall carefully examine all preparatory Work that has been executed to receive their Work. Check carefully, by whatever means are required, to insure that its Work and adjacent, related Work, will finish to proper contours, planes and levels. Promptly notify the General Contractor/Construction Manager of any defects or imperfections in preparatory Work which will in any way affect satisfactory completion of its Work. Absence of such notification will be construed as an acceptance of preparatory Work and later claims of defects will not be recognized.

3.4.5 Under no circumstances shall the Contractor's Work proceed prior to preparatory Work having been completely cured, dried and/or otherwise made satisfactory to receive this Work. Responsibility for timely installation of all materials rests solely with the Contractor responsible for that Work, who shall maintain coordination at all times.

3.5 WARRANTY

Add the following Paragraphs:

3.5.1 The Contractor will guarantee all materials and workmanship against original defects, except injury from proper and usual wear when used for the purpose intended, for two years after Acceptance by the Owner, and will maintain all items in perfect condition during the period of guarantee.

3.5.2 Defects appearing during the period of guarantee will be made good by the Contractor at his expense upon demand of the Owner, it being required that all work will be in perfect condition when the period of guarantee will have elapsed.

3.5.3 In addition to the General Guarantee there are other guarantees required for certain items for different periods of time than the two years as above, and are particularly so stated in that part of the specifications referring to same. The said guarantees will commence at the same time as the General Guarantee.

3.5.4 If the Contractor fails to remedy any failure, defect or damage within a reasonable time after receipt of notice, the Owner will have the right to replace, repair, or otherwise remedy the failure, defect or damage at the Contractor's expense.

3.11 DOCUMENTS AND SAMPLES AT THE SITE

Add the following Paragraphs:

3.11.1 During the course of the Work, the Contractor shall maintain a record set of drawings on which the Contractor shall mark the actual physical location of all piping, valves, equipment, conduit, outlets, access panels, controls, actuators, including all appurtenances that will be concealed once construction is complete, etc., including all invert elevations.

3.11.2 At the completion of the project, the Contractor shall obtain a set of reproducible drawings from the Architect, and neatly transfer all information outlined in 3.11.1 to provide a complete record of the as-built conditions.

3.11.3 The Contractor shall provide two (2) prints of the as-built conditions, along with the reproducible drawings themselves, to the Owner and one (1) set to the Architect. In addition, attach one complete set to each of the Operating and Maintenance Instructions/Manuals.

3.17 In the first sentence of the paragraph, insert "indemnify" between "shall" and "hold".

ARTICLE 4: ADMINISTRATION OF THE CONTRACT

4.2 ADMINISTRATION OF THE CONTRACT

Delete the first sentence of Paragraph 4.2.7 and replace with the following:

The Architect will review and approve or take other appropriate action upon the Contractor's submittals such as Shop Drawings, Product Data and Samples for the purpose of checking for conformance with the Contract Documents.

Delete the second sentence of Paragraph 4.2.7 and replace with the following:

The Architect's action will be taken with such reasonable promptness as to cause no delay in the Work in the activities of the Owner, Contractor or separate Contractors, while allowing sufficient time in the Owner's professional judgment to permit adequate review.

Add the following Paragraph:

4.2.10.1 There will be no full-time project representative provided by the Owner or Architect on this project.

Add to Paragraph 4.2.13 "and in compliance with all local requirements." to the end of the sentence

ARTICLE 5: SUBCONTRACTORS

5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

Delete Paragraph 5.2.3 in its entirety and replace with the following:

5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection, subject to the statutory requirements of 29 Delaware Code § 6962(d)(10)b.3 and 4.

ARTICLE 6: CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

6.1 OWNER'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

Delete Paragraph 6.1.4 in its entirety.

6.2 MUTUAL RESPONSIBILITY

6.2.3 In the second sentence, strike the word "shall" and insert the word "may".

ARTICLE 7: CHANGES IN THE WORK

(SEE ARTICLE 7: CHANGES IN WORK IN THE GENERAL REQUIREMENTS)

ARTICLE 8: TIME

8.2 PROGRESS AND COMPLETION

Add the following Paragraphs:

8.2.1.1 Refer to Specification Section SUMMARY OF WORK for Contract time requirements.

8.2.4 If the Work falls behind the Progress Schedule as submitted by the Contractor, the Contractor shall employ additional labor and/or equipment necessary to bring the Work into compliance with the Progress Schedule at no additional cost to the Owner.

8.3 DELAYS AND EXTENSION OF TIME

8.3.1 Strike "arbitration" and insert "remedies at law or in equity".

Add the following Paragraph:

8.3.2.1 The Contractor shall update the status of the suspension, delay, or interruption of the Work with each Application for Payment. (The Contractor shall report the termination of such cause immediately upon the termination thereof.) Failure to comply with this procedure shall constitute a waiver for any claim for adjustment of time or price based upon said cause.

Delete Paragraph 8.3.3 in its entirety and replace with the following:

8.3.3 Except in the case of a suspension of the Work directed by the Owner, an extension of time under the provisions of Paragraph 8.3.1 shall be the Contractor's sole remedy in the progress of the Work and there shall be no payment or compensation to the Contractor for any expense or damage resulting from the delay.

Add the following Paragraph:

8.3.4 By permitting the Contractor to work after the expired time for completion of the project, the Owner does not waive their rights under the Contract.

ARTICLE 9: PAYMENTS AND COMPLETION

9.2 SCHEDULE OF VALUES

Add the following Paragraphs:

9.2.1 The Schedule of Values shall be submitted using AIA Document G702, Continuation Sheet to G703.

- 9.2.2 The Schedule of Values is to include a line item for Project Closeout Document Submittal. The value of this item is to be no less than 1% of the initial contract amount.

9.3 APPLICATIONS FOR PAYMENT

Add the following Paragraph:

- 9.3.1.3 Application for Payment shall be submitted on AIA Document G702 "Application and Certificate for Payment", supported by AIA Document G703 "Continuation Sheet". Said Applications shall be fully executed and notarized.

Add the following Paragraphs:

- 9.3.4 Until Closeout Documents have been received and outstanding items completed the Owner will pay 95% (ninety-five percent) of the amount due the Contractor on account of progress payments.
- 9.3.5 The Contractor shall provide a current and updated Progress Schedule to the Architect with each Application for Payment. Failure to provide Schedule will be just cause for rejection of Application for Payment.

9.5 DECISIONS TO WITHHOLD CERTIFICATION

Add the following to 9.5.1:

- .8 failure to provide a current Progress Schedule;
- .9 a lien or attachment is filed;
- .10 failure to comply with mandatory requirements for maintaining Record Documents.

9.6 PROGRESS PAYMENTS

Delete Paragraph 9.6.1 in its entirety and replace with the following:

- 9.6.1 After the Architect has approved and issued a Certificate for Payment, payment shall be made by the Owner within 30 days after Owner's receipt of the Certificate for Payment.

9.7 FAILURE OF PAYMENT

In first sentence, strike "seven" and insert "thirty (30)". Also strike "binding dispute resolution" and insert "remedies at law or in equity".

9.8 SUBSTANTIAL COMPLETION

To Subparagraph 9.8.3- Add the following sentence:

"If the Architect is required to make more than 2 inspections of the same portion of work, the Contractor shall be responsible for all costs associated with subsequent inspections including but not limited to any Architect's fees."

- 9.8.5 In the second sentence, strike "shall" and insert "may".

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

10.1 SAFETY PRECAUTIONS AND PROGRAMS

Add the following Paragraphs:

10.1.1.1.1 Each Contractor shall develop a safety program in accordance with the Occupational Safety and Health Act of 1970. A copy of said plan shall be furnished to the Owner and Architect prior to the commencement of that Contractor's Work.

10.1.2 Each Contractor shall appoint a Safety Representative. Safety Representatives shall be someone who is on site on a full time basis. If deemed necessary by the Owner or Architect, Contractor Safety meetings will be scheduled. The attendance of all Safety Representatives will be required. Minutes will be recorded of said meetings by the Contractor and will be distributed to all parties as well as posted in all job offices/trailers etc.

10.2 SAFETY OF PERSONS AND PROPERTY

Add the following Paragraph:

10.2.4.1 As required in the Hazardous Chemical Act of June 1984, all vendors supplying any material that may be defined as hazardous must provide Material Safety Data Sheets for those products. Any chemical product should be considered hazardous if it has a caution warning on the label relating to a potential physical or health hazard, if it is known to be present in the work place, and if employees may be exposed under normal conditions or in foreseeable emergency situations. Material Safety Data Sheets shall be provided directly to the Owner, along with the shipping slips that include those products.

10.3 HAZARDOUS MATERIALS

Delete Paragraph 10.3.3 in its entirety.

10.5 Delete Paragraphs 10.3.6 in its entirety.

ARTICLE 11: INSURANCE AND BONDS

11.1 CONTRACTOR'S LIABILITY INSURANCE

11.1.4 Strike "the Owner" immediately following "(1)" and strike "and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's completed operations."

11.2 OWNER'S LIABILITY INSURANCE

Delete Paragraph 11.2 in its entirety.

11.3 PROPERTY INSURANCE

Delete Paragraph 11.3 in its entirety and replace with the following:

11.3 The State will not provide Builder's All Risk Insurance for the Project. The Contractor and all Subcontractors shall provide property coverage for their tools and equipment, as necessary. Any mandatory deductible required by the Contractor's Insurance shall be the responsibility of the Contractor.

11.4 PERFORMANCE BOND AND PAYMENT BOND

Add the following sentence: "The bonds will conform to those forms approved by the Office of Management and Budget."

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

12.2.2 AFTER SUBSTANTIAL COMPLETION

Add the following Paragraph:

12.2.2.1.1 At any time during the progress of the Work, or in any case where the nature of the defects will be such that it is not expedient to have corrected, the Owner, at its option, will have the right to deduct such sum, or sums, of money from the amount of the Contract as it considers justified to adjust the difference in value between the defective work and that required under contract including any damage to the structure.

12.2.2.1 Strike "one" and insert "two".

12.2.2.2 Strike "one" and insert "two".

12.2.2.3 Strike "one" and insert "two".

12.2.5 In second sentence, strike "one" and insert "two".

ARTICLE 13: MISCELLANEOUS PROVISIONS

13.1 GOVERNING LAW

Strike "except that, if the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4."

13.6 INTEREST

Strike "the date payment is due at such rate as the parties may agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located." Insert "30 days of presentment of the authorized Certificate of Payment at the annual rate of 12% or 1% per month.

13.7 TIME LIMITS ON CLAIMS

Strike the last sentence.

Add the following Paragraph:

13.8 CONFLICTS WITH FEDERAL STATUTES OR REGULATIONS

- 13.8.1 If any provision, specifications or requirement of the Contract Documents conflict or is inconsistent with any statute, law or regulation of the government of the United State of America, the Contractor shall notify the Architect and Owner immediately upon discovery.

ARTICLE 14: TERMINATION OR SUSPENSION OF THE CONTRACT

14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

Delete Paragraph 14.4.3 in its entirety and replace with the following:

- 14.4.3 In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment for Work executed, and cost incurred by reason of such termination along with reasonable overhead.

ARTICLE 15: CLAIMS AND DISPUTES

- 15.1.2 Throughout the Paragraph strike "21" and insert "45".

15.1.6 CLAIMS FOR CONSEQUENTIAL DAMAGES

Delete Paragraph 15.1.6 in its entirety.

15.2 INITIAL DECISION

Delete Paragraph 15.2.5 in its entirety and replace with the following:

- 15.2.5 The Architect will approve or reject Claims by written decision, which shall state the reasons therefore and shall notify the parties of any change in the Contract Sum or Contract Time or both. The approval or rejection of a Claim by the Architect shall be subject to mediation and other remedies at law or in equity.

Delete Paragraph 15.2.6 and its subparagraphs in their entirety.

15.3 MEDIATION

- 15.3.1 Strike "binding dispute resolution" and insert "any or all remedies at law or in equity".

- 15.3.2 In the first sentence, delete "administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedure in effect on the date of the Agreement," Strike "binding dispute resolution" and insert "remedies at law and in equity".

15.4 ARBITRATION

Delete Paragraph 15.4 and its sub-sections in its entirety.

END OF SUPPLEMENTARY GENERAL CONDITIONS

CONTRACT FOR CONSTRUCTION A101-2007

The following supplements modify the "Standard Form of Agreement Between Owner and Constructor," AIA Document A101-2007. Where a portion of the Standard Form of Agreement is modified or deleted by the following, the unaltered portions of the Standard Form of Agreement shall remain in effect.

ARTICLE 5: PAYMENTS

5.1 PROGRESS PAYMENTS

5.1.3 Delete paragraph 5.1.3 in its entirety and replace with the following:

"Provided that a valid Application for Payment is received by the Architect that meets all requirements of the Contract, payment shall be made by the Owner not later than 30 days after the Owner receives the valid Application for Payment."

ARTICLE 6: DISPUTE RESOLUTION

6.2 BINDING DISPUTE RESOLUTION

Check Other – and add the following sentence:

"Any remedies available in law or in equity."

ARTICLE 8: MISCELLANEOUS PROVISIONS

8.2 Insert the following:

"Payments are due 30 days after receipt of a valid Application for Payment. After that 30 day period, interest may be charged at the rate of 1% per month not to exceed 12% per annum."

8.5 Delete paragraph 8.5 in its entirety and replace with the following:

"The Contractor's representative shall not be changed without ten days written notice to the Owner."

END OF CONTRACT FOR CONSTRUCTION

BETHANY BEACH TRAINING SITE
DEARNG CONTRACT NUMBER 10-2010
REGIONAL TRAINING INSTITUTE

BID FORM

For Bids Due: June 21, 2013, 2:00 pm

To: DELAWARE ARMY NATIONAL GUARD
Joint Force Headquarters
First Regiment Road
Wilmington, DE 19808-2191

Name of Bidder: _____

Delaware Business License No.: _____ **Taxpayer ID No.:** _____

(Other License Nos.): _____

Phone No.: () _____ - _____ **Fax No.:** () _____ - _____

The undersigned, representing that he has read and understands the Bidding Documents and that this bid is made in accordance therewith, that he has visited the site and has familiarized himself with the local conditions under which the Work is to be performed, and that his bid is based upon the materials, systems and equipment described in the Bidding Documents without exception, hereby proposes and agrees to provide all labor, materials, plant, equipment, supplies, transport and other facilities required to execute the work described by the aforesaid documents for the lump sum itemized below:

BASE BID:

In writing \$ _____

In numbers \$ _____

OPTIONS

Option prices conform to applicable project specification section. Refer to specifications for a complete description of the following Options. An "ADD" or "DEDUCT" amount is indicated by the crossed out part that does not apply.

OPTION No. 1: Foldable Panel Partitions _____

Add/Deduct: In writing \$ _____

In numbers \$ _____

OPTION No. 2: Fire Pump System and Room Number 135

Add/Deduct: In writing \$ _____

In numbers \$ _____

BETHANY BEACH TRAINING SITE
DEARNG CONTRACT NUMBER 10-2010
REGIONAL TRAINING INSTITUTE

BID FORM

UNIT PRICES

Unit prices conform to applicable project specification section. Refer to the specifications for a complete description of the following Unit Prices:

	<u>ADD</u>	<u>DEDUCT</u>
UNIT PRICE No. 1: _____	\$ _____	\$ _____
UNIT PRICE No. 2: _____	\$ _____	\$ _____
UNIT PRICE No. 3: _____	\$ _____	\$ _____

BETHANY BEACH TRAINING SITE
DEARNG CONTRACT NUMBER 10-2010
REGIONAL TRAINING INSTITUTE

BID FORM

I/We acknowledge receipt of Addendums numbered _____ and the price(s) submitted include any cost/schedule impact they may have.

This bid shall remain valid and cannot be withdrawn for 30 days from the date of opening of bids, and the undersigned shall abide by the Bid Security forfeiture provisions. Bid Security is attached to this Bid.

The Owner shall have the right to reject any or all bids, and to waive any informality or irregularity in any bid received.

This bid is based upon work being accomplished by the Sub-Contractors named on the list attached to this bid.

Should I/We be awarded this contract, I/We pledge to achieve substantial completion of all the work within 365 calendar days of the Notice to Proceed.

The undersigned represents and warrants that he has complied and shall comply with all requirements of local, state, and national laws; that no legal requirement has been or shall be violated in making or accepting this bid, in awarding the contract to him or in the prosecution of the work required; that the bid is legal and firm; that he has not, directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken action in restraint of free competitive bidding.

Upon receipt of written notice of the acceptance of this Bid, the Bidder shall, within twenty (20) calendar days, execute the agreement in the required form and deliver the Contract Bonds, and Insurance Certificates, required by the Contract Documents.

I am / We are an Individual / a Partnership / a Corporation

By _____ Trading as _____
(Individual's / General Partner's / Corporate Name)

(State of Corporation)

Business Address: _____

Witness: _____ By: _____
(SEAL) (Authorized Signature)

(Title)
Date: _____

- ATTACHMENTS**
Sub-Contractor List
Non-Collusion Statement
Bid Security
(Others as Required by Project Manuals)

BID FORM

SUBCONTRACTOR LIST

In accordance with Title 29, Chapter 6962 (d)(10)b Delaware Code, the following sub-contractor listing must accompany the bid submittal. The name and address of the sub-contractor must be listed for each category where the bidder intends to use a sub-contractor to perform that category of work. In order to provide full disclosure and acceptance of the bid by the *Owner*, **it is required that bidders list themselves as being the sub-contractor for all categories where he/she is qualified and intends to perform such work.**

<u>Subcontractor Category</u>	<u>Subcontractor</u>	<u>Address (City & State)</u>
1. SITEWORK	_____	_____
2. CONCRETE	_____	_____
3. MASONRY	_____	_____
4. STRUCTURAL STEEL ERECTOR	_____	_____
5. METAL STUDS AND DRYWALL	_____	_____
6. CARPENTRY	_____	_____
7. ACOUSTICAL CEILINGS	_____	_____
8. PAINTING	_____	_____
9. VINYL COMPOSITION TILE FLOORING	_____	_____
10. PLUMBING	_____	_____
11. GEOTHERMAL WELL FIELD	_____	_____
12. ROOFING	_____	_____
13. MECHANICAL	_____	_____
14. ELECTRICAL	_____	_____
15. TELECOMMUNICATIONS	_____	_____
16. FIRE ALARM SYSTEM	_____	_____
17. FIRE SUPPRESSION SYSTEM	_____	_____
18. BUILDING AUTOMATION	_____	_____
19. BITUMINOUS PAVEMENT	_____	_____

- 20. HM DOORS, WOOD DOORS,
FRAMES, HARDWARE SUPPLIER _____
- 21. ALUM STOREFRONT
CURTAIN WALL _____
- 22. CERAMIC TILE _____
- 23. CARPET CONTRACTOR _____

BID FORM

NON-COLLUSION and EPLS DISCLOSURE STATEMENT

This is to certify that the undersigned bidder has neither directly nor indirectly, entered into any agreement, participated in any collusion or otherwise taken any action in restraint of free competitive bidding in connection with this proposal submitted this date to the State of Delaware, Delaware National Guard.

In addition, by signing this Statement, the undersigned bidder certifies that it is currently not listed as a suspended or debarred party on the Excluded Parties List System (EPLS.)

All the terms and conditions of DEARNG CONTRACT NUMBER 10-2010 have been thoroughly examined and are understood.

NAME OF BIDDER: _____

AUTHORIZED REPRESENTATIVE (TYPED): _____

AUTHORIZED REPRESENTATIVE (SIGNATURE): _____

TITLE: _____

ADDRESS OF BIDDER: _____

PHONE NUMBER: _____

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

My Commission expires _____. NOTARY PUBLIC _____.

THIS PAGE MUST BE SIGNED AND NOTARIZED FOR YOUR BID TO BE CONSIDERED.

STATE OF DELAWARE
DEPARTMENT OF LABOR
DIVISION OF INDUSTRIAL AFFAIRS
OFFICE OF LABOR LAW ENFORCEMENT
PHONE: (302) 451-3423

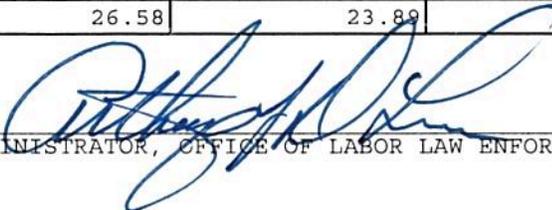
Mailing Address:
225 CORPORATE BOULEVARD
SUITE 104
NEWARK, DE 19702

Located at:
225 CORPORATE BOULEVARD
SUITE 104
NEWARK, DE 19702

PREVAILING WAGES FOR BUILDING CONSTRUCTION EFFECTIVE MARCH 15, 2013

CLASSIFICATION	NEW CASTLE	KENT	SUSSEX
ASBESTOS WORKERS	21.87	26.94	39.20
BOILERMAKERS	65.47	33.22	48.83
BRICKLAYERS	46.83	46.83	46.83
CARPENTERS	50.06	50.06	39.82
CEMENT FINISHERS	27.61	29.11	21.20
ELECTRICAL LINE WORKERS	43.49	37.29	28.44
ELECTRICIANS	60.60	60.60	60.60
ELEVATOR CONSTRUCTORS	75.33	40.93	30.55
GLAZIERS	64.10	64.10	54.20
INSULATORS	51.48	51.48	51.48
IRON WORKERS	59.12	59.12	59.12
LABORERS	38.30	38.30	38.30
MILLWRIGHTS	62.18	62.18	48.75
PAINTERS	42.02	42.02	42.02
PILEDRIVERS	67.87	37.64	30.45
PLASTERERS	28.55	28.55	17.50
PLUMBERS/PIPEFITTERS/STEAMFITTERS	59.00	49.26	46.28
POWER EQUIPMENT OPERATORS	57.06	57.06	24.13
ROOFERS-COMPOSITION	21.77	17.96	19.34
ROOFERS-SHINGLE/SLATE/TILE	17.59	17.50	16.45
SHEET METAL WORKERS	62.74	62.74	62.74
SOFT FLOOR LAYERS	45.97	45.97	45.97
SPRINKLER FITTERS	51.75	51.75	51.75
TERRAZZO/MARBLE/TILE FNRS	51.41	51.41	45.45
TERRAZZO/MARBLE/TILE STRS	59.03	59.03	52.63
TRUCK DRIVERS	26.58	23.89	20.03

CERTIFIED: 4/4/13

BY: 
ADMINISTRATOR, OFFICE OF LABOR LAW ENFORCEMENT

NOTE: THESE RATES ARE PROMULGATED AND ENFORCED PURSUANT TO THE PREVAILING WAGE REGULATIONS ADOPTED BY THE DEPARTMENT OF LABOR ON APRIL 3, 1992.

CLASSIFICATIONS OF WORKERS ARE DETERMINED BY THE DEPARTMENT OF LABOR. FOR ASSISTANCE IN CLASSIFYING WORKERS, OR FOR A COPY OF THE REGULATIONS OR CLASSIFICATIONS, PHONE (302) 451-3423.

NON-REGISTERED APPRENTICES MUST BE PAID THE MECHANIC'S RATE.

PROJECT: 10-2010 Regional Training Institute Phase I DEARNG Project

STATE OF DELAWARE
OFFICE OF MANAGEMENT AND BUDGET

PAYMENT BOND

Bond Number: _____

KNOW ALL PERSONS BY THESE PRESENTS, that we, _____, as principal (“**Principal**”), and _____, a _____ corporation, legally authorized to do business in the State of Delaware, as surety (“**Surety**”), are held and firmly bound unto the Delaware National Guard (“**Owner**”) in the amount of _____ (\$_____), to be paid to **Owner**, for which payment well and truly to be made, we do bind ourselves, our and each and every of our heirs, executors, administrations, successors and assigns, jointly and severally, for and in the whole firmly by these presents.

Sealed with our seals and dated this _____ day of _____, 20__.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH, that if **Principal**, who has been awarded by **Owner** that certain contract known as DEARNG BBTS RTI MILCON Project 10-2010 dated the _____ day of _____, 20__ (the “Contract”), which Contract is incorporated herein by reference, shall well and truly pay all and every person furnishing materials or performing labor or service in and about the performance of the work under the Contract, all and every sums of money due him, her, them or any of them, for all such materials, labor and service for which **Principal** is liable, shall make good and reimburse **Owner** sufficient funds to pay such costs in the completion of the Contract as **Owner** may sustain by reason of any failure or default on the part of **Principal**, and shall also indemnify and save harmless **Owner** from all costs, damages and expenses arising out of or by reason of the performance of the Contract and for as long as provided by the Contract; then this obligation shall be void, otherwise to be and remain in full force and effect.

Surety, for value received, for itself and its successors and assigns, hereby stipulates and agrees that the obligation of **Surety** and its bond shall be in no way impaired or affected by any extension of time, modification, omission, addition or change in or to the Contract or the work to be performed thereunder, or by any payment thereunder before the time required therein, or by any waiver of any provisions thereof, or by any assignment, subletting or other transfer thereof or of any work to be performed or any monies due or to become due thereunder; and **Surety** hereby waives notice of any and all such extensions, modifications, omissions, additions, changes, payments, waivers, assignments, subcontracts and transfers and hereby expressly stipulates and agrees that any and all things done and omitted to be done by and in relation to assignees, subcontractors, and other transferees shall have the same effect as to **Surety** as though done or omitted to be done by or in relation to **Principal**.

Surety hereby stipulates and agrees that no modifications, omission or additions in or to the terms of the Contract shall in any way whatsoever affect the obligation of **Surety** and its bond.

Any proceeding, legal or equitable, under this Bond may be brought in any court of competent jurisdiction in the State of Delaware. Notices to **Surety** or Contractor may be mailed or delivered to them at their respective addresses shown below.

IN WITNESS WHEREOF, **Principal** and **Surety** have hereunto set their hand and seals, and such of them as are corporations have caused their corporate seal to be hereto affixed and these presents to be signed by their duly authorized officers, the day and year first above written.

PRINCIPAL

Name: _____

Witness or Attest: Address: _____

Name:

(Corporate Seal)

By: _____ (SEAL)
Name:
Title:

SURETY

Name: _____

Witness or Attest: Address: _____

Name:

(Corporate Seal)

By: _____ (SEAL)
Name:
Title:

STATE OF DELAWARE
OFFICE OF MANAGEMENT AND BUDGET

PERFORMANCE BOND

Bond Number: _____

KNOW ALL PERSONS BY THESE PRESENTS, that we, _____, as principal (“**Principal**”), and _____, a _____ corporation, legally authorized to do business in the State of Delaware, as surety (“**Surety**”), are held and firmly bound unto the Delaware National Guard (“**Owner**”) in the amount of _____ (\$_____), to be paid to **Owner**, for which payment well and truly to be made, we do bind ourselves, our and each and every of our heirs, executors, administrations, successors and assigns, jointly and severally, for and in the whole, firmly by these presents.

Sealed with our seals and dated this _____ day of _____, 20__.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH, that if **Principal**, who has been awarded by **Owner** that certain contract known as DEARNG BBTS RTI MILCON Project 10-2010 dated the _____ day of _____, 20__ (the “Contract”), which Contract is incorporated herein by reference, shall well and truly provide and furnish all materials, appliances and tools and perform all the work required under and pursuant to the terms and conditions of the Contract and the Contract Documents (as defined in the Contract) or any changes or modifications thereto made as therein provided, shall make good and reimburse **Owner** sufficient funds to pay the costs of completing the Contract that **Owner** may sustain by reason of any failure or default on the part of **Principal**, and shall also indemnify and save harmless **Owner** from all costs, damages and expenses arising out of or by reason of the performance of the Contract and for as long as provided by the Contract; then this obligation shall be void, otherwise to be and remain in full force and effect.

Surety, for value received, hereby stipulates and agrees, if requested to do so by **Owner**, to fully perform and complete the work to be performed under the Contract pursuant to the terms, conditions and covenants thereof, if for any cause **Principal** fails or neglects to so fully perform and complete such work.

Surety, for value received, for itself and its successors and assigns, hereby stipulates and agrees that the obligation of **Surety** and its bond shall be in no way impaired or affected by any extension of time, modification, omission, addition or change in or to the Contract or the work to be performed thereunder, or by any payment thereunder before the time required therein, or by any waiver of any provisions thereof, or by any assignment, subletting or other transfer thereof or of any work to be performed or any monies due or to become due thereunder; and **Surety** hereby waives notice of any and all such extensions, modifications, omissions, additions, changes, payments, waivers, assignments, subcontracts and transfers and hereby expressly stipulates and agrees that any and all things done and omitted to be done by and in relation to assignees, subcontractors, and other

transferees shall have the same effect as to **Surety** as though done or omitted to be done by or in relation to **Principal**.

Surety hereby stipulates and agrees that no modifications, omissions or additions in or to the terms of the Contract shall in any way whatsoever affect the obligation of **Surety** and its bond.

Any proceeding, legal or equitable, under this Bond may be brought in any court of competent jurisdiction in the State of Delaware. Notices to **Surety** or Contractor may be mailed or delivered to them at their respective addresses shown below.

IN WITNESS WHEREOF, **Principal** and **Surety** have hereunto set their hand and seals, and such of them as are corporations have caused their corporate seal to be hereto affixed and these presents to be signed by their duly authorized officers, the day and year first above written.

PRINCIPAL

Name: _____

Witness or Attest: Address: _____

Name:

(Corporate Seal)

By: _____ (SEAL)
Name:
Title:

SURETY

Name: _____

Witness or Attest: Address: _____

Name:

(Corporate Seal)

By: _____ (SEAL)
Name:
Title:

STATE OF DELAWARE
OFFICE OF MANAGEMENT AND BUDGET

BID BOND

TO ACCOMPANY PROPOSAL
(Not necessary if security is used)

KNOW ALL MEN BY THESE PRESENTS That: _____
_____ of _____ in the County of _____
_____ and State of _____ as **Principal**, and _____
_____ of _____ in the County of _____
and State of _____ as **Surety**, legally authorized to do business in the State of Delaware
("State"), are held and firmly unto the **State** in the sum of _____
_____ Dollars (\$ _____), or _____ percent not to exceed _____
_____ Dollars (\$ _____)
of amount of bid on DEARNG BBTS RTI MILCON Project 10-2010 to be paid to the **State** for the use and
benefit of Delaware National Guard for which payment well and truly to be made, we do bind ourselves, our
and each of our heirs, executors, administrators, and successors, jointly and severally for and in the whole
firmly by these presents.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH That if the above bonded **Principal**
who has submitted to the Delaware National Guard a certain proposal to enter into this contract for the
furnishing of certain material and/or services within the **State**, shall be awarded this Contract, and if said
Principal shall well and truly enter into and execute this Contract as may be required by the terms of this
Contract and approved by the Delaware National Guard this Contract to be entered into within twenty days
after the date of official notice of the award thereof in accordance with the terms of said proposal, then this
obligation shall be void or else to be and remain in full force and virtue.

Sealed with _____ seal and dated this _____ day of _____ in the year of our Lord two
thousand and _____ (20____).

SEALED, AND DELIVERED IN THE
Presence of

Name of Bidder (Organization)

Corporate
Seal

By:

Authorized Signature

Attest _____

Title

Name of Surety

Witness: _____

By:

Title

DRAFT AIA® Document G702™ - 1992

Application and Certificate for Payment

TO OWNER:		PROJECT:	Draft	APPLICATION NO:	001	Distribution to:
						OWNER: <input type="checkbox"/>
						ARCHITECT: <input type="checkbox"/>
FROM CONTRACTOR:		VIA ARCHITECT:		PERIOD TO:		CONTRACTOR: <input type="checkbox"/>
				CONTRACT FOR:	General Construction	FIELD: <input type="checkbox"/>
				CONTRACT DATE:		: <input type="checkbox"/>
				PROJECT NOS:	/ /	: <input type="checkbox"/>

CONTRACTOR'S APPLICATION FOR PAYMENT

Application is made for payment, as shown below, in connection with the Contract. Continuation Sheet, AIA Document G703, is attached.

1. ORIGINAL CONTRACT SUM.....		\$0.00		
2. NET CHANGE BY CHANGE ORDERS.....		\$0.00		
3. CONTRACT SUM TO DATE (Line 1 ± 2)		\$0.00		
4. TOTAL COMPLETED & STORED TO DATE (Column G on G703).....		\$0.00		
5. RETAINAGE:				
a. <u> 0 </u> % of Completed Work				
(Column D + E on G703: <u> \$0.00 </u>)=		<u> \$0.00 </u>		
b. <u> 0 </u> % of Stored Material				
(Column F on G703: <u> \$0.00 </u>)=		<u> \$0.00 </u>		
Total Retainage (Lines 5a + 5b or Total in Column I of G703).....		\$0.00		
6. TOTAL EARNED LESS RETAINAGE.....		\$0.00		
(Line 4 Less Line 5 Total)				
7. LESS PREVIOUS CERTIFICATES FOR PAYMENT.....		\$0.00		
(Line 6 from prior Certificate)				
8. CURRENT PAYMENT DUE.....		\$0.00		
9. BALANCE TO FINISH, INCLUDING RETAINAGE				
(Line 3 less Line 6)		<u> \$0.00 </u>		

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

CONTRACTOR: _____

By: _____ Date: _____

State of: _____

County of: _____

Subscribed and sworn to before me this _____ day of _____

Notary Public: _____

My Commission expires: _____

ARCHITECT'S CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, based on on-site observations and the data comprising this application, the Architect certifies to the Owner that to the best of the Architect's knowledge, information and belief the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment of the AMOUNT CERTIFIED.

AMOUNT CERTIFIED..... \$0.00

(Attach explanation if amount certified differs from the amount applied. Initial all figures on this Application and on the Continuation Sheet that are changed to conform with the amount certified.)

ARCHITECT: _____

By: _____ Date: _____

This Certificate is not negotiable. The AMOUNT CERTIFIED is payable only to the Contractor named herein. Issuance, payment and acceptance of payment are without prejudice to any rights of the Owner or Contractor under this Contract.

CHANGE ORDER SUMMARY	ADDITIONS	DEDUCTIONS
Total changes approved in previous months by Owner	\$0.00	\$0.00
Total approved this Month	\$0.00	\$0.00
TOTALS	\$0.00	\$0.00
NET CHANGES by Change Order		\$0.00

ARTICLE VIII – APPLICABLE LAWS AND REGULATIONS**Section 801. Applicable Law.**

This MCCA is incidental to implementation of a federal program. Accordingly, this MCCA shall be governed by and construed according to federal law as it may affect rights, remedies, and obligations of the United States.

Section 802. Governing Regulations.

To the extent not inconsistent with express terms of this MCCA, provisions of 32 CFR Part 33, Uniform Administrative Requirements for Grants and Cooperative Agreements, the DoD 3210.6R, DoD Grant and Agreement Regulations (4/13/98), OMB Circular A-87, and NGR 5-1/ANGI 63-101, which circular and regulations are hereby incorporated into this MCCA by reference as if fully set forth herein, shall govern this MCCA.

Section 803. Officials Not to Benefit

No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit arising from it, in accordance with 41 U.S.C. 22.

Section 804. Nondiscrimination.

The State covenants and agrees that by signing this agreement or accepting funds under this agreement, the recipient assures that it will comply with applicable provision of the following, national policies prohibiting discrimination:

- a. On the basis of race, color, or national origin, in Title VII of the Civil Rights Act of 1964 (42 U.S.C. § 2000d et seq.), as implemented by DOD regulations 32 CFR Part 195.
- b. On the basis of race, color, religion, sex, or national origin, in Executive Order 11246 [3 CFR, 1964-1965 Comp. p. 339], as implemented by Department of Labor regulations issued thereunder (41 CFR Part 60);
- c. On the basis of handicap, in Section 504 of the Rehabilitation Act of 1973 (29 U.S.C. § 794) as implemented by Department of Justice regulations at 28 CFR part 41 and DoD Regulations at 32 CFR Part 56; and,
- d. On the basis of Age, in the Age Discrimination Act of 1975 (42 U.S.C. § 6101 et seq.) as implemented by Department of Health and Human Services regulations at 45 CFR Part 90.

Section 805. Lobbying.

a. The State covenants and agrees that it will not expend any funds appropriated by Congress to pay any person for influencing or attempting to influence an officer or employee of any agency or a member of Congress in connection with any of the following covered federal actions: The awarding of any federal contract; the making of any federal grant; the making of any federal loan; the entering into of any cooperative agreement; and the extension, continuation, renewal, amendment, or modification of any federal contract, grant, loan, or cooperative agreement.

b. New Restrictions on Lobbying, issued by the Office of Management and Budget and the Department of Defense (32 CFR Part 28) to implement provisions of Section 319 of Public Law 102-121 (31 U.S.C. § 1352) is incorporated by reference and the State agrees to comply with provisions thereof, including amendments to the that may hereafter be issued.

Section 806. Drug-Free Work Place.

a. The State covenants and agrees that it will comply with provisions of the Drug-Free Work Place Act of 1988 (Public Law 100-690, Title V, Subtitle D; 41 U.S.C. § 701 et seq.) and will maintain a drug-free workplace.

b. Government-Wide Requirements for Drug-Free Workplace (Grants), issued by the Office of Management and Budget and the Department of Defense (41 USC 702) to implement provisions of the Drug-Free Work Place Act of 1988, is incorporated by reference and the State covenants and agrees to comply with provisions thereof, including amendments that may hereafter be issued.

Section 807. Environmental Standards. (By signing this agreement or accepting funds under this agreement, the recipient assure that it will):

a. Comply with applicable provision of the Clean Air Act (42 U.S.C. § 7401, et seq) and Clean Water Act (33 USC 1251, et.seq.), as implemented by Executive Order 11738 [3 CFR, 1971-1975 comp., p.799] and Environmental Protection Agency (EPA) rules at 40 CFR Part 15. In accordance with the EPA rules, the recipient further agrees that it will:

- Not use any facility on the EPA's List of Violating Facilities in performing any award that is nonexempt under 40 CFR 15.5 (awards of less than \$100,000, and certain other awards, exempt from the EPA regulations), as long as the facility remains on the list.
- Notify the awarding agency if it intends to use a facility in performing this award that is on the List of Violating Facilities or that the recipient knows has been recommended to be placed on the List of Violating Facilities.

b. Identify to the awarding agency any impact this award may have on:

(1) The quality of the human environment, and provide help the agency may need to comply with the National Environmental Policy Act (NEPA, at 42 U.S.C 4321, et.seq.) and to prepare Environment Impact Statements or other required environmental documentation. In such cases, the recipient agrees to take no action that will have an adverse environmental impact (e.g., physical disturbance of a site such as breaking of ground) until the agency provides written notification of compliance with the environmental impact analysis process.

(2) Flood-prone areas, and provide help the agency may need to comply with the National Flood Insurance Act of 1968 and Flood Disaster Protection Act of 1973 (42 U.S.C. 4001, et. Seq.), which require flood insurance, when available, for Federally assisted construction or acquisition in flood-prone areas.

(3) Coastal zones, and provide help the agency may need to comply with the Coastal Zone Management Act of 1972 (16 U.S.C. 1451, et seq.), concerning protection of U.S. coastal resources.

(4) Coastal barriers, and provide help the agency may need to comply with the Coastal Barriers Resource Act (16 U.S.C. 3501 et.seq.), concerning preservation of barrier resources.

(5) Any existing or proposed component of the National Wild and Scenic Rivers system, and provide help the agency may need to comply with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. 1271 et seq.).

(6) Underground sources of drinking water in areas that have an aquifer that is the sole or principal drinking water source, and provide help the agency may need to comply with the Safe Drinking Water Act (42 U.S.C 300h-3).

Section 808. Preference for U.S. Flag Air Carriers.

(Any agreement under which international air travel may be supported by U.S. Government funds)

Travel supported by U.S. Government funds under this agreement shall use U.S flag air carriers (air carriers holding certificates under 49U.S.C. 41102) for international air transportation of people and property to the extent that such service is available, in accordance with the International Air Transportation Fair Competitive Practices Act of 1974 (49 U.S.C. 40118) and the interpretative guidelines issued by the Comptroller General of the United States in the March 31, 1981, amendment to Comptroller General Decision B138942.

Section 809. Debarment and Suspension.

a. The State shall not make any award or permit any award (subgrant or contract) at any tier to any party which is debarred or suspended or is otherwise excluded from or ineligible for participation in federal assistance programs under Executive Order 12549 "Debarment and Suspension".

b. Government-Wide Debarment and Suspension (Nonprocurement), issued by the Office of Management and Budget and the Department of Defense (32 CFR Part 25) to implement provisions of Executive Order 12549 "Debarment and Suspension," is incorporated by reference and the State covenants and agrees to comply with provisions thereof, including amendments that may hereafter be issued.

Section 810. Buy American Act.

The State covenants and agrees that it will not expend any funds appropriated by Congress without complying with The Buy American Act (41 U.S.C. 10). The Buy American Act gives preference to domestic end products and domestic construction material. In addition, the Memorandum of Understanding between the United States of America and the European Economic Community (EEC) on Government Procurement, and the North American Free Trade Agreement (NAFTA), provide that EEC and NAFTA end products and construction materials are exempted from application of the Buy American Act.

Section 811. Relocation Assistance and Real Property Acquisition Policies.

The State covenants and assures that it will comply with 49 CFR part 24, which implements the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (42 U.S.C. § 4601 *et seq.*) and provides for fair and equitable treatment of persons displaced by Federally assisted programs or persons whose property is acquired as a result of such programs.

Section 812. Copeland "Anti-Kickback" Act. *(All contracts and subgrants for construction or repair)*

The State covenants and agrees that it will comply with the Copeland "Anti-Kickback" Act (18 U.S.C. 874), as supplemented in Department of Labor regulations (29 CFR Part 3). As applied to this MCCA, the Copeland "Anti-Kickback" Act makes it unlawful to induce, by force, intimidation, threat of procuring dismissal from employment, or otherwise, any person employed in the construction or repair of public buildings or public works, financed in whole or in part by the United States, to give up any part of the compensation to which that person is entitled under a contract of employment.

Section 813. Contract Work Hours and Safety Standards Act. *(Construction contracts awarded by grantees and subgrantees in excess of \$2,000, and in excess of \$2,500 for other contracts which involve the employment of mechanics and laborers)*

The State covenants and agrees that it will comply with Sections 103 and 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 327-330), as supplemented by Department of Labor regulations (29 CFR Part 5). As applied to this MCCA, the Contract Work Hours and Safety Standards Act specifies that no laborer or mechanic doing any part of the work contemplated by this MCCA shall be required or permitted to work more than 40 hours in any work week unless paid for all additional hours at not less than 1 1/2 times the basic rate of pay.

Section 814. Davis-Bacon Act. Contractor to comply with State of Delaware prevailing wage requirements, pursuant to Delaware Code, Title 29, Section 6960
~~DO NOT USE THIS CLAUSE UNLESS AUTHORIZED BY NCB ARI.~~

~~The State covenants and agrees that it will comply with the Davis-Bacon (40 U.S.C. 276 a to a-7) as supplemented by U.S. Department of Labor regulations (29 CFR Part 5). (Construction contracts in excess of \$2,000 awarded by grantees and subgrantees when required by Federal grant program legislation). All rulings and interpretations of the Davis-Bacon Act contained in 29 CFR Part 5 are incorporated by reference in this MCCA. As applied to this MCCA, the Davis-Bacon Act (40 U.S.C. 276a-276a-7) provides that contracts in excess of \$2,000 to which the Federal Government provides assistance funding for construction, alteration, or repair (including painting and decorating) of public buildings or public works within the United States, shall contain a provision that no laborer or mechanic employed directly upon the site of the work shall receive less than the prevailing wage rates as determined by the U.S. Secretary of Labor.~~

Section 815. National Historic Preservation. *(Any construction, acquisition, modernization, or other activity that may impact a historic property.)*

The State covenants and agrees to identify to the awarding agency any property listed or eligible for listing on the National Register of Historic Places that will be affected by this award, and to provide any help the awarding agency may need, with respect to this award, to comply with Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470, *et seq.*), as implemented by the Advisory Council on Historic Preservation regulations at 36 CFR Part 800 and Executive Order 11593 (3 CFR, 1971-1975 Comp., p. 559).

(36 CFR Part 800 requires Grants Officers to get comments from the Advisory Council on Historic Preservation before proceeding with Federally assisted projects that may affect properties listed on or eligible for listing on the National Register of Historic Places.)

Section 816. Hatch Act.

The State covenants and agrees to comply with the Hatch Act (5 U.S.C. 1501 - 1508 and 7324 - 7326), as implemented by the Office of Personnel Management at 5 CFR Part 151, which limits political activity of employees or officers of State or local governments whose employment is connected to an activity financed in whole or part with Federal funds.

Section 817. Equal Employment Opportunity. *(All construction contracts awarded in excess of \$10,000 by grantees and their contractors or subgrantees.)*

The State covenants and agrees to comply with Executive Order 11246 of September 24, 1965 entitled "Equal Employment Opportunity," as amended by Executive Order 11375 of October 13, 1967 and as supplemented in Department of Labor regulations (41 CFR Chapter 60).

Section 818. Cargo Preference. *(Any agreement under which international air travel may be supported by U.S. Government funds.)*

The State covenants and agrees that it will comply with the Cargo Preference Act of 1954 (46 USC 1241), as implemented by Department of Transportation regulations at 46 CFR 381.7, which require that at least 50 percent of equipment, materials or commodities procured or otherwise obtained with U.S. Government funds under this Grant, and which may be transported by ocean vessel, shall be transported on privately owned U.S. flag commercial vessels, if available.

Section 819. Preservation of Open Competition and Government Neutrality Towards Government Contractors' Labor Relations on Federal and Federally Funded Construction Projects.

The State covenants and agrees that it will comply with Executive Order 13202 of February 17, 2001, Preservation of Open Competition and Government Neutrality Towards Government Contractors' Labor Relations on Federal and Federally Funded Construction Projects, as amended on April 6, 2001.

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 011000 - SUMMARY

PART 1 - GENERAL

- 1.01 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.
- 1.02 SUMMARY:
- A. Section Includes:
 - 1. Project information.
 - 2. Work covered by Contract Documents.
 - 3. Phased construction.
 - 4. Work by Owner.
 - 5. Work under separate contracts.
 - 6. Future work.
 - 7. Purchase contracts.
 - 8. Owner-furnished products.
 - 9. Contractor-furnished, Owner-installed products.
 - 10. Access to site.
 - 11. Coordination with occupants.
 - 12. Work restrictions.
 - 13. Specification and drawing conventions.
 - 14. Miscellaneous provisions.
 - B. Related Requirements:
 - 1. DIVISION 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
- 1.03 PROJECT INFORMATION:
- A. Project Identification: Regional Training Institute, Phase I.
 - 1. Project Location: Bethany Beach, Delaware.
 - B. Owner: Delaware Army National Guard.
 - 1. Owner's Representative: CPT Eric Reigner, HQ, Delaware Army National Guard, First Regiment Road, Wilmington, DE 19808-2191
 - C. Architect: Burns & McDonnell Engineering Company, 9400 Ward Parkway, Kansas City, MO 64114.
 - D. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:
 - 1. Civil Engineer: Mr. Cliff Mitchell, 302-764-7635 (x 153).
 - E. Other Owner Consultants: The Owner has retained the following design professionals who have prepared designated portions of the Contract Documents:
 - 1. Vandemark & Lynch: Mr. Cliff Mitchell, Associate Civil Engineer has prepared the following portions of the Contract Documents:
 - a. Bethany Beach Water Infrastructure Improvement Project.
 - F. Project Web Site: A project Web site administered by Owner will be used for purposes of managing communication and documents during the construction stage.
 - 1. See DIVISION 01 Section "Project Management and Coordination" for requirements for administering and using the Project Web site.

SECTION 011000 - SUMMARY: continued

1.04 WORK COVERED BY CONTRACT DOCUMENTS:

- A. The Work of Project is defined by the Contract Documents and consists of the following:
 - 1. Construct a 13,920 square foot, single-story education and administration facility to be used by the Delaware Army National Guard as a Regional Training Institute.
- B. Type of Contract:
 - 1. Project will be constructed under a single prime contract.

1.05 WORK UNDER SEPARATE CONTRACTS:

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.
- B. Concurrent Work: Owner will award separate contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.
 - 1. Bethany Beach Water Infrastructure Improvement Project: A firm to be determined later will upgrade the water infrastructure to the Bethany Beach Training Site to increase the available pressure within the lines. This work, identified "BY OTHER CONTRACT" is indicated on drawings C120 and C130.
- C. Subsequent Work: Owner will award separate contract(s) for the following additional work to be performed at site. Completion of that work will depend on successful completion of preparatory work under this Contract.
 - 1. Fixtures, Furnishings, and Equipment. A firm to be determined later will provide the furniture, fixtures, and equipment to be installed within this facility.
 - 2. Electronic Security Systems. A firm to be determined later will provide electronic card readers, balanced magnetic switches, and other ESS gear to be installed within this facility.

1.06 ACCESS TO SITE:

- A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. Use of Site: Limit use of Project site to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Limits: Confine construction operations to the limit of V & L 2011 Survey as indicated on C-110.
 - 2. Driveways, Walkways and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.07 COORDINATION WITH OCCUPANTS:

- A. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to

SECTION 011000 - SUMMARY: continued

Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.08 WORK RESTRICTIONS:

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7:30 a.m. to 4:30 p.m., Monday through Friday, unless otherwise indicated.
 1. Weekend Hours: Work during the National Guard drill weekends is prohibited. Coordinate weekend work with Owner or Owner's Representative at least one month in advance of planned work on a weekend.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
 1. Notify Owner's Representative not less than two days in advance of proposed disruptive operations.
 2. Obtain Owner's Representative written permission before proceeding with disruptive operations.
- E. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.
- F. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.
- G. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- H. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
 1. Maintain list of approved screened personnel with Owner's Representative.

SECTION 011000 - SUMMARY: continued

1.09 SPECIFICATION AND DRAWING CONVENTIONS:

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. DIVISION 01 General Requirements: Requirements of Sections in DIVISION 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 - 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
 - 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.10 MISCELLANEOUS PROVISIONS:

- A. Contractor will pay for and obtain all permits required for the project in this contract.
- B. Contractor will complete the Final DD Form 1354 for this project. Architect will provide the Draft DD Form 1354 to the Contractor.

PART 2 - PRODUCTS - NOT APPLICABLE.

PART 3 - EXECUTION - NOT APPLICABLE.

END OF SECTION 011000

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY:

- A. Section includes administrative and procedural requirements for alternates.

1.03 DEFINITIONS:

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.04 PROCEDURES:

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into 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 indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS - NOT APPLICABLE.

PART 3 - EXECUTION

3.01 SCHEDULE OF ALTERNATES:

- A. Alternate No. 1: Folding Panel Partitions.
 - 1. Alternate Bid: Provide folding panel partitions in Training Rooms 131, 132, 133, and 134, as indicated on Sheets A-100, A-102, A-108, A-300 and as specified in DIVISION 10, SECTION 102226.

SECTION 012300 - ALTERNATES: CONTINUED

- B. Alternate No. 2: Fire Pump System and Room Number 135.
 - 1. Alternate Bid: Provide a Fire Pump System and Room #135 as indicated on Sheets A-109, A-600, FP-001, FP-101, FP-301, and FP-401, and as specified in DIVISION 21, SECTION 213113.

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

- 1.01 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.
- 1.02 SUMMARY:
- A. Section includes administrative and procedural requirements for substitutions.
 - B. Related Requirements:
 - 1. DIVISION 01 Section "Allowances" for products selected under an allowance.
 - 2. DIVISION 01 Section "Alternates" for products selected under an alternate.
 - 3. DIVISION 01 Section "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
 - 4. DIVISIONS 02 through 33 Sections for specific requirements and limitations for substitutions.
- 1.03 DEFINITIONS:
- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
- 1.04 ACTION SUBMITTALS:
- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use CSI Form 13.1A.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.

SECTION 012500 - SUBSTITUTION PROCEDURES: continued

- h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor through Construction Manager of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.
- 1.05 QUALITY ASSURANCE:
- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.
- 1.06 PROCEDURES:
- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

- 2.01 SUBSTITUTIONS:
- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.

SECTION 012500 - SUBSTITUTION PROCEDURES: continued

- b. Requested substitution provides sustainable design characteristics that specified product provided for achieving LEED® prerequisites and credits.
- c. Substitution request is fully documented and properly submitted.
- d. Requested substitution will not adversely affect Contractor's construction schedule.
- e. Requested substitution has received necessary approvals of authorities having jurisdiction.
- f. Requested substitution is compatible with other portions of the Work.
- g. Requested substitution has been coordinated with other portions of the Work.
- h. Requested substitution provides specified warranty.
- i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 - EXECUTION - NOT APPLICABLE.

END OF SECTION 012500

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS:
- A. Drawings and general provisions of the Contract, including General Requirements and Supplementary General Conditions and other DIVISION 01 Specification Sections, apply to this Section.
- 1.02 SUMMARY:
- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
 - B. Related Requirements: Article 7, page 7 of the General Requirements, Changes in the Work.
 - C. DIVISION 01 Section "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
- 1.03 MINOR CHANGES IN THE WORK:
- A. Architect will issue Owner's Representative supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."
- 1.04 PROPOSAL REQUESTS:
- A. Owner-Initiated Proposal Requests: Architect or Owner's Representative will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - B. Work Change Proposal Requests issued by Architect or Owner's Representative are not instructions either to stop work in progress or to execute the proposed change.
 - 1. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. 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. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use CSI Form 13.6D, "Proposal Worksheet Summary," and Form 13.6C, "Proposal Worksheet Detail."
 - C. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect or Owner's Representative.
 - D. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES: continued

1. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
2. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
3. Include costs of labor and supervision directly attributable to the change.
4. 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. Use available total float before requesting an extension of the Contract Time.
5. Comply with requirements in DIVISION 01 Section "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
6. Proposal Request Form: Use CSI Form 13.6A, "Change Order Request (Proposal)," with attachments CSI Form 13.6D, "Proposal Worksheet Summary," and Form 13.6C, "Proposal Worksheet Detail."
7. Refer to Article 7, page 7 of the General Requirements, Changes in the Work for further information on what to include in the Proposal Request Form.

1.05 CHANGE ORDER PROCEDURES:

- A. On Owner's approval of a Work Changes Proposal Request, Architect or Owner's Representative will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.06 CONSTRUCTION CHANGE DIRECTIVE:

- A. Construction Change Directive: Architect or Owner's Representative may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
- B. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- C. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
- D. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS:
- A. Drawings and general provisions of the Contract, including General Requirements and Supplementary General Conditions and other DIVISION 01 Specification Sections, apply to this Section.
- 1.02 SUMMARY:
- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
 - B. Related Requirements:
 - 1. DIVISION 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. DIVISION 01 Section "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.
 - 3. DIVISION 01 sustainable design requirements Section for administrative requirements governing submittal of cost breakdown information required for LEED documentation.
- 1.03 DEFINITIONS:
- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.
- 1.04 SCHEDULE OF VALUES:
- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule. Cost-loaded Critical Path Method Schedule may serve to satisfy requirements for the schedule of values.
 - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect or Owner's Representative at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment. Refer to Article 9.2.2, page 7 of the Supplementary General Conditions, Schedule of Values for further information.
 - 3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
 - 4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
 - 5. Subschedules for Separate Design Contracts: Where the Owner has retained design professionals under separate contracts who will each provide certification of payment requests, provide subschedules showing values coordinated with the scope of each design services contract as described in DIVISION 01 Section "Summary."

SECTION 012900 - PAYMENT PROCEDURES: continued

- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 2. Arrange schedule of values consistent with format of AIA Document G703.
 3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100%.
 - (1) Labor.
 - (2) Materials.
 - (3) Equipment.
 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five% of the Contract Sum.
 - a. Include separate line items under Contractor and principal subcontracts for LEED documentation and other Project closeout requirements in an amount totaling five% of the Contract Sum and subcontract amount.
 5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
 7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
 8. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
 9. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.
 10. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

SECTION 012900 - PAYMENT PROCEDURES: continued

11. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.05 APPLICATIONS FOR PAYMENT:

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and Owner's Representative and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use AIA Document G702 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect or Owner's Representative will return incomplete applications without action.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect or Owner's Representative by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

SECTION 012900 - PAYMENT PROCEDURES: continued

- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
 - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 - 2. When an application shows completion of an item, submit conditional final or full waivers.
 - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 - 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 - 5. Waiver Forms: Submit executed waivers of lien on forms, acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 - 1. List of subcontractors.
 - 2. Schedule of values.
 - 3. LEED submittal for project materials cost data.
 - 4. Contractor's construction schedule (preliminary if not final).
 - 5. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 - 6. Products list (preliminary if not final).
 - 7. LEED action plans.
 - 8. Schedule of unit prices.
 - 9. Submittal schedule (preliminary if not final).
 - 10. List of Contractor's staff assignments.
 - 11. List of Contractor's principal consultants.
 - 12. Copies of building permits.
 - 13. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 - 14. Initial progress report.
 - 15. Report of preconstruction conference.
 - 16. Certificates of insurance and insurance policies.
 - 17. Performance and payment bonds.
 - 18. Data needed to acquire Owner's insurance.
- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100% completion for portion of the Work claimed as substantially complete.
 - 1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted as per paragraph 9.4 of the General Requirements.

SECTION 012900 - PAYMENT PROCEDURES: continued

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY:

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. Requests for Information (RFIs).
 - 4. Project Web site.
 - 5. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. DIVISION 01 Section "Multiple Contract Summary" for a description of the division of work among separate contracts and responsibility for coordination activities not in this Section.
 - 2. DIVISION 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 3. DIVISION 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 4. DIVISION 01 Section "Closeout Procedures" for coordinating closeout of the Contract.
 - 5. DIVISION 01 Section "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.03 DEFINITIONS:

- 1. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.04 INFORMATIONAL SUBMITTALS:

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 15 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, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of list in project meeting room, in temporary field office, on Project Web site, and by each temporary telephone. Keep list current at all times.

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION: continued

1.05 GENERAL COORDINATION PROCEDURES:

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. 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 performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- 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. Project closeout activities.
 - 8. Startup and adjustment of systems.
- E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.06 COORDINATION DRAWINGS:

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION: continued

required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
 1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION: continued

- b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 - 8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 - 9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
 - 10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in DIVISION 01 Section "Submittal Procedures."
 - C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
 - 1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 - 2. BIM File Incorporation: Develop and incorporate coordination drawing files into Building Information Model established for Project.
 - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
 - 3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available in AutoCAD 2010.
 - c. Contractor shall execute a data licensing agreement in the form of AIA Document C106.
- 1.07 REQUESTS FOR INFORMATION (RFIS):
- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 - 1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 - 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
 - B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 - 1. Project name.
 - 2. Project number.
 - 3. Date.
 - 4. Name of Contractor.
 - 5. Name of Architect.
 - 6. RFI number, numbered sequentially.
 - 7. RFI subject.
 - 8. Specification Section number and title and related paragraphs, as appropriate.
 - 9. Drawing number and detail references, as appropriate.

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION: continued

10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- D. Architect's or Owner's representative Action: Architect or Owner's representative will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect or Owner's representative after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to DIVISION 01 Section "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and Owner's Representative in writing within 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following: Software log with not less than the following:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect or Owner's representative's response was received.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION: continued

1.08 PROJECT WEB SITE:

- A. Use Owner's Project Web site for purposes of hosting and managing project communication and documentation until Final Completion. The Project Web site is by Projectmates (214-217-4100) and administered by the Air National Guard. Project Web site shall include the following functions:
 - 1. Project directory.
 - 2. Project correspondence.
 - 3. Meeting minutes.
 - 4. Contract modifications forms and logs.
 - 5. RFI forms and logs.
 - 6. Task and issue management.
 - 7. Photo documentation.
 - 8. Schedule and calendar management.
 - 9. Submittals forms and logs.
 - 10. Payment application forms.
 - 11. Drawing and specification document hosting, viewing, and updating.
 - 12. Online document collaboration.
 - 13. Reminder and tracking functions.
 - 14. Archiving functions.
- B. Contractor shall pay for its own and its subcontractors' Projectmates user licenses for the duration of the project from Notice to Proceed through completion of the warranty period. Provide eight hours of software training at Owner's office for Project Web site users to include Architect, Architect's consultants, and Owner's Commissioning Authority.
- C. On completion of Project, provide one complete archive copy(ies) of Project Web site files to Owner and to Architect in a digital storage format acceptable to Architect.
- D. Contractor, subcontractors, and other parties granted access by Contractor to Project Web site shall execute a data licensing agreement in the form of AIA Document C106.

1.09 PROJECT MEETINGS:

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 - 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, Owner's representative, and Architect within three days of the meeting.
- B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect.
 - 1. Conduct the conference to review responsibilities and personnel assignments.
 - 2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Owner's Technical Representative, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION: continued

- b. Safety.
 - c. Quality Control/Quality Assurance.
 - d. Phasing.
 - e. Critical work sequencing and long-lead items.
 - f. Designation of key personnel and their duties.
 - g. Lines of communications.
 - h. Procedures for processing field decisions and Change Orders.
 - i. Procedures for RFIs.
 - j. Procedures for testing and inspecting.
 - k. Procedures for processing Applications for Payment.
 - l. Distribution of the Contract Documents.
 - m. Submittal procedures.
 - n. LEED® requirements.
 - o. Preparation of record documents.
 - p. Use of the premises.
 - q. Work restrictions.
 - r. Working hours.
 - s. Owner's occupancy requirements.
 - t. Responsibility for temporary facilities and controls.
 - u. Procedures for moisture and mold control.
 - v. Procedures for disruptions and shutdowns.
 - w. Construction waste management and recycling.
 - x. Parking availability.
 - y. Office, work, and storage areas.
 - z. Equipment deliveries and priorities.
 - aa. First aid.
 - bb. Security.
 - cc. Progress cleaning.
4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. LEED Coordination Conference: Architect will schedule and conduct a LEED coordination conference before starting construction, at a time convenient to Owner, Architect, and Contractor.
- 1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent and LEED coordinator; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Discuss items of significance that could affect meeting requirements for LEED certification, including the following:
 - a. LEED Project Checklist.
 - b. General requirements for LEED-related procurement and documentation.
 - c. Project closeout requirements and LEED certification procedures.
 - d. Role of LEED coordinator.
 - e. Construction waste management.
 - f. Construction operations and LEED requirements and restrictions.
 - 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION: continued

- D. Preinstallation Conferences: 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 Architect, and Owner's Commissioning Authority of scheduled meeting dates.
 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. LEED requirements.
 - i. Review of mockups.
 - j. Possible conflicts.
 - k. Compatibility requirements.
 - l. Time schedules.
 - m. Weather limitations.
 - n. Manufacturer's written instructions.
 - o. Warranty requirements.
 - p. Compatibility of materials.
 - q. Acceptability of substrates.
 - r. Temporary facilities and controls.
 - s. Space and access limitations.
 - t. Regulations of authorities having jurisdiction.
 - u. Testing and inspecting requirements.
 - v. Installation procedures.
 - w. Coordination with other work.
 - x. Required performance results.
 - y. Protection of adjacent work.
 - z. Protection of construction and personnel.
 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- E. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION: continued

- meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of record documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 - d. Requirements for completing LEED documentation.
 - e. Requirements for preparing operations and maintenance data.
 - f. Requirements for delivery of material samples, attic stock, and spare parts.
 - g. Requirements for demonstration and training.
 - h. Preparation of Contractor's punch list.
 - i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - j. Submittal procedures.
 - k. Coordination of separate contracts.
 - l. Owner's partial occupancy requirements.
 - m. Installation of Owner's furniture, fixtures, and equipment.
 - n. Responsibility for removing temporary facilities and controls.
 - o. DD Form 1354, Final Version.
 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- F. Progress Meetings: Conduct progress meetings at biweekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - (1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - (1) Interface requirements.
 - (2) Sequence of operations.
 - (3) Resolution of BIM component conflicts.
 - (4) Status of submittals.
 - (5) Status of LEED documentation.
 - (6) Deliveries.
 - (7) Off-site fabrication.
 - (8) Access.
 - (9) Site utilization.

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION: continued

- (10) Temporary facilities and controls.
 - (11) Progress cleaning.
 - (12) Quality and work standards.
 - (13) Status of correction of deficient items.
 - (14) Field observations.
 - (15) Status of RFIs.
 - (16) Status of proposal requests.
 - (17) Pending changes.
 - (18) Status of Change Orders.
 - (19) Pending claims and disputes.
 - (20) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- G. Coordination Meetings: Conduct Project coordination meetings at biweekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor present, including the following:
 - (1) Interface requirements.
 - (2) Sequence of operations.
 - (3) Resolution of BIM component conflicts.
 - (4) Status of submittals.
 - (5) Deliveries.
 - (6) Off-site fabrication.
 - (7) Access.
 - (8) Site utilization.
 - (9) Temporary facilities and controls.
 - (10) Work hours.
 - (11) Hazards and risks.

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION: continued

- (12) Progress cleaning.
 - (13) Quality and work standards.
 - (14) Change Orders.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS - NOT APPLICABLE.

PART 3 - EXECUTION - NOT APPLICABLE.

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY:

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's construction schedule.
 - 3. Construction schedule updating reports.
 - 4. Daily construction reports.
 - 5. Material location reports.
 - 6. Site condition reports.
 - 7. Special reports.
- B. Related Requirements:
 - 1. DIVISION 01 Section "Multiple Contract Summary" for preparing a combined Contractor's construction schedule.
 - 2. DIVISION 01 Section "Submittal Procedures" for submitting schedules and reports.
 - 3. DIVISION 01 Section "Quality Control" for submitting a schedule of tests and inspections.

1.03 DEFINITIONS:

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Architect.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time belongs to Owner.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION: continued

1.04 INFORMATIONAL SUBMITTALS:

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file, where indicated.
 - 2. PDF electronic file.
- B. Startup construction schedule.
 - 1. Approval of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - 1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 - 1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
 - 3. Total Float Report: List of all activities sorted in ascending order of total float.
 - 4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.
- F. Construction Schedule Updating Reports: Submit with Applications for Payment.
- G. Daily Construction Reports: Submit at weekly intervals.
- H. Material Location Reports: Submit at monthly intervals.
- I. Site Condition Reports: Submit at time of discovery of differing conditions.
- J. Special Reports: Submit at time of unusual event.
- K. Qualification Data: For scheduling consultant.

1.05 QUALITY ASSURANCE:

- A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.
- B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in DIVISION 01 Section "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
 - 1. Review software limitations and content and format for reports.
 - 2. Verify availability of qualified personnel needed to develop and update schedule.
 - 3. Discuss constraints, including phasing, work stages, area separations, interim milestones and partial Owner occupancy.
 - 4. Review delivery dates for Owner-furnished products.
 - 5. Review schedule for work of Owner's separate contracts.
 - 6. Review submittal requirements and procedures.
 - 7. Review time required for review of submittals and resubmittals.

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION: continued

8. Review requirements for tests and inspections by independent testing and inspecting agencies.
 9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
 10. Review and finalize list of construction activities to be included in schedule.
 11. Review procedures for updating schedule.
- 1.06 COORDINATION:
- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
 - B. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 1. Secure time commitments for performing critical elements of the Work from entities involved.
 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

- 2.01 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL:
- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion.
 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
 - B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - a. Ground Source Heat Pump System.
 3. Submittal Review Time: Include review and resubmittal times indicated in DIVISION 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's and Construction Manager's administrative procedures necessary for certification of Substantial Completion.
 6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion. Refer to Article 8.5.2, page 8 of the General Requirements Time.
 - C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 1. Phasing: Arrange list of activities on schedule by phase.
 2. Work under More Than One Contract: Include a separate activity for each contract.

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION: continued

3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in DIVISION 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in DIVISION 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 6. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
 7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Fabrication.
 - e. Sample testing.
 - f. Deliveries.
 - g. Installation.
 - h. Tests and inspections.
 - i. Adjusting.
 - j. Curing.
 - k. Building flush-out.
 - l. Startup and placement into final use and operation.
 8. Construction Areas: Identify each major area of construction for each major portion of the Work. 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. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.
 - e. Completion of electrical installation.
 - f. Substantial Completion.
 9. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.
- D. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
1. See DIVISION 01 Section "Payment Procedures" for cost reporting and payment procedures.

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION: continued

- E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 - 1. Unresolved issues.
 - 2. Unanswered Requests for Information.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
 - 5. Pending modifications affecting the Work and Contract Time.
- F. Recovery Schedule: When periodic update indicates the Work is [14] <Insert number> or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- G. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
 - 1. Use Scheduling component of Project Web site software specified in DIVISION 01 Section "Project Management and Coordination" for Windows XP operating system.

2.02 STARTUP CONSTRUCTION SCHEDULE:

- A. Bar-Chart Schedule: Submit startup, horizontal, bar-chart-type construction schedule within seven days of date established from the Notice to Proceed.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.03 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART):

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 30 days of date established for the Notice to Proceed. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 - 1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10% increments within time bar.

2.04 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE):

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's construction schedule using a time-scaled CPM network analysis diagram for the Work.
 - 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established from the Notice to Proceed.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION: continued

2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing[and commissioning].
 - j. Punch list and final completion.
 - k. Activities occurring following final completion.
 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
 5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, LEED[®] documentation, and demonstration and training (if applicable), in the amount of 5% of the Contract Sum.
 - a. Each activity cost shall reflect an appropriate value subject to approval by Architect.
 - b. Total cost assigned to activities shall equal the total Contract Sum.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION: continued

- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
 - 1. Contractor or subcontractor and the Work or activity.
 - 2. Description of activity.
 - 3. Main events of activity.
 - 4. Immediate preceding and succeeding activities.
 - 5. Early and late start dates.
 - 6. Early and late finish dates.
 - 7. Activity duration in workdays.
 - 8. Total float or slack time.
 - 9. Average size of workforce.
 - 10. Dollar value of activity (coordinated with the schedule of values).
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 - 1. Identification of activities that have changed.
 - 2. Changes in early and late start dates.
 - 3. Changes in early and late finish dates.
 - 4. Changes in activity durations in workdays.
 - 5. Changes in the critical path.
 - 6. Changes in total float or slack time.
 - 7. Changes in the Contract Time.
- H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
 - 1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
 - 2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
 - 3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
 - 4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
 - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
 - b. Submit value summary printouts one week before each regularly scheduled progress meeting.

2.05 REPORTS:

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 - 1. List of subcontractors at Project site.
 - 2. List of separate contractors at Project site.
 - 3. Approximate count of personnel at Project site.
 - 4. Equipment at Project site.
 - 5. Material deliveries.
 - 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 - 7. Accidents.
 - 8. Meetings and significant decisions.
 - 9. Unusual events (see special reports).

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION: continued

10. Stoppages, delays, shortages, and losses.
 11. Meter readings and similar recordings.
 12. Emergency procedures.
 13. Orders and requests of authorities having jurisdiction.
 14. Change Orders received and implemented.
 15. Construction Change Directives received and implemented.
 16. Services connected and disconnected.
 17. Equipment or system tests and startups.
 18. Partial completions and occupancies.
 19. Substantial Completions authorized.
- B. Material Location Reports: At weekly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
1. Material stored prior to previous report and remaining in storage.
 2. Material stored prior to previous report and since removed from storage and installed.
 3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.06 SPECIAL REPORTS:

- A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.01 CONTRACTOR'S CONSTRUCTION SCHEDULE:

- A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.
1. In-House Option: Owner may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
 2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.
- B. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION: continued

2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate final completion percentage for each activity.
- C. Distribution: Distribute copies of approved schedule to Architect, Construction Manager, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY:

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Requirements:
 - 1. DIVISION 01 Section "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. DIVISION 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 3. DIVISION 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 4. DIVISION 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 5. DIVISION 01 Section "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.03 DEFINITIONS:

- A. Action Submittals: Written and graphic information and physical samples that require Architect's or Owner's Representative's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's or Owner's Representative's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.04 ACTION SUBMITTALS:

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and Owner's Representative's and additional time for handling and reviewing submittals required by those corrections.
 - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 - 2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals

SECTION 013300 - SUBMITTAL PROCEDURES: continued

required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's or Owner's Representative's final release or approval.
 - g. Scheduled date of fabrication.
 - h. Scheduled dates for purchasing.
 - i. Scheduled dates for installation.
 - j. Activity or event number.

1.05 SUBMITTAL ADMINISTRATIVE REQUIREMENTS:

- A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
 1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
 - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - b. Digital Drawing Software Program: The Contract Drawings are available in AutoCAD 2010.
 - c. Contractor shall execute a data licensing agreement in the form of AIA Document C106, Digital Data Licensing Agreement.
 - d. The following digital data files will be furnished for each appropriate discipline:
 - (1) Floor plans.
 - (2) Reflected ceiling plans.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect and Construction Manager reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the

SECTION 013300 - SUBMITTAL PROCEDURES: continued

Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect or Owner's Representative will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
 4. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
- D. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect or Owner's Representative.
 4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Name of firm or entity that prepared submittal.
 - g. Names of subcontractor, manufacturer, and supplier.
 - h. Category and type of submittal.
 - i. Submittal purpose and description.
 - j. Specification Section number and title.
 - k. Specification paragraph number or drawing designation and generic name for each of multiple items.
 - l. Drawing number and detail references, as appropriate.
 - m. Location(s) where product is to be installed, as appropriate.
 - n. Related physical samples submitted directly.
 - o. Indication of full or partial submittal.
 - p. Transmittal number, numbered consecutively.
 - q. Submittal and transmittal distribution record.
 - r. Other necessary identification.
 - s. Remarks.

SECTION 013300 - SUBMITTAL PROCEDURES: continued

5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
 - a. Project name.
 - b. Number and title of appropriate Specification Section.
 - c. Manufacturer name.
 - d. Product name.
- E. Options: Identify options requiring selection by Architect or Owner's Representative.
- F. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect or Owner's Representative on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's or Owner's Representative's action stamp.
- H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- I. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's and Construction Manager's action stamp.

PART 2 - PRODUCTS

2.01 SUBMITTAL PROCEDURES:

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 1. Post electronic submittals as PDF electronic files directly to Architect's FTP site specifically established for Project.
 - a. Architect, through Construction Manager, will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 2. Submit electronic submittals via email as PDF electronic files.
 - a. Architect, through Construction Manager, will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 3. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
 - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

SECTION 013300 - SUBMITTAL PROCEDURES: continued

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before or concurrent with Samples.
 6. Submit Product Data in the following format:
 - a. PDF electronic file.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 2. 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 30 by 42 inches.
 3. Submit Shop Drawings in the following format:
 - a. PDF electronic file.
 4. BIM File Incorporation: Develop and incorporate Shop Drawing files into Building Information Model established for Project.
 - a. Prepare Shop Drawings in the following format: Same digital data software program, version, and operating system as the original Drawings.
 - b. Refer to DIVISION 01 Section "Project Management and Coordination" for requirements for coordination drawings.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.

SECTION 013300 - SUBMITTAL PROCEDURES: continued

- b. Product name and name of manufacturer.
- c. Sample source.
- d. Number and title of applicable Specification Section.
- e. Specification paragraph number and generic name of each item.
3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect or Owner's Representative will return submittal with options selected.
6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect and Construction Manager will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.
 - (1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - (2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least [three] <Insert number> sets of paired units that show approximate limits of variations.
- E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
 5. Submit product schedule in the following format:
 - a. PDF electronic file.

SECTION 013300 - SUBMITTAL PROCEDURES: continued

- F. Coordination Drawing Submittals: Comply with requirements specified in DIVISION 01 Section "Project Management and Coordination."
- G. Contractor's Construction Schedule: Comply with requirements specified in DIVISION 01 Section "Construction Progress Documentation."
- H. Application for Payment and Schedule of Values: Comply with requirements specified in DIVISION 01 Section "Payment Procedures."
- I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in DIVISION 01 Section "Quality Requirements."
- J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in DIVISION 01 Section "Closeout Procedures."
- K. Maintenance Data: Comply with requirements specified in DIVISION 01 Section "Operation and Maintenance Data."
- L. LEED® Submittals: Comply with requirements specified in DIVISION 01 sustainable design requirements Section.
- M. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- N. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- O. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- P. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- Q. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- R. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- S. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- T. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- U. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.

SECTION 013300 - SUBMITTAL PROCEDURES: continued

- V. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- W. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- X. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- Y. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.02 DELEGATED-DESIGN SERVICES:

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
- C. BIM File Incorporation: Incorporate delegated-design drawing and data files into Building Information Model established for Project.
 - 1. Prepare delegated-design drawings in the following format: Same digital data software program, version, and operating system as the original Drawings.

PART 3 - EXECUTION

3.01 CONTRACTOR'S REVIEW:

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect and Owner's Representative.
- B. Project Closeout and Maintenance Material Submittals: See requirements in DIVISION 01 Section "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

SECTION 013300 - SUBMITTAL PROCEDURES: continued

3.02 ARCHITECT'S ACTION:

- A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

A - SUBMITTAL APPROVED: Signifies Equipment or Material represented by the Submittal conforms with the design concept and complies with the intent of the Contract Documents and is approved for incorporation in the Work Contractor is to proceed with fabrication or procurement of the items and with related Work. Copies of the Submittal are to be transmitted to Engineer for final distribution.

B - SUBMITTAL APPROVED AS NOTED (RESUBMIT): Signifies Equipment and Material represented by the Submittal conforms with the design concept and complies with the intent of the Contract Documents and is approved for incorporation in the Work in accordance with Engineer's notations. Contractor is to proceed with fabrication or procurement of the items and with related Work in accordance with Engineer's notations and is to submit a revised Submittal responsive to notations marked on the returned Submittal or written in the letter of transmittal.

C - SUBMITTAL RETURNED FOR REVISION (RESUBMIT): Signifies Equipment and Material represented by the Submittal appears to conform with the design concept and comply with the intent of the Contract Documents but information is either insufficient in detail or contains discrepancies which prevent Engineer from completing his review. Contractor is to resubmit revised information responsive to Engineer's annotations on the returned Submittal or written in the letter of transmittal. Fabrication or procurement of items represented by the Submittal and related Work is not to proceed until the Submittal is approved.

D - SUBMITTAL NOT APPROVED (SUBMIT ANEW): Signifies Equipment and Material represented by the Submittal does not conform with the design concept or comply with the intent of the Contract Documents and is disapproved for use in the Work. Contractor is to provide Submittals responsive to the Contract Documents.

E - PRELIMINARY SUBMITTAL: Signifies Submittals of such preliminary nature that a determination of conformance with the design concept or compliance with the intent of the Contract Documents must be deferred until additional information is furnished. Contractor is to submit such additional information to permit layout and related activities to proceed.

F - FOR REFERENCE, NO APPROVAL REQUIRED: Signifies Submittals which are for supplementary information only; pamphlets, general information sheets, catalog cuts, standard sheets, bulletins and similar data, all of which are useful to Engineer or Owner in design, operation, or maintenance, but which by their nature do not constitute a basis for determining that items represented thereby conform with the design concept or comply with the intent of the Contract Documents. Engineer reviews such Submittals for general content but not for basic details.

SECTION 013300 - SUBMITTAL PROCEDURES: continued

G - DISTRIBUTION COPY (PREVIOUSLY APPROVED): Signifies Submittals which have been previously approved and are being distributed to Contractor, Owner, Resident Project Representative, and others for coordination and construction purposes.

- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect or Owner's Representative will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 013300

Project and Contract Identification

Contractor _____

Project Name DE ARNG RTI Phase I

Project Number _____

Contract Title _____

Contract No. _____

Spec. Sect. No. _____ Art. No. _____

Contractor's Approval: Submission of this document shall represent Contractor's approval as specified in the Contract Documents. Contractor remains liable for accuracy of Submittals as provided in the Contract Documents.

Date Engineer Received

Engineer's Action

(See Contract Documents)

Initials & Date

Initials & Date

A _____

E _____

B _____

F _____

C _____

G _____

D _____

SECTION 013526 - GOVERNMENTAL SAFETY REQUIREMENTS

1.01 GENERAL:

- A. References: The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
 - 1. American Society of Safety Engineers (ASSE/SAFE):
 - a. ASSE/SAFE A10.32 - Fall Protection, 2004.
 - b. ASSE/SAFE A10.34 - Protection of the Public on or Adjacent to Construction Sites, 2001; R 2005.
 - c. ASSE/SAFE Z359.1 - Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components, 2007.
 - 2. ASME International (ASME):
 - a. ASME B30.22 - Articulating Boom Cranes, 2005.
 - b. ASME B30.3 - Tower Cranes, 2009.
 - c. ASME B30.5 - Mobile and Locomotive Cranes, 2007.
 - 3. National Aeronautics And Space Administration (NASA):
 - a. NASA NPG 8621.1 - NASA Mishap Reporting, Investigating and Record Keeping Policy, 2004a.
 - 4. National Fire Protection Association (NFPA):
 - a. NFPA 10 - Standard for Portable Fire Extinguishers, 2010.
 - b. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations, 2009.
 - c. NFPA 51B - Standard for Fire Prevention during Welding, Cutting, and Other Hot Work, 2009.
 - d. NFPA 70 - National Electrical Code, 2011.
 - e. NFPA 70E - Standard for Electrical Safety in the Workplace, 2009; Errata 09-1.
 - 5. U.S. Army Corps of Engineers (USACE):
 - a. EM 385-1-1 - Safety and Health Requirements Manual, 2008.
 - 6. U.S. National Archives and Records Administration (NARA):
 - a. 29 CFR 1910 - Occupational Safety and Health Standards.
 - b. 29 CFR 1910.146 - Permit-Required Confined Spaces.
 - c. 29 CFR 1915 - Confined and Enclosed Spaces and Other Dangerous Atmospheres in Shipyard Employment.
 - d. 29 CFR 1926 - Safety and Health Regulations for Construction.
 - e. 29 CFR 1926.500 - Fall Protection.

1.02 SUBMITTALS:

- A. Submit the following in accordance with SECTION 013300 - SUBMITTAL PROCEDURES and the Contractor shall use the Project Web Site (Projectmates) system as specified in SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION for transmittal of documentary/paper type submittals.
- B. Preconstruction Submittals:
 - 1. Accident Prevention Plan (APP).
 - 2. Activity Hazard Analysis (AHA).
 - 3. Crane Critical Lift Plan.
 - 4. Proof of Qualification for Crane Operators.
 - 5. Severe Storm Plan.
- C. Test Reports:
 - 1. Reports: Submit reports as their incidence occurs, in accordance with the requirements of the paragraph entitled, "Reports."
 - 2. Accident Reports.

SECTION 013526 - GOVERNMENTAL SAFETY REQUIREMENTS: continued

3. Crane Reports.
- D. Certificates:
 1. Competent Persons Credentials.
 2. Confined Space Entry Permit.
 3. Hot work permit.
 4. Contractor Safety Self Evaluation Checklist.
 5. Certificate of Compliance (Crane): Submit one copy of each permit/certificate attached to each Daily Production Report.

1.03 DEFINITIONS:

- A. Competent Person for Fall Protection: A person who is capable of identifying hazardous or dangerous conditions in the personal fall arrest system or any component thereof, as well as their application and use with related equipment, and has the authority to take prompt corrective measures to eliminate the hazards of falling.
- B. High Visibility Accident: Any mishap which may generate publicity and/or high visibility.
- C. Medical Treatment:
 1. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician.
 2. Medical treatment does not include first aid treatment even through provided by a physician or registered personnel.
- D. Operating Envelope: The area surrounding any crane. Inside this "envelope" is the crane, the operator, riggers and crane walkers, rigging gear between the hook and the load, the load and the crane's supporting structure (ground, rail, etc.).
- E. Qualified Person for Fall Protection: A person with a recognized degree or professional certificate and with extensive knowledge, training and experience in the field of fall protection; who is capable of performing design, analysis, and evaluation of fall protection systems and equipment.
- F. Recordable Injuries or Illnesses: Any work-related injury or illness that results in:
 1. Death, regardless of the time between the injury and death, or the length of the illness.
 2. Days away from work (any time lost after day of injury/illness onset).
 3. Restricted work.
 4. Transfer to another job.
 5. Medical treatment beyond first aid.
 6. Loss of consciousness.
 7. A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (6) above.
- G. Weight Handling Equipment (WHE) Accident:
 1. A WHE accident occurs when any one or more of the 6 elements in the operating envelope fails to perform correctly during operation, including operation during maintenance or testing resulting in personnel injury or death; material or equipment damage; dropped load; derailment; two-blocking; overload; and/or collision, including unplanned contact between the load, crane, and/or other objects.
 2. A dropped load, derailment, two-blocking, overload and collision are considered accidents even though no material damage or injury occurs.
 3. A component failure (e.g., motor burnout, gear tooth failure, bearing failure) is not considered an accident solely due to material or equipment damage unless the component failure results in damage to other components (e.g., dropped boom, dropped load, roll over, etc.).

SECTION 013526 - GOVERNMENTAL SAFETY REQUIREMENTS: continued

4. Any mishap meeting the criteria described above shall be documented in both the Contractor Significant Incident Report (CSIR) and using the NAVFAC prescribed Navy Crane Center (NCC) form submitted within 5 days both as provided by the Contracting Officer or Designated Representative.
- 1.04 CONTRACTOR SAFETY SELF EVALUATION CHECKLIST:
- A. The checklist shall be updated and posted monthly to Projectmates by the Contractor and submitted with each request for payment.
 - B. Additionally, monthly exposure reporting to the Contracting Officer or Designated Representative is required to be attached to the monthly payment request.
 - C. This report is a compilation of employee-hours worked each month for all site workers, both prime and subcontractor.
 - D. The Contracting Officer or Designated Representative will provide copies of any special forms. An acceptable score of 90 or greater is required.
 - E. Failure to submit the completed safety self-evaluation checklist or achieve a score of at least 90 will result in retention of up to 10% of the voucher.
 - F. A copy of the Contractor Safety Self Evaluation Checklist is attached at the end of this Section.
- 1.05 REGULATORY REQUIREMENTS:
- A. In addition to the detailed requirements included in the provisions of this contract, comply with the most recent addition of USACE EM 385-1-1, and the following Federal, state, and local, laws, ordinances, criteria, rules and regulations.
 - B. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work.
 - C. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements govern.
- 1.06 SITE QUALIFICATIONS, DUTIES AND MEETINGS:
- A. Personnel Qualifications:
 1. Site Safety and Health Officer (SSHO):
 - a. The Contractor shall provide a Safety oversight team that includes a minimum of one (1) Competent Person at the project construction site to function as the Safety and Health Officer (SSHO).
 - b. The SSHO shall be at the work site at all times, unless specified differently in the contract, to perform safety and occupational health management, surveillance, inspections, and safety enforcement for the Contractor, and their training, experience, and qualifications shall be as required by EM 385-1-1 paragraph 01.A.17 and all associated sub-paragraphs.
 - c. A Competent Person shall be provided for all of the hazards identified in the Contractor's Safety and Health Program in accordance with the accepted Accident Prevention Plan, and shall be on-site at all times when the work that presents the hazards associated with their professional expertise is being performed.
 - d. Submit Competent Persons Credentials for approval by the Contracting Officer or Designated Representative in consultation with the Safety Office.
 - e. The Contractor Quality Control (QC) person can be the SSHO on this project.
 2. Competent Person for Confined Space Entry:
 - a. Provide a competent person for confined space meeting the definition and requirements of EM 385-1-1.
 - b. Submit Competent Person Credentials.

SECTION 013526 - GOVERNMENTAL SAFETY REQUIREMENTS: continued

3. Crane Operators:
 - a. Meet the crane operators' requirements in USACE EM 385-1-1, Section 16 and Appendix I.
 - b. In addition, for mobile cranes with Original Equipment Manufacturer (OEM) rated capacities of 50,000 pounds or greater, designate crane operators as qualified by a source that qualifies crane operators (i.e., union, a government agency, or organization that tests and qualifies crane operators).
 - c. Provide proof of current qualification.
- B. Personnel Duties:
 1. Site Safety and Health Officer (SSHO):
 - a. Conduct daily safety and health inspections and maintain a written log which includes area/operation inspected, date of inspection, identified hazards, recommended corrective actions, estimated and actual dates of corrections. Attach safety inspection logs to the Contractors' daily production and quality control reports.
 - b. Conduct mishap investigations and complete required reports.
 - c. Maintain the OSHA Form 300 and Daily Production reports for prime and sub-contractors.
 - d. Maintain applicable safety reference material on the job site.
 - e. Attend the pre-construction conference, pre-work meetings including preparatory inspection meeting, and periodic in-progress meetings.
 - f. Implement and enforce accepted APPs and AHAs.
 - g. Maintain a safety and health deficiency tracking system that monitors outstanding deficiencies until resolution. Post a list of unresolved safety and health deficiencies on the safety bulletin board.
 - h. Ensure subcontractor compliance with safety and health requirements.
 - i. Failure to perform the above duties will result in dismissal of the superintendent, QC Manager, and/or SSHO, and a project work stoppage.
 - j. The project work stoppage will remain in effect pending approval of a suitable replacement.
 - k. Maintain a list of hazardous chemicals on site and their material safety data sheets.
- C. Meetings:
 1. Preconstruction Conference:
 - a. Contractor representatives who have a responsibility or significant role in accident prevention on the project shall attend the preconstruction conference. This includes the project superintendent, site safety and health officer, quality control supervisor, or any other assigned safety and health professionals who participated in the development of the APP (including the Activity Hazard Analyses (AHAs) and special plans, program and procedures associated with it).
 - b. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract.
 - c. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer's representative as to which phases will require an analysis.
 - d. In addition, establish a schedule for the preparation, submittal, review, and acceptance of AHAs to preclude project delays.

SECTION 013526 - GOVERNMENTAL SAFETY REQUIREMENTS: continued

- e. Deficiencies in the submitted APP will be brought to the attention of the Contractor at the preconstruction conference, and the Contractor shall revise the plan to correct deficiencies and re-submit it for acceptance.
 - f. Do not begin work until there is an accepted APP.
 - g. The functions of a preconstruction conference may take place at the Post-Award Kickoff meeting for Design Build Contracts.
2. Safety Meetings:
- a. Conduct and document meetings as required by EM 385-1-1.
 - b. Attach minutes showing contract title, signatures of attendees and a list of topics discussed to the Contractors' daily production and quality control reports.
- 1.07 ACCIDENT PREVENTION PLAN (APP):
- A. Use a qualified person to prepare the written site-specific APP:
- 1. Prepare the APP in accordance with the format and requirements of USACE EM 385-1-1 and as supplemented herein.
 - 2. Cover all paragraph and subparagraph elements in USACE EM 385-1-1, Appendix A, "Minimum Basic Outline for Accident Prevention Plan".
 - 3. Specific requirements for some of the APP elements are described below:
 - a. The APP shall be job-specific and address any unusual or unique aspects of the project or activity for which it is written.
 - b. The APP shall interface with the Contractor's overall safety and health program. Include any portions of the Contractor's overall safety and health program referenced in the APP in the applicable APP element and made site-specific.
 - 4. The Government considers the Prime Contractor to be the "controlling authority" for all work site safety and health of the subcontractors.
 - 5. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out.
 - 6. The APP shall be signed by the person and firm (senior person) preparing the APP, the Contractor, the on-site superintendent, the designated site safety and health officer, the Contractor Quality control Manager, and any designated CSP and/or CIH.
 - 7. Submit the APP to the Contracting Officer or Designated Representative 15 calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP.
 - 8. Once accepted by the Contracting Officer or Designated Representative, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the Contracting Officer or Designated Representative, until the matter has been rectified.
 - 9. Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the Contracting Officer or Designated Representative, project superintendent, SSHO and quality control manager. Should any severe hazard exposure, i.e., imminent danger, become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard.
 - 10. Notify the Contracting Officer or Designated Representative within 24 hours of discovery.

SECTION 013526 - GOVERNMENTAL SAFETY REQUIREMENTS: continued

11. Eliminate/remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ASSE/SAFE A10.34,) and the environment.
 12. Copies of the accepted plan will be maintained at the Contracting Officer's or Designated Representative's office and at the job site.
 13. Continuously review and amend the APP, as necessary, throughout the life of the contract. Incorporate unusual or high-hazard activities not identified in the original APP as they are discovered.
- B. EM 385-1-1 Contents:
1. In addition to the requirements outlines in Appendix A of USACE EM 385-1-1, the following is required:
 - a. Names and qualifications (resumes, including education, training, experience and certifications) of all site safety and health personnel designated to perform work on this project to include the designated site safety and health officer and other competent and qualified personnel to be used such as CSPs, CIHs, STSs, CHSTs. Specify the duties of each position.
 - b. Qualifications of competent and of qualified persons. As a minimum, designate and submit qualifications of competent persons for each of the following major areas: excavation; scaffolding; fall protection; hazardous energy; confined space; health hazard recognition, evaluation and control of chemical, physical and biological agents; personal protective equipment and clothing to include selection, use and maintenance.
 - c. Confined Space Entry Plan: Develop a confined and/or enclosed space entry plan in accordance with USACE EM 385-1-1, applicable OSHA standards 29 CFR 1910, 29 CFR 1915, and 29 CFR 1926, OSHA Directive 2.100, and any other federal, state and local regulatory requirements identified in this contract.
 - (1) Identify the qualified person's name and qualifications, training, and experience.
 - (2) Delineate the qualified person's authority to direct work stoppage in the event of hazardous conditions.
 - (3) Include procedure for rescue by contractor personnel and the coordination with emergency responders. (If there is no confined space work, include a statement that no confined space work exists and none will be created.)
 - d. Crane Critical Lift Plan: Prepare and sign weight handling critical lift plans for lifts over 75% of the capacity of the crane or hoist (or lifts over 50% of the capacity of a barge mounted mobile crane's hoists) at any radius of lift; lifts involving more than one crane or hoist; lifts of personnel; and lifts involving non-routine rigging or operation, sensitive equipment, or unusual safety risks.
 - (1) Submit 15 calendar days prior to on-site work and include the requirements of USACE EM 385-1-1, paragraph 16.H. and the following: For lifts of personnel, demonstrate compliance with the requirements of 29 CFR 1926.550(g).
 - e. Fall Protection and Prevention (FP&P) Program Documentation: The program documentation shall be site specific and address all fall hazards in the work place and during different phases of construction.
 - (1) Address how to protect and prevent workers from falling to lower levels when they are exposed to fall hazards above 6 feet.
 - (2) A qualified person for fall protection shall prepare and sign the program documentation. Include fall protection and prevention systems, equipment

SECTION 013526 - GOVERNMENTAL SAFETY REQUIREMENTS: continued

and methods employed for every phase of work, responsibilities, assisted rescue, self-rescue and evacuation procedures, training requirements, and monitoring methods.

- (3) Revise the Fall Protection and Prevention Program documentation every 6 months for lengthy projects, reflecting any changes during the course of construction due to changes in personnel, equipment, systems or work habits.
 - (4) Keep and maintain the accepted Fall Protection and Prevention Program documentation at the job site for the duration of the project.
 - (5) Include the Fall Protection and Prevention Program documentation in the Accident Prevention Plan (APP).
- f. Excavation Plan: The safety and health aspects prepared in accordance with SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION.

1.08 ACTIVITY HAZARD ANALYSIS (AHA):

- A. The Activity Hazard Analysis (AHA) format shall be in accordance with USACE EM 385-1-1, Section 1. Submit the AHA for review at least 15 calendar days prior to the start of each phase.
- B. Format subsequent AHAs as amendments to the APP. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.
- C. The AHA list will be reviewed periodically (at least monthly) at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change.
- D. Develop the activity hazard analyses using the project schedule as the basis for the activities performed.
- E. Any activities listed on the project schedule will require an AHA.
- F. The AHAs will be developed by the contractor, supplier or subcontractor and provided to the prime contractor for submittal to the Contracting Officer or Designated Representative.

1.09 DISPLAY OF SAFETY INFORMATION:

- A. Within 1 calendar day after commencement of work, erect a safety bulletin board at the job site.
- B. Where size, duration, or logistics of project do not facilitate a bulletin board, an alternative method, acceptable to the Contracting Officer or Designated Representative, that is accessible and includes all mandatory information for employee and visitor review, shall be deemed as meeting the requirement for a bulletin board.
- C. Include and maintain information on safety bulletin board as required by EM 385-1-1, Section 01.A.06.
- D. Additional items required to be posted include:
 1. Confined space entry permit.
 2. Hot work permit.

1.10 SITE SAFETY REFERENCE MATERIALS:

- A. Maintain safety-related references applicable to the project, including those listed in the article "References."
- B. Maintain applicable equipment manufacturer's manuals.

1.11 EMERGENCY MEDICAL TREATMENT:

- A. Contractors will arrange for their own emergency medical treatment.
- B. Government has no responsibility to provide emergency medical treatment.

SECTION 013526 - GOVERNMENTAL SAFETY REQUIREMENTS: continued

1.12 REPORTS:

- A. Accident Reports:
1. Conduct an accident investigation for recordable injuries and illnesses, as defined in 1.3.h and property damage accidents resulting in at least \$2,000 in damages, to establish the root cause(s) of the accident, complete the Navy Contractor Significant Incident Report (CSIR) from USACE Accident Report Form 3394 and provide the report to the Contracting Officer or Designated Representative within 5 calendar days of the accident. The Contracting Officer or Designated Representative will provide copies of any required or special forms.
 2. Conduct an accident investigation for any weight handling equipment accident (including rigging gear accidents) to establish the root cause(s) of the accident, complete the WHE Accident Report (Crane and Rigging Gear) form and provide the report to the Contracting Officer or Designated Representative within 30 calendar days of the accident.
 - a. Do not proceed with crane operations until cause is determined and corrective actions have been implemented to the satisfaction of the Contracting Officer or Designated Representative.
 - b. The Contracting Officer or Designated Representative will provide a blank copy of the accident report form.
- B. Accident Notification:
1. Immediately contact local emergency services organizations (911) for assistance as needed.
 2. Notify the Contracting Officer or Designated Representative as soon as practical, but not more than four hours, after any accident meeting the definition of Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than \$2,000, or any weight handling equipment accident in accordance with NASA NPG 8621.1.
 3. Within notification include:
 - a. Contractor name.
 - b. Contract title.
 - c. Type of contract.
 - d. Name of activity.
 - e. Installation or location where accident occurred.
 - f. Date and time of accident.
 - g. Names of personnel injured.
 - h. Extent of property damage, if any.
 - i. Extent of injury, if known.
 - j. Brief description of accident (to include type of construction equipment used, PPE used, etc.).
 4. Preserve the conditions and evidence on the accident site until the Government investigation team arrives on-site and Government investigation is conducted.
- C. Crane Reports: Submit crane inspection reports required in accordance with USACE EM 385-1-1, Appendix I and as specified herein with Daily Reports of Inspections.
- D. Certificate of Compliance:
1. Provide a Certificate of Compliance for each crane entering an activity under this contract (see Contracting Officer or Designated Representative for a blank certificate).
 2. State within the certificate that the crane and rigging gear meet applicable OSHA regulations (with the Contractor citing which OSHA regulations are applicable, e.g., cranes used in construction, demolition, or maintenance comply with 29 CFR 1926 and USACE EM 385-1-1 Section 16 and Appendix I.

SECTION 013526 - GOVERNMENTAL SAFETY REQUIREMENTS: continued

3. Certify on the Certificate of Compliance that the crane operator(s) is qualified and trained in the operation of the crane to be used. Also certify that all of its crane operators working on the DOD activity have been trained in the proper use of all safety devices (e.g., anti-two block devices).
 4. Post certifications on the crane.
- 1.13 HOT WORK:
- A. Submit and obtain a written permit prior to performing "Hot Work" (welding, cutting, etc.) or operating other flame-producing/spark producing devices, from the local Fire Protection authorities having jurisdiction as required by law or regulation.
 - B. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED.
 - C. The Contractor will provide at least two 20-pound 4A:20 BC rated extinguishers for normal "Hot Work". All extinguishers shall be current inspection tagged, approved safety pin and tamper resistant seal.
 - D. Comply with applicable laws and regulations for any "Hot Work" performed on this Project.
 - E. A Fire Watch shall be trained in accordance with NFPA 51B and remain on-site for a minimum of 30 minutes after completion of the task or as specified on the hot work permit.
 - F. When starting work in the facility, require personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the emergency Fire Division phone number.
 - G. ANY FIRE, NO MATTER HOW SMALL, SHALL BE REPORTED TO THE LOCAL FIRE DEPARTMENT IMMEDIATELY.
- 1.14 CLOSURES:
- A. Streets, walks, and other facilities occupied and used by the public shall not be closed or obstructed without written permission from the local authorities having jurisdiction.
 - B. Contracting Officer or Designated Representative shall be kept informed of such closures as required.
- 1.15 SEVERE STORM PLAN:
- A. The Contractor shall prepare and submit a Severe Storm Plan to the Contracting Officer or Designated Representative.
 - B. In the event of a severe storm warning, the Contractor must:
 1. Secure outside equipment and materials and place materials that could be damaged in protected areas.
 2. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.
 3. Ensure that temporary erosion controls are adequate.
 4. Prepare a personnel protection and shelter plan, conduct a severe weather drill at not more than 90 calendar day intervals during construction to familiarize construction workers with severe weather sheltering procedures.
- 1.16 CONFINED SPACE ENTRY REQUIREMENTS:
- A. Contractors entering and working in confined spaces performing general industry work are required to follow the requirements of OSHA 29 CFR Part 1926.

SECTION 013526 - GOVERNMENTAL SAFETY REQUIREMENTS: continued

PART 2 - PRODUCTS

2.01 CONFINED SPACE SIGNAGE:

- A. Provide permanent signs integral to or securely attached to access covers for new permit-required confined spaces.
- B. Signs wording "DANGER - PERMIT - REQUIRED CONFINED SPACE - DO NOT ENTER - " in bold letters a minimum of one inch in height and constructed to be clearly legible with all paint removed.
- C. The signal word "DANGER" shall be red and readable from 5 feet.

2.02 FALL PROTECTION ANCHORAGE:

- A. Leave in place fall protection anchorage, conforming to ASSE/SAFE Z359.1, installed under the supervision of a qualified person in fall protection, for continued customer use and so identified by signage stating the capacity of the anchorage (strength and number of persons who may be tied-off to it at any one time).

PART 3 - EXECUTION

3.01 CONSTRUCTION AND/OR OTHER WORK:

- A. Comply with USACE EM 385-1-1, NFPA 241, the APP, the AHA, Federal and/or State OSHA regulations, and other related submittals and activity fire and safety regulations. The most stringent standard prevails.
- B. Hazardous Material Use:
 - 1. Each hazardous material must receive approval from the Contracting Officer or Designated Representative prior to being brought onto the job site or prior to any other use in connection with this contract.
 - 2. Allow a minimum of 14 Calendar days for processing of the request for use of a hazardous material.
- C. Hazardous Material Exclusions:
 - 1. Notwithstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with USACE EM 385-1-1 such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocyanates, lead-based paint are prohibited.
 - 2. The Contracting Officer or Designated Representative, upon written request by the Contractor, may consider exceptions to the use of any of the above excluded materials.
 - 3. The Radiation Safety Officer (RSO) must be notified prior to excepted items of radioactive material and devices being brought on base.
- D. Unforeseen Hazardous Material:
 - 1. The design should have identified materials such as PCB, lead paint, and friable and non-friable asbestos and other OSHA regulated chemicals (i.e., 29 CFR Part 1910.1000).
 - 2. If material, not indicated, that may be hazardous to human health upon disturbance during construction operations is encountered, stop that portion of work and notify the Contracting Officer or Designated Representative immediately.
 - 3. Within 14 calendar days the Government will determine if the material is hazardous:
 - a. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change.

SECTION 013526 - GOVERNMENTAL SAFETY REQUIREMENTS: continued

- b. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to "FAR 52.243-4, Changes" and "FAR 52.236-2, Differing Site Conditions."

3.02 PRE-OUTAGE COORDINATION MEETING:

- A. Contractors are required to apply for utility outages with local utility companies, at least 15 calendar days in advance.
- B. As a minimum, the request should include the location of the outage, utilities being affected, duration of outage and any necessary sketches.
- C. Special requirements for electrical outage requests are contained elsewhere in this specification Section.
- D. Once approved, and prior to beginning work on the utility system requiring shut down, attend a pre-outage coordination meeting with the Contracting Officer or Designated Representative and the local Public Utilities representative to review the scope of work and the lock-out/tag-out procedures for worker protection.
- E. No work will be performed on energized electrical circuits unless proof is provided that no other means exist.

3.03 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT):

- A. Contractor shall ensure that each employee is familiar with and complies with these procedures and USACE EM 385-1-1, Section 12, Control of Hazardous Energy.
 - 1. No person, regardless of position or authority, shall operate any switch, valve, or equipment that has an official lockout/tagout tag attached to it, nor shall such tag be removed except as provided in this Section.
 - 2. No person shall work on any energized equipment including, but not limited to activities such as erecting, installing, constructing, repairing, adjusting, inspecting, un-jamming, setting up, trouble shooting, testing, cleaning, dismantling, servicing and maintaining machines equipment of processes until an evaluation has been conducted identifying the energy source and the procedures which will be taken to ensure the safety of personnel.
 - 3. When work is to be performed on electrical circuits, only qualified personnel shall perform work on electrical circuits.
 - 4. A supervisor who is required to enter an area protected by a lockout/tagout tag will be considered a member of the protected group provided he notifies the holder of the tag stub each time he enters and departs from the protected area.
 - 5. Identification markings on building light and power distribution circuits shall not be relied on for established safe work conditions.
 - 6. Before clearance will be given on any equipment other than electrical (generally referred to as mechanical apparatus), the apparatus, valves, or systems shall be secured in a passive condition with the appropriate vents, pins, and locks.
 - 7. Pressurized or vacuum systems shall be vented to relieve differential pressure completely.
 - 8. Vent valves shall be tagged open during the course of the work.
 - 9. Where dangerous gas or fluid systems are involved, or in areas where the environment may be oxygen deficient, system or areas shall be purged, ventilated, or otherwise made safe prior to entry.
- B. Tag Placement:
 - 1. Lockout/tagout tags shall be completed in accordance with the regulations printed on the back thereof and attached to any device which, if operated, could cause an unsafe condition to exist.

SECTION 013526 - GOVERNMENTAL SAFETY REQUIREMENTS: continued

2. If more than one group is to work on any circuit or equipment, the employee in charge of each group shall have a separate set of lockout/tagout tags completed and properly attached.
 3. When it is required that certain equipment be tagged, the Government will review the characteristics of the various systems involved that affect the safety of the operations and the work to be done; take the necessary actions, including voltage and pressure checks, grounding, and venting, to make the system and equipment safe to work on; and apply such lockout/tagout tags to those switches, valves, vents, or other mechanical devices needed to preserve the safety provided. This operation is referred to as "Providing Safety Clearance."
- C. Tag Removal:
1. When any individual or group has completed its part of the work and is clear of the circuits or equipment, the supervisor, project leader, or individual for whom the equipment was tagged shall turn in his signed lockout/tagout tag stub to the Contracting Officer or Designated Representative.
 2. That group's or individual's lockout/tagout tags on equipment may then be removed on authorization by the Contracting Officer or Designated Representative.
- 3.04 FALL HAZARD PROTECTION AND PREVENTION PROGRAM:
- A. Establish a fall protection and prevention program, for the protection of all employees exposed to fall hazards. Within the program include company policy, identify responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and evacuation procedures.
- B. Training:
1. Institute a fall protection training program.
 2. As part of the Fall Hazard Protection and Prevention Program, provide training for each employee who might be exposed to fall hazards.
 3. Provide training by a competent person for fall protection in accordance with USACE EM 385-1-1, Section 21.B.
- C. Fall Protection Equipment and Systems:
1. Enforce use of the fall protection equipment and systems designated for each specific work activity in the Fall Protection and Prevention Plan and/or AHA at all times when an employee is exposed to a fall hazard.
 2. Protect employees from fall hazards as specified in EM 385-1-1, Section 21.
 3. In addition to the required fall protection systems, safety skiff, personal floatation devices, life rings etc., are required when working above or next to water in accordance with USACE EM 385-1-1, Paragraphs 21.N through 21.N.04.
 4. Personal fall arrest systems are required when working from an articulating or extendible boom, swing stages, or suspended platform.
 5. In addition, personal fall arrest systems are required when operating other equipment such as scissor lifts if the work platform is capable of being positioned outside the wheelbase.
 6. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment during raising, lowering, or travel.
 7. Fall protection must comply with 29 CFR 1926.500, Subpart M, USACE EM 385-1-1 and ASSE/SAFE A10.32.

SECTION 013526 - GOVERNMENTAL SAFETY REQUIREMENTS: continued

- a. Personal Fall Arrest Equipment:
 - (1) Personal fall arrest equipment, systems, subsystems, and components shall meet ASSE/SAFE Z359.1.
 - (2) Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device.
 - (3) Body belts may only be used as a positioning device system (for uses such as steel reinforcing assembly and in addition to an approved fall arrest system).
 - (4) Harnesses shall have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system.
 - (5) Only locking snap hooks and carabiners shall be used. Webbing, straps, and ropes shall be made of synthetic fiber.
 - (6) The maximum free fall distance when using fall arrest equipment shall not exceed 6 feet.
 - (7) The total fall distance and any swinging of the worker (pendulum-like motion) that can occur during a fall shall always be taken into consideration when attaching a person to a fall arrest system.
- D. Fall Protection for Roofing Work:
 - 1. Implement fall protection controls based on the type of roof being constructed and work being performed. Evaluate the roof area to be accessed for its structural integrity including weight-bearing capabilities for the projected loading.
 - a. Low Sloped Roofs:
 - (1) For work within 6 feet of an edge, on low-slope roofs, protect personnel from falling by use of personal fall arrest systems, guardrails, or safety nets. A safety monitoring system is not adequate fall protection and is not authorized.
 - (2) For work greater than 6 feet from an edge, erect and install warning lines in accordance with 29 CFR 1926.500 and USACE EM 385-1-1.
- E. Horizontal Lifelines: Design, install, certify and use under the supervision of a qualified person horizontal lifelines for fall protection as part of a complete fall arrest system which maintains a safety factor of 2 (29 CFR 1926.500).
- F. Guardrails and Safety Nets: Design, install and use guardrails and safety nets in accordance with EM 385-1-1 and 29 CFR 1926 Subpart M.
- G. Rescue and Evacuation Procedures:
 - 1. When personal fall arrest systems are used, the contractor must ensure that the mishap victim can self-rescue or can be rescued promptly should a fall occur.
 - 2. Prepare a Rescue and Evacuation Plan and include a detailed discussion of the following:
 - a. Methods of rescue.
 - b. Methods of self-rescue.
 - c. Equipment used.
 - d. Training requirement.
 - e. Specialized training for the rescuers.
 - f. Procedures for requesting rescue and medical assistance.
 - g. Transportation routes to a medical facility.
 - h. Include the Rescue and Evacuation Plan within the Activity Hazard Analysis (AHA) for the phase of work in the Fall Protection and Prevention (FP&P) Plan and the Accident Prevention Plan (APP).

SECTION 013526 - GOVERNMENTAL SAFETY REQUIREMENTS: continued

3.05 SCAFFOLDING:

- A. Provide employees with a safe means of access to the work area on the scaffold.
- B. Climbing of any scaffold braces or supports not specifically designed for access is prohibited.
- C. Access scaffold platforms greater than 20 feet maximum in height by use of a scaffold stair system.
- D. Do not use vertical ladders commonly provided by scaffold system manufacturers for accessing scaffold platforms greater than 20 feet maximum in height.
- E. The use of an adequate gate is required.
- F. Ensure that employees are qualified to perform scaffold erection and dismantling.
- G. Do not use scaffold without the capability of supporting at least four times the maximum intended load or without appropriate fall protection as delineated in the accepted fall protection and prevention plan.
- H. Stationary scaffolds must be attached to structural building components to safeguard against tipping forward or backward.
- I. Give special care to ensure scaffold systems are not overloaded.
- J. Side brackets used to extend scaffold platforms on self-supported scaffold systems for the storage of material are prohibited.
- K. The first tie-in shall be at the height equal to 4 times the width of the smallest dimension of the scaffold base.
- L. Place work platforms on mud sills.
- M. Scaffold or work platform erectors shall have fall protection during the erection and dismantling of scaffolding or work platforms that are more than 6 feet.
- N. Delineate fall protection requirements when working above 6 feet or above dangerous operations in the Fall Protection and Prevention (FP&P) Plan and Activity Hazard Analysis (AHA) for the phase of work.

3.06 EQUIPMENT:

- A. Material Handling Equipment:
 - 1. Material handling equipment such as forklifts shall not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions.
 - 2. The use of hooks on equipment for lifting of material must be in accordance with manufacturer's printed instructions.
 - 3. Operators of forklifts or power industrial trucks shall be licensed in accordance with OSHA.
- B. Weight Handling Equipment:
 - 1. Equip cranes and derricks as specified in EM 385-1-1, Section 16.
 - 2. The Contractor shall coordinate the location, height, warning light, etc., requirements of construction cranes with the City of Bethany Beach, DE and other agencies having jurisdiction on such matters. The cost of any permits shall be included in the Contract Price.
 - 3. Notify the Contracting Officer or Designated Representative 15 days in advance of any cranes entering the construction site so that necessary quality assurance spot checks can be coordinated. Contractor's operator shall remain with the crane during the spot check.
 - 4. Comply with the crane manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work.
 - a. Perform erection under the supervision of a designated person (as defined in ASME B30.5).
 - b. Perform all testing in accordance with the manufacturer's recommended procedures.

SECTION 013526 - GOVERNMENTAL SAFETY REQUIREMENTS: continued

5. Comply with ASME B30.5 for mobile cranes, ASME B30.22 for articulating boom cranes, ASME B30.3 for construction tower cranes.
 6. Under no circumstance shall a Contractor make a lift at or above 90% of the cranes rated capacity in any configuration.
 7. When operating in the vicinity of overhead transmission lines, operators and riggers shall be alert to this special hazard and follow the requirements of USACE EM 385-1-1 Section 11 and ASME B30.5 or ASME B30.22 as applicable.
 8. Do not crane suspended personnel work platforms (baskets), unless the Contractor proves that using any other access to the work location would provide a greater hazard to the workers or is impossible. Do not lift personnel with a line hoist or friction crane.
 9. Inspect, maintain, and recharge portable fire extinguishers as specified in NFPA 10, Standard for Portable Fire Extinguishers.
 10. All employees must keep clear of loads about to be lifted and of suspended loads.
 11. Use cribbing when performing lifts on outriggers.
 12. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.
 13. A physical barricade must be positioned to prevent personnel from entering the counterweight swing (tail swing) area of the crane.
 14. Certification records which include the date of inspection, signature identifier of the crane that was inspected shall always be available for review by Contracting Officer or Designated Representative personnel.
 15. Written reports listing the load test procedures used along with any repairs or alterations performed on the crane shall be available for review by Contracting Officer personnel.
 16. Certify that all crane operators have been trained in proper use of all safety devices (e.g., anti-two block devices).
 17. Take steps to ensure that wind speed does not contribute to loss of control of the load during lifting operations.
 - a. Prior to conducting lifting operations set a maximum wind speed at which a crane can be safely operated based on the equipment being used, the load being lifted, experience of operators and riggers, and hazards on the work site.
 - b. This maximum wind speed determination shall be included as part of the activity hazard analysis plan for that operation.
- C. Equipment and Mechanized Equipment:
1. Proof of qualifications for operator shall be kept on the project site for review.
 2. Manufacturer's specifications or owner's manual for the equipment shall be on-site and reviewed for additional safety precautions or requirements that are sometimes not identified by OSHA or USACE EM 385-1-1. Incorporate such additional safety precautions or requirements into the AHAs.
- D. Use of Explosives:
- E. Explosives shall not be used or brought to the project site without prior written approval from the Contracting Officer or Designated Representative. Such approval shall not relieve the Contractor of responsibility for injury to persons or for damage to property due to blasting operations.

3.07 EXCAVATIONS:

- A. Perform soil classification by a competent person in accordance with 29 CFR 1926.
- B. Utility Locations:
 1. Prior to digging, the appropriate digging permit must be obtained.

SECTION 013526 - GOVERNMENTAL SAFETY REQUIREMENTS: continued

2. All underground utilities in the work area must be positively identified by a private utility locating service (Miss Utility).
 3. Any markings made during the utility investigation must be maintained throughout the contract.
- C. Utility Location Verification:
1. The Contractor must physically verify underground utility locations by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within three feet of the underground system.
 2. Digging within 2 feet of a known utility must not be performed by means of mechanical equipment; hand digging shall be used.
 3. If construction is parallel to an existing utility expose the utility by hand digging every 100 feet if parallel within 5 feet of the excavation.
- D. Shoring Systems:
1. Trench and shoring systems must be identified in the accepted safety plan and AHA.
 2. Manufacture tabulated data and specifications or registered engineer tabulated data for shoring or benching systems shall be readily available on-site for review.
 3. Job-made shoring or shielding must have the registered professional engineer stamp, specifications, and tabulated data.
 4. Extreme care must be used when excavating near direct burial electric underground cables.
- E. Trenching Machinery:
1. Operate trenching machines with digging chain drives only when the spotters/laborers are in plain view of the operator.
 2. Provide operator and spotters/laborers training on the hazards of the digging chain drives with emphasis on the distance that needs to be maintained when the digging chain is operating.
 3. Keep documentation of the training on file at the project site.

3.08 UTILITIES WITHIN CONCRETE SLABS:

- A. Existing utilities located within concrete slabs on the project site are not anticipated.
- B. If encountered notify the Contracting Officer or Designated Representative immediately.
- C. Whenever contract work involves concrete chipping, saw cutting, or core drilling, the existing utility location must be coordinated with local utility location service (Miss Utility).
- D. Outages to isolate utility systems must be used in circumstances where utilities are unable to be positively identified.
- E. The use of historical drawings does not relieve the contractor from meeting this requirement.

3.09 ELECTRICAL:

- A. Conduct of Electrical Work:
1. Underground electrical spaces must be certified safe for entry before entering to conduct work.
 2. Cables that will be cut must be positively identified and de-energized prior to performing each cut. Positive cable identification must be made prior to submitting any outage request for electrical systems.
 3. Arrangements are to be coordinated with the Contracting Officer or Designated Representative and Station Utilities for identification.
 4. The Contracting Officer or Designated Representative will not accept an outage request until the Contractor satisfactorily documents that the circuits have been clearly identified.
 5. Perform all high voltage cable cutting remotely using hydraulic cutting tool.

SECTION 013526 - GOVERNMENTAL SAFETY REQUIREMENTS: continued

6. When racking in or live switching of circuit breakers, no additional person other than the switch operator will be allowed in the space during the actual operation.
 7. Plan so that work near energized parts is minimized to the fullest extent possible.
 8. Use of electrical outages clear of any energized electrical sources is the preferred method.
 9. When working in energized substations, only qualified electrical workers will be permitted to enter.
 10. When work requires Contractor to work near energized circuits as defined by the NFPA 70, high voltage personnel must use personal protective equipment that includes, as a minimum, electrical hard hat, safety shoes, insulating gloves with leather protective sleeves, fire retarding shirts, coveralls, face shields, and safety glasses.
 11. In addition, provide electrical arc flash protection for personnel as required by NFPA 70E.
 12. Insulating blankets, hearing protection, and switching suits may also be required, depending on the specific job and as delineated in the Contractor's AHA.
- B. Portable Extension Cords:
1. Size portable extension cords in accordance with manufacturer ratings for the tool to be powered and protected from damage.
 2. Immediately removed from service all damaged extension cords.
 3. Portable extension cords shall meet the requirements of NFPA 70E and OSHA electrical standards.

3.10 WORK IN CONFINED SPACES:

- A. Comply with the requirements in Section 34 of USACE EM 385-1-1, OSHA 29 CFR 1910.146 and OSHA 29 CFR 1926.21(b)(6).
- B. Any potential for a hazard in the confined space requires a permit system to be used.
 1. Entry Procedures:
 - a. Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. (See Section 34 of USACE EM 385-1-1 for entry procedures.)
 - b. All hazards pertaining to the space shall be reviewed with each employee during review of the AHA.
 2. Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained to ensure exposure to any hazardous atmosphere is kept below its action level.
 3. Sewer wet wells require continuous atmosphere monitoring with audible alarm for toxic gas detection.

END OF SECTION 013526

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.01 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.

1.02 DEFINITIONS:

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.03 INDUSTRY STANDARDS:

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.04 ABBREVIATIONS AND ACRONYMS:

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

SECTION 014200 - REFERENCES: continued

B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AA	Aluminum Association (The) www.aluminum.org	(703) 358-2960
AABC	Associated Air Balance Council www.aabchq.com	(202) 737-0202
AAMA	www.aamanet.org	
AASHTO	American Association of State Highway and Transportation Officials	(202) 624-5800
AATCC	American Association of Textile Chemists and Colorists www.aatcc.org	(919) 549-8141
ABAA	Air Barrier Association of America www.airbarrier.org	(866) 956-5888
ABMA	www.abma-dc.org	
ACI	American Concrete Institute	(248) 848-3700
ACPA	American Concrete Pipe Association www.concrete-pipe.org	(972) 506-7216
AEIC	Association of Edison Illuminating Companies, Inc. (The) www.aeic.org	(205) 257-2530
AF&PA	www.afandpa.org	(202) 463-2700
AGA	American Gas Association	(202) 824-7000
AHAM	Association of Home Appliance Manufacturers www.aham.org	(202) 872-5955
AHRI	Air-Conditioning, Heating, and Refrigeration Institute, The www.ahrinet.org	(703) 524-8800

SECTION 014200 - REFERENCES: continued

AI	www.asphaltinstitute.org	
AIA	American Institute of Architects (The)	(800) 242-3837
AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
AITC	www.aitc-glulam.org	
ALSC	American Lumber Standard Committee, Incorporated	(301) 972-1700
AMCA	Air Movement and Control Association International, Inc. www.amca.org	(847) 394-0150
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020
AOSA	www.aosaseed.com	
APA	APA - The Engineered Wood Association	(253) 565-6600
APA	Architectural Precast Association www.archprecast.org	(239) 454-6989
API	American Petroleum Institute www.api.org	(202) 682-8000
ARI	www.ari.org	
ARMA	Asphalt Roofing Manufacturers Association	(202) 207-0917
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)	

SECTION 014200 - REFERENCES: continued

ASHRAE	www.ashrae.org	(404) 636-8400
ASME	ASME International www.asme.org	(800) 843-2763
ASSE	American Society of Sanitary Engineering	(440) 835-3040
ASTM	ASTM International (American Society for Testing and Materials International)	(610) 832-9500
ATIS	Alliance for Telecommunications Industry Solutions www.atis.org	(202) 628-6380
AWCMA	American Window Covering Manufacturers Association (Now WCMA)	
AWCI	www.awci.org	
AWI	Architectural Woodwork Institute	(571) 323-3636
AWPA	American Wood Protection Association (Formerly: American Wood Preservers' Association)	(205) 733-4077
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BHMA	www.buildershardware.com	
BIA	Brick Industry Association (The)	(703) 620-0010
BICSI	BICSI, Inc. www.bicsi.org	(800) 242-7405 (813) 979-1991
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International) www.bifma.com	(616) 285-3963

SECTION 014200 - REFERENCES: continued

BISSC	Baking Industry Sanitation Standards Committee www.bissc.org	(866) 342-4772
CCC	www.carpetcushion.org	
CDA	Copper Development Association	(800) 232-3282
CEA	Canadian Electricity Association www.canelect.ca	(613) 230-9263
CEA	Consumer Electronics Association www.ce.org	(866) 858-1555 (703) 907-7600
CFFA	www.chemicalfabricsandfilm.com	
CGA	Compressed Gas Association	(703) 788-2700
CIMA	Cellulose Insulation Manufacturers Association www.cellulose.org	(888) 881-2462 (937) 222-2462
CISCA	Ceilings & Interior Systems Construction Association www.cisca.org	(630) 584-1919
CISPI	www.cispi.org	
CLFMI	Chain Link Fence Manufacturers Institute	(301) 596-2583
CPA	Composite Panel Association www.pbmdf.com	(703) 724-1128
CRI	Carpet and Rug Institute (The) www.carpet-rug.com	(800) 882-8846 (706) 278-3176
CRRC	www.coolroofs.org	(510) 485-7175
CRSI	Concrete Reinforcing Steel Institute	(847) 517-1200
CRRC	Cool Roof Rating Council www.coolroofs.org	(866) 465-2523 (510) 485-7175

SECTION 014200 - REFERENCES: continued

CSA	Canadian Standards Association www.csa.ca	(800) 463-6727 (416) 747-4000
CSA	(Formerly: IAS - International Approval Services) www.csa-international.org	(416) 747-4000
CSI	www.csinet.org	(703) 684-0300
CSSB	Cedar Shake & Shingle Bureau	(604) 820-7700
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute)	(281) 583-4087
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
ECA	Electrical Components Association www.ec-central.org	(703)907-8024
EIA	www.eia.org	
EIMA	EIFS Industry Members Association	(800) 294-3462
EJCDC	Engineers Joint Contract Documents Committee http://content.asce.org/ejcdc/	(703) 295-6000
EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
ESD	(Electrostatic Discharge Association) www.esda.org	
ETL SEMCO	(Formerly: ITS - Intertek Testing Service NA) www.intertek-etlsemko.com	
FIBA	(The International Basketball Federation) www.fiba.com	

SECTION 014200 - REFERENCES: continued

FIVB	(The International Volleyball Federation) www.fivb.ch	
FM Approvals	www.fmglobal.com	
FM Global	FM Global www.fmglobal.com	(401) 275-3000
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.	(407) 671-3772
FSA	Fluid Sealing Association www.fluidsealing.com	(610) 971-4850
FSC	Forest Stewardship Council www.fsc.org	49 228 367 66 0
GA	www.gypsum.org	(301) 277-8686
GANA	Glass Association of North America	(785) 271-0208
GRI	(Part of GSI)	
GS	www.greenseal.org	
GSI	Geosynthetic Institute	(610) 522-8440
HI	Hydronics Institute www.gamanet.org	(908) 464-8200
HI/GAMA	Hydronics Institute/Gas Appliance Manufacturers Association Division of Air-Conditioning, Heating, and Refrigeration Institute (AHRI) www.ahrinet.org	(908) 464-8200
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)	
HPVA	www.hpva.org	

SECTION 014200 - REFERENCES: continued

HPW	H. P. White Laboratory, Inc.	(410) 838-6550
IAPSC	International Association of Professional Security Consultants www.iapsc.org	(515) 282-8192
ICBO	International Conference of Building Officials www.iccsafe.org	(888) 422-7233
ICEA	www.icea.net	
ICRI	International Concrete Repair Institute, Inc.	(847) 827-0830
ICPA	International Cast Polymer Association www.icpa-hq.org	(703) 525-0320
IEC	International Electrotechnical Commission www.iec.ch	41 22 919 02 11
IEEE	www.ieee.org	
IES	Illuminating Engineering Society of North America	(703) 525-0320
IEST	Institute of Environmental Sciences and Technology www.iest.org	(847) 255-1561
IGMA	Insulating Glass Manufacturers Alliance www.igmaonline.org	(613) 233-1510
ILI	www.iliai.com	
ISA	Instrumentation, Systems, and Automation Society, The	(919) 549-8411
ISO	International Organization for Standardization www.iso.ch	41 22 749 01 11
ISSFA	International Solid Surface Fabricators Association www.issfa.net	(877) 464-7732 (801) 341-7360
ITS	(Now ETL SEMCO)	

SECTION 014200 - REFERENCES: continued

ITU	International Telecommunication Union	41 22 730 51 11
KCMA	Kitchen Cabinet Manufacturers Association www.kcma.org	(703) 264-1690
LGSEA	Light Gauge Steel Engineers Association www.arcat.com	(202) 263-4488
LMA	(Now part of CPA)	
LPI	Lightning Protection Institute	(800) 488-6864
MBMA	Metal Building Manufacturers Association www.mbma.com	(216) 241-7333
MCA	Metal Construction Association www.metalconstruction.org	(847) 375-4718
MFMA	www.maplefloor.org	
MFMA	Metal Framing Manufacturers Association, Inc.	(312) 644-6610
MH	Material Handling (Now MHIA)	
MHIA	Material Handling Industry of America www.mhia.org	(800) 345-1815 (704) 676-1190
MIA	www.marble-institute.com	
MPI	Master Painters Institute	(888) 674-8937
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc. www.mss-hq.com	(703) 281-6613
NAAMM	National Association of Architectural Metal Manufacturers www.naamm.org	(630) 942-6591
NACE	(National Association of Corrosion Engineers International) www.nace.org	(281) 228-6200

SECTION 014200 - REFERENCES: continued

NADCA	www.nadca.com	
NAGWS	National Association for Girls and Women in Sport	(800) 213-7193, ext. 453
NAIMA	North American Insulation Manufacturers Association www.naima.org	(703) 684-0084
NBGQA	National Building Granite Quarries Association, Inc. www.nbgqa.com	(800) 557-2848
NCAA	www.ncaa.org	
NCMA	National Concrete Masonry Association	(703) 713-1900
NCTA	National Cable & Telecommunications Association www.ncta.com	(202) 222-2300
NEBB	National Environmental Balancing Bureau www.nebb.org	(301) 977-3698
NECA	www.necanet.org	
NeLMA	Northeastern Lumber Manufacturers' Association	(207) 829-6901
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NETA	InterNational Electrical Testing Association www.netaworld.org	(888) 300-6382 (269) 488-6382
NFHS	www.nfhs.org	
NFPA	NFPA www.nfpa.org	(800) 344-3555
NFRC	National Fenestration Rating Council	(301) 589-1776

SECTION 014200 - REFERENCES: continued

NGA	National Glass Association www.glass.org	(866) 342-5642 (703) 442-4890
NHLA	National Hardwood Lumber Association www.natlhardwood.org	(800) 933-0318 (901) 377-1818
NLGA	www.nlga.org	
NOFMA	NOFMA: The Wood Flooring Manufacturers Association www.nofma.org	(901) 526-5016
NOMMA	National Ornamental & Miscellaneous Metals Association	(888) 516-8585
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400
NSF	(National Sanitation Foundation International) www.nsf.org	(734) 769-8010
NSSGA	www.nssga.org	(703) 525-8788
NTMA	National Terrazzo & Mosaic Association, Inc. (The)	(800) 323-9736
NWFA	National Wood Flooring Association www.nwfa.org	(800) 422-4556 (636) 519-9663
PCI	Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300
PDI	www.pdionline.org	(978) 557-0720
PGI	PVC Geomembrane Institute	(217) 333-3929
PTI	Post-Tensioning Institute www.post-tensioning.org	(248) 848-3180
RCSC	Research Council on Structural Connections www.boltcouncil.org	

SECTION 014200 - REFERENCES: continued

RFCI	www.rfci.com	(706) 882-3833
RIS	Redwood Inspection Service	
SAE	SAE International www.sae.org	(877) 606-7323 (724) 776-4841
SCAQMD	South Coast Air Quality Management District www.aqmd.com	(909) 396-2000
SCTE	www.scte.org	(610) 363-6888
SDI	Steel Deck Institute	(847) 458-4647
SDI	Steel Door Institute www.steeldoor.org	(440) 899-0010
SEFA	Scientific Equipment and Furniture Association www.sefalabs.com	(877) 294-5424 (516) 294-5424
SEI/ASCE	(See ASCE)	
SIA	Security Industry Association	(866) 817-8888
SJI	Steel Joist Institute www.steeljoist.org	(843) 626-1995
SMA	Screen Manufacturers Association www.smacentral.org	(561) 533-0991
SMACNA	National Association www.smacna.org	
SMPTE	www.smpte.org	
SPFA	Spray Polyurethane Foam Alliance www.sprayfoam.org	(800) 523-6154
SPIB	Southern Pine Inspection Bureau (The)	(850) 434-2611

SECTION 014200 - REFERENCES: continued

SPRI	Single Ply Roofing Industry www.spri.org	(781) 647-7026
SSINA	Specialty Steel Industry of North America www.ssina.com	(800) 982-0355 (202) 342-8630
SSPC	www.sspc.org	(412) 281-2331
STI	Steel Tank Institute	(847) 438-8265
SWI	Steel Window Institute www.steelwindows.com	(216) 241-7333
SWPA	Submersible Wastewater Pump Association www.swpa.org	(847) 681-1868
TCA	www.tilt-up.org	
TCNA	Tile Council of North America, Inc.	(864) 646-8453
TEMA	Tubular Exchanger Manufacturers Association www.tema.org	(914) 332-0040
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance www.tiaonline.org	(703) 907-7700
TMS	www.masonrysociety.org	
TPI	Truss Plate Institute, Inc.	(703) 683-1010
TPI	Turfgrass Producers International www.turfgrassod.org	(800) 405-8873 (847) 649-5555
TRI	Tile Roofing Institute www.tilerroofing.org	(312) 670-4177
UL	www.ul.com	(847) 272-8800
UNI	Uni-Bell PVC Pipe Association	(972) 243-3902

SECTION 014200 - REFERENCES: continued

USAV	USA Volleyball www.usavolleyball.org	(888) 786-5539 (719) 228-6800
USGBC	U.S. Green Building Council www.usgbc.org	(800) 795-1747
USITT	www.usitt.org	(315) 463-6463
WASTEC	Waste Equipment Technology Association	(800) 424-2869
WCLIB	West Coast Lumber Inspection Bureau www.wclib.org	(800) 283-1486 (503) 639-0651
WCMA	Window Covering Manufacturers Association www.wcmanet.org	(212) 297-2122
WDMA	(Formerly: NWWDA - National Wood Window and Door Association) www.wdma.com	(312) 321-6802
WI	www.wicnet.org	
WMMPA	Wood Moulding & Millwork Producers Association	(800) 550-7889
WSRCA	Western States Roofing Contractors Association www.wsrca.com	(800) 725-0333 (650) 570-5441
WWPA	Western Wood Products Association www.wwpa.org	(503) 224-3930

- C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

DIN

www.din.de

IAPMO International Association of Plumbing and Mechanical Officials (909) 472-4100

SECTION 014200 - REFERENCES: continued

ICC International Code Council (888) 422-7233
www.iccsafe.org

ICC-ES ICC Evaluation Service, Inc. (800) 423-6587
www.icc-es.org (562) 699-0543

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

COE Army Corps of Engineers
www.usace.army.mil

CPSC Consumer Product Safety Commission (800) 638-2772
www.cpsc.gov (301) 504-7923

DOC Department of Commerce (202) 482-2000
www.commerce.gov

DOD Department of Defense (215) 697-6257
http://dodssp.daps.dla.mil

DOE Department of Energy (202) 586-9220
www.energy.gov

EPA Environmental Protection Agency (202) 272-0167

FAA Federal Aviation Administration (866) 835-5322
www.faa.gov

FCC Federal Communications Commission (888) 225-5322
www.fcc.gov

FDA
www.fda.gov

GSA General Services Administration (800) 488-3111

HUD Department of Housing and Urban Development (202) 708-1112
www.hud.gov

LBL Lawrence Berkeley National Laboratory (510) 486-4000
www.lbl.gov

NCHRP
(See TRB)

SECTION 014200 - REFERENCES: continued

NIST	National Institute of Standards and Technology	(301) 975-6478
OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742 (202) 693-1999
PBS	Public Buildings Service (See GSA)	
PHS	http://www.hhs.gov/ophs/	
RUS	Rural Utilities Service	(202) 720-9540
SD	State Department www.state.gov	(202) 647-4000
TRB	Transportation Research Board http://gulliver.trb.org	(202) 334-2934
USDA	www.usda.gov	
USP	U.S. Pharmacopeia	(800) 227-8772
USPS	Postal Service www.usps.com	(202) 268-2000

- E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG	Americans with Disabilities Act (ADA) Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities Available from U.S. Access Board www.access-board.gov	(202) 272-0080
CFR	Code of Federal Regulations Available from Government Printing Office www.gpoaccess.gov/cfr/index.html	(866) 512-1800 (202) 512-1800
DOD	Department of Defense Military Specifications and Standards Available from Department of Defense Single Stock Point	(215) 697-2664

SECTION 014200 - REFERENCES: continued

<http://dodssp.daps.dla.mil>

DSCC Defense Supply Center Columbus
(See FS)

FED-STD Federal Standard
(See FS)

FS Available from Department of Defense Single Stock Point
<http://dodssp.daps.dla.mil/>

www.dsp.dla.mil

Available from General Services Administration (202) 619-8925

Available from National Institute of Building Sciences (202) 289-7800
www.wbdg.org/ccb

FTMS Federal Test Method Standard
(See FS)

MIL

MIL-STD (See MILSPEC)

MILSPEC Available from Department of Defense Single Stock Point
<http://dodssp.daps.dla.mil>

UFAS Available from Access Board (202) 272-0080
www.access-board.gov

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CBHF www.dca.ca.gov/bhfti (916) 574-2041

CCR California Code of Regulations (916) 323-6815

CDHS California Department of Health Services (916) 445-4171
www.dhcs.ca.gov

SECTION 014200 - REFERENCES: continued

CDPH California Department of Public Health, Indoor Air Quality Section
www.cal-iaq.org

CPUC
www.cpuc.ca.gov

TFS Texas Forest Service
<http://txforests-service.tamu.edu>

PART 2 - PRODUCTS - NOT APPLICABLE.

PART 3 - EXECUTION - NOT APPLICABLE.

END OF SECTION 014200

SECTION 014500 - QUALITY CONTROL

PART 1 - GENERAL

1.01 REFERENCES:

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
 - 1. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - a. ASHRAE 52.2 - (2007; Addenda B 2008; Errata 2009, Errata 2010; INT 2010) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
 - 2. ASTM International (ASTM):
 - a. ASTM D6245 - (2007) Using Indoor Carbon Dioxide Concentrations to Evaluate Indoor Air Quality and Ventilation.
 - b. ASTM D6345 - (2010) Selection of Methods for Active, Integrative Sampling of Volatile Organic Compounds in Air.
 - 3. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - a. ANSI/SMACNA 008 - (2007) IAQ Guidelines for Occupied Buildings Under Construction, 2nd Edition.
 - 4. U.S. Army Corps of Engineers (USACE):
 - a. EM 385-1-1 - (2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011) Safety and Health Requirements Manual.
 - 5. U.S. Green Building Council (USGBC):
 - a. LEED® - (2009) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC), and Major Renovations.
 - b. LEED Reference Guide - (2009) LEED-NC Reference Guide for Green Building Design and Construction.

1.02 ACTION SUBMITTALS:

- A. Submit the following in accordance with SECTION 013300 - SUBMITTAL PROCEDURES:
 - 1. Preconstruction Submittals:
 - a. Construction Quality Control (QC) Plan.
 - b. Indoor Air Quality (IAQ) Management Plan.
 - 2. Certificates:
 - a. QC Manager Resume.
 - b. CA Resume.

1.03 INFORMATION FOR THE CONTRACTING OFFICER:

- A. Prior to commencing work on construction, the Contractor can obtain a single copy set of the current report forms from the Contracting Officer.
- B. The report forms will consist of the Contractor Production Report, Contractor Production Report (Continuation Sheet), Contractor Quality Control (CQC) Report, (CQC) Report (Continuation Sheet), Preparatory Phase Checklist, Initial Phase Checklist, Rework Items List, and Testing Plan and Log.
- C. Deliver the following to the Contracting Officer during Construction:
 - 1. CQC Report:
 - a. Mail or hand-carry the original (wet signatures) and one copy by 10:00 a.m. the next working day after each day that work is performed and for every seven consecutive calendar days of no-work by 10:00 a.m. the next working day after each day that

SECTION 014500 - QUALITY CONTROL: continued

- work is performed and for every seven consecutive calendar days of no-work, attached to the CQC Report.
2. Contractor Production Report:
 - a. Submit the report electronically by 10:00 AM the next working day after each day that work is performed and for every seven consecutive calendar days of no-work by 10:00 AM the next working day after each day that work is performed and for every seven consecutive calendar days of no-work, attached to the CQC Report.
 3. Preparatory Phase Checklist:
 - a. Submit the report electronically in the same manner as the CQC Report for each Preparatory Phase held.
 4. Initial Phase Checklist:
 - a. Submit the report electronically in the same manner as the CQC Report for each Initial Phase held.
 5. QC Specialist Reports:
 - a. Submit the report electronically by 10:00 a.m. the next working day after each day that work is performed.
 6. Field Test Reports:
 - a. Within two working days after the test is performed, submit the report as an electronic attachment to the CQC Report.
 7. Monthly Summary Report of Tests:
 - a. Submit the report as an electronic attachment to the CQC Report at the end of each month.
 8. Testing Plan and Log:
 - a. Submit the report as an electronic attachment to the CQC Report, at the end of each month. A copy of the final Testing Plan and Log shall be provided to the OMSI preparer for inclusion into the OMSI documentation.
 9. Rework Items List:
 - a. Submit lists containing new entries daily, in the same manner as the CQC Report.
 10. CQC Meeting Minutes:
 - a. Within two working days after the meeting is held, submit the report as an electronic attachment to the CQC Report.
 11. QC Certifications:
 - a. As required by the paragraph entitled "QC Certifications."
- 1.04 QC PROGRAM REQUIREMENTS:
- A. Establish and maintain a QC program as described in this Section. This QC program is a key element in meeting the objectives of DE ARNG Commissioning. The QC program consists of a QC Organization, QC Plan, QC Plan Meeting(s), a Coordination and Mutual Understanding Meeting, QC meetings, three phases of control, submittal review and approval, testing, completion inspections, and QC certifications and documentation necessary to provide materials, equipment, workmanship, fabrication, construction and operations which comply with the requirements of this Contract. The QC program must cover on-site and off-site work and be keyed to the work sequence. No construction work or testing may be performed unless the QC Manager is on the work site. The QC Manager must report to an officer of the firm and not be subordinate to the Project Superintendent or the Project Manager. The QC Manager, Project Superintendent and Project Manager must work together effectively. Although the QC Manager is the primary individual responsible for quality control, all individuals will be held responsible for the quality of work on the job.

SECTION 014500 - QUALITY CONTROL: continued

- B. Commissioning:
 - 1. Commissioning (Cx) is a systematic process of ensuring that all building systems meet the requirements and perform interactively according to the Contract. The QC Program is a key to this process by coordinating, verifying and documenting measures to achieve the following objectives:
 - a. Verify and document that the applicable equipment and systems are installed in accordance with the design intent as expressed through the Contract and according to the manufacturer's recommendations and industry accepted minimum standards.
 - b. Verify and document that equipment and systems receive complete operational checkout by the installing contractors.
 - c. Verify and document proper performance of equipment and systems.
 - d. Verify that Operation and Maintenance (O&M) documentation is complete.
 - e. Verify the Training Plan and training materials are accurate and provide correct instruction and documentation on the critical elements of the products, materials, and systems in the constructed facility. Verify that all identified Government operating personnel are trained.
- C. Acceptance of the Construction Quality Control (QC) Plan:
 - 1. Acceptance of the QC Plan is required prior to the start of construction. The Contracting Officer reserves the right to require changes in the QC Plan and operations as necessary, including removal of personnel, to ensure the specified quality of work. The Contracting Officer reserves the right to interview any member of the QC organization at any time in order to verify the submitted qualifications. All QC organization personnel are subject to acceptance by the Contracting Officer. The Contracting Officer may require the removal of any individual for non-compliance with quality requirements specified in the Contract.
- D. Preliminary Construction Work Authorized Prior to Acceptance:
 - 1. The only construction work that is authorized to proceed prior to the acceptance of the QC Plan is mobilization of storage and office trailers, temporary utilities, and surveying.
- E. Notification of Changes:
 - 1. Notify the Contracting Officer, in writing, of any proposed changes in the QC Plan or changes to the QC organization personnel, a minimum of 10 work days prior to a proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

1.05 QC ORGANIZATION:

- A. QC Manager:
 - 1. Duties:
 - a. Provide a QC Manager at the work site to implement and manage the QC program. The only duties and responsibilities of the QC Manager are to manage and implement the QC program on this Contract. The QC Manager is required to attend the partnering meetings, QC Plan Meetings, Coordination and Mutual Understanding Meeting, conduct the QC meetings, perform the three phases of control except for those phases of control designated to be performed by QC Specialists, perform submittal review and approval, ensure testing is performed and provide QC certifications and documentation required in this Contract. The QC Manager is responsible for managing and coordinating the three phases of control and documentation performed by the QC Specialists, testing laboratory personnel and any other inspection and testing personnel required by this Contract. The QC Manager is the manager of all QC activities.

SECTION 014500 - QUALITY CONTROL: continued

2. Qualifications:
 - a. An individual with a minimum of 5 years combined experience in the following positions: Project Superintendent, QC Manager, Project Manager, Project Engineer or Construction Manager on similar size and type construction contracts which included the major trades that are part of this Contract. The individual must have at least two years' experience as a QC Manager. The individual must be familiar with the requirements of EM 385-1-1, and have experience in the areas of hazard identification, safety compliance, and sustainability. Resume is required.
- B. LEED Commissioning Authority:
 1. Duties:
 - a. Provide a Commissioning Authority (CA) as key person for the Cx and documentation thereof, who is subordinate to the QC Manager. The CA coordinates Cx activities and submits Cx reports to the Contracting Officer and DE ARNG-hired Commissioning Agent to meet the submittal and reporting requirements of the LEED EA Prerequisite Requirement for Fundamental Commissioning and the EA Credit 3 Requirement for Enhanced Commissioning. The CA coordinates the actions of the QC Specialists, Testing Laboratory personnel, and other inspection and testing personnel required by this Contract for building Cx.
 2. Qualifications:
 - a. The CA must be certified as a commissioning professional by the Association of Energy Engineers (AEE), the Building Commissioning Association (BCA), the National Environmental Balancing Bureau (NEBB), or the University of Wisconsin - Madison (UWM). CA resume is required, providing education, experience and management capabilities on at least two similar size and type contracts. The CA may not have been involved with the project design, construction management, or supervision. The CA must be a Leadership in Energy and Environmental Design Accredited Professional (LEED AP).
- C. Construction Quality Management Training:
 1. In addition to the above experience and education requirements, the QC Manager must have completed the course entitled "Construction Quality Management (CQM) for Contractors." If the QC Manager does not have a current certification, they must obtain the CQM for Contractors course certification within 90 days of award. This course is periodically offered by the Naval Facilities Engineering Command and the Army Corps of Engineers. Contact the Contracting Officer for information on the next scheduled class.
- D. Alternate QC Manager Duties and Qualifications:
 1. Designate an alternate for the QC Manager at the work site to serve in the event of the designated QC Manager's absence. The period of absence may not exceed two weeks at one time, and not more than 30 workdays during a calendar year. The qualification requirements for the Alternate QC Manager must be the same as for the QC Manager.
- E. QC Specialists Duties and Qualifications:
 1. Provide a separate QC Specialist at the work site for each of the areas of responsibilities, specified in Part 3, Execution, Field Quality Control, of the technical sections, who shall assist and report to the QC Manager and who may perform production related duties but must be allowed sufficient time to perform their assigned quality control duties. QC Specialists are required to attend the Coordination and Mutual Understanding Meeting, QC meetings and be physically present at the construction site to perform the three phases of control and prepare documentation for each definable feature of work in their area of responsibility at the frequency specified below.

SECTION 014500 - QUALITY CONTROL: continued

Qualification/Experience in Area of Responsibility	Area of Responsibility	Frequency
Roofing Manufacturer's Technical Representative/five years minimum	Installation and testing of roofing systems, SECTION 075323 - ETHYLENE-PROPYLENE-DIENE-MONOMER ROOFING	Full time
Mechanical Inspector, International Code Council (ICC) Certified/five years minimum	Installation and testing of boilers, SECTION 235249.0020 - STEAM BOILERS AND EQUIPMENT (500,000 - 18,000,000 BTU/HR)	Minimum three times a week during installation and full time during testing
	Erection of structural steel, SECTION 051200 - STRUCTURAL STEEL	Minimum twice a week

1.06 QUALITY CONTROL (QC) PLAN:

A. Construction Quality Control (QC) Plan:

1. Requirements:

- a. Provide, for acceptance by the Contracting Officer, a Construction QC Plan submitted in a three-ring binder that includes a table of contents, with major sections identified with tabs, with pages numbered sequentially, and that documents the proposed methods and responsibilities for accomplishing commissioning activities during the construction of the project:
 - (1) QC Organization:
 - (a) A chart showing the QC organizational structure.
 - (2) Names and Qualifications:
 - (a) Names and qualifications, in resume format, for each person in the QC organization. Include the CQM for Contractors course certifications for the QC Manager and Alternate QC Manager as required by the paragraphs entitled "Construction Quality Management Training" and "Alternate QC Manager Duties and Qualifications".
 - (3) Duties, Responsibility and Authority of QC Personnel:
 - (a) Duties, responsibilities, and authorities of each person in the QC organization.
 - (4) Outside Organizations:
 - (a) A listing of outside organizations, such as architectural and consulting engineering firms, that will be employed by the Contractor and a description of the services these firms will provide.

SECTION 014500 - QUALITY CONTROL: continued

- (5) Appointment Letters:
 - (a) Letters signed by an officer of the firm appointing the QC Manager and Alternate QC Manager and stating that they are responsible for implementing and managing the QC program as described in this Contract. Include in this letter the responsibility of the QC Manager and Alternate QC Manager to implement and manage the three phases of control, and their authority to stop work which is not in compliance with the Contract. Letters of direction are to be issued by the QC Manager to [the Assistant QC Manager and] all other QC Specialists outlining their duties, authorities, and responsibilities. Include copies of the letters in the QC Plan.
- (6) Submittal Procedures and Initial Submittal Register:
 - (a) Procedures for reviewing, approving, and managing submittals. Provide the name(s) of the person(s) in the QC organization authorized to review and certify submittals prior to approval. Provide the initial submittal of the Submittal Register as specified in SECTION 013300 - SUBMITTAL PROCEDURES.
- (7) Testing Laboratory Information:
 - (a) Testing laboratory information required by the paragraphs entitled "Accreditation Requirements", as applicable.
- (8) Testing Plan and Log:
 - (a) A Testing Plan and Log that includes the tests required, referenced by the specification paragraph number requiring the test, the frequency, and the person responsible for each test. Use Government forms to log and track tests.
- (9) Procedures to Complete Rework Items:
 - (a) Procedures to identify, record, track, and complete rework items. Use Government forms to record and track rework items.
- (10) Documentation Procedures:
 - (a) Use Government form.
- (11) List of Definable Features:
 - (a) A Definable Feature of Work (DFOW) is a task that is separate and distinct from other tasks and has control requirements and work crews unique to that task. A DFOW is identified by different trades or disciplines and is an item or activity on the construction schedule. Include in the list of DFOWs, but not be limited to, all critical path activities on the NAS. Include all activities for which this Specification requires QC Specialists or specialty inspection personnel. Provide separate DFOWs in the Network Analysis Schedule for each design development stage and submittal package.
- (12) Procedures for Performing the Three Phases of Control:
 - (a) Identify procedures used to ensure the three phases of control to manage the quality on this project. For each DFOW, a Preparatory and Initial phase checklist will be filled out during the Preparatory and Initial phase meetings. Conduct the Preparatory and Initial Phases and meetings with a view towards obtaining quality construction by planning ahead and identifying potential problems for each DFOW.

SECTION 014500 - QUALITY CONTROL: continued

- (13) Personnel Matrix:
 - (a) A personnel matrix showing for each section of the Specification who will review and approve submittals, who will perform and document the three phases of control, and who will perform and document the testing.
- (14) Procedures for Completion Inspection:
 - (a) Procedures for identifying and documenting the completion inspection process. Include in these procedures the responsible party for punch out inspection, pre-final inspection, and final acceptance inspection.
- (15) Training Procedures and Training Log:
 - (a) Not Applicable.
- (16) Organization and Personnel Certifications Log:
 - (a) Procedures for coordinating, tracking and documenting all certifications on subcontractors, testing laboratories, suppliers, personnel, etc. QC Manager will ensure that certifications are current, appropriate for the work being performed, and will not lapse during any period of the contract that the work is being performed.

1.07 QC PLAN MEETINGS:

- A. Prior to submission of the QC Plan, the QC Manager will meet with the Contracting Officer to discuss the QC Plan requirements of this Contract. The purpose of this meeting is to develop a mutual understanding of the QC Plan requirements prior to plan development and submission and to agree on the Contractor's list of DFOWs.

1.08 COORDINATION AND MUTUAL UNDERSTANDING MEETING:

- A. After submission of the QC Plan, and prior to the start of construction, the QC Manager will meet with the Contracting Officer to present the QC program required by this Contract. When a new QC Manager is appointed, the coordination and mutual understanding meeting shall be repeated.
 - 1. Purpose:
 - a. The purpose of this meeting is to develop a mutual understanding of the QC details, including documentation, administration for on-site and off-site work, design intent, Cx, environmental requirements and procedures, coordination of activities to be performed, and the coordination of the Contractor's management, production, and QC personnel. At the meeting, the Contractor will be required to explain in detail how three phases of control will be implemented for each DFOW, as well as how each DFOW will be affected by each management plan or requirement as listed below:
 - (1) Waste Management Plan.
 - (2) IAQ Management Plan.
 - (3) Procedures for noise and acoustics management.
 - (4) Environmental Protection Plan.
 - (5) Environmental regulatory requirements.
 - (6) Cx Plan.
 - 2. Coordination of Activities:
 - a. Coordinate activities included in various sections to assure efficient and orderly installation of each component. Coordinate operations included under different sections that are dependent on each other for proper installation and operation. Schedule construction operations with consideration for indoor air quality as

SECTION 014500 - QUALITY CONTROL: continued

specified in the IAQ Management Plan. Coordinate prefunctional tests and startup testing with Cx.

3. Attendees:
 - a. As a minimum, the Contractor's personnel required to attend include an officer of the firm, the Project Manager, Project Superintendent, QC Manager, Alternate QC Manager, QC Specialists, CA, Environmental Manager, and subcontractor representatives. Each subcontractor who will be assigned QC responsibilities shall have a principal of the firm at the meeting. Minutes of the meeting will be prepared by the QC Manager and signed by the Contractor and the Owner's Representative. Provide a copy of the signed minutes to all attendees and shall be included in the QC Plan.

1.09 QC MEETINGS:

- A. After the start of construction, conduct QC meetings once every two weeks by the QC Manager at the work site with the Project Superintendent, QC Specialists, the CA, and the foremen who are performing the work of the DFOWs. The QC Manager is to prepare the minutes of the meeting and provide a copy to the Contracting Officer within two working days after the meeting. The Contracting Officer may attend these meetings. As a minimum, accomplish the following at each meeting:
 1. Review the minutes of the previous meeting.
 2. Review the schedule and the status of work and rework.
 3. Review the status of submittals.
 4. Review the work to be accomplished in the next two weeks and documentation required.
 5. Resolve QC and production problems (RFI, etc.).
 6. Address items that may require revising the QC Plan.
 7. Review Accident Prevention Plan (APP).
 8. Review environmental requirements and procedures.
 9. Review Waste Management Plan.
 10. Review IAQ Management Plan.
 11. Review Environmental Management Plan.
 12. Review the status of training completion.
 13. Review Cx Plan and progress.

1.10 DESIGN REVIEW AND DOCUMENTATION:

- A. Basis of Design and Design Intent:
 1. Review the basis of design received from the Contracting Officer and the design intent.
 2. Design Review:
 - a. Review design documents to verify that each commissioned system meets the design intent relative to functionality, energy performance, water performance, maintainability, sustainability, system cost, indoor environmental quality, and local environmental impacts. Fully document review in written report.
 3. Contract Document Review:
 - a. Review the Contract documents to verify that Cx is adequately specified, and that each commissioned system is likely to meet the design intent relative to functionality, energy performance, water performance, maintainability, sustainability, system cost, indoor environmental quality, and local environmental impacts.

SECTION 014500 - QUALITY CONTROL: continued

1.11 THREE PHASES OF CONTROL:

- A. Adequately cover both on-site and off-site work with the Three Phases of Control and include the following for each DFWO.
- B. Preparatory Phase:
 - 1. Notify the Contracting Officer at least two work days in advance of each preparatory phase meeting. The meeting will be conducted by the QC Manager and attended by the QC Specialists, the Project Superintendent, the CA, and the foreman responsible for the DFWO. When the DFWO will be accomplished by a subcontractor, that subcontractor's foreman shall attend the preparatory phase meeting. Document the results of the preparatory phase actions in the daily Contractor Quality Control Report and in the Preparatory Phase Checklist. Perform the following prior to beginning work on each DFWO:
 - a. Review each paragraph of the applicable specification sections.
 - b. Review the Contract drawings.
 - c. Verify that field measurements are as indicated on construction and/or shop drawings before confirming product orders, in order to minimize waste due to excessive materials.
 - d. Verify that appropriate shop drawings and submittals for materials and equipment have been submitted and approved. Verify receipt of approved factory test results, when required.
 - e. Review the testing plan and ensure that provisions have been made to provide the required QC testing.
 - f. Examine the work area to ensure that the required preliminary work has been completed.
 - g. Coordinate the schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
 - h. Arrange for the return of shipping/packaging materials, such as wood pallets, where economically feasible.
 - i. Examine the required materials, equipment and sample work to ensure that they are on hand and conform to the approved shop drawings and submitted data.
 - j. Discuss specific controls used and construction methods, construction tolerances, workmanship standards, and the approach that will be used to provide quality construction by planning ahead and identifying potential problems for each DFWO.
 - k. Review the APP and appropriate Activity Hazard Analysis (AHA) to ensure that applicable safety requirements are met, and that required Material Safety Data Sheets (MSDS) are submitted.
 - l. Review the Cx Plan and ensure all preliminary work items have been completed and documented.
- C. Initial Phase:
 - 1. Notify the Contracting Officer at least two work days in advance of each initial phase. When construction crews are ready to start work on a DFWO, conduct the initial phase with the QC Specialists, the Project Superintendent, and the foreman responsible for that DFWO. Observe the initial segment of the DFWO to ensure that the work complies with Contract requirements. Document the results of the initial phase in the [daily CQC Report and in the]Initial Phase Checklist. Repeat the initial phase for each new crew to work on-site, or when acceptable levels of specified quality are not being met. Perform the following for each DFWO:
 - a. Establish the quality of workmanship required.
 - b. Resolve conflicts.

SECTION 014500 - QUALITY CONTROL: continued

- c. Ensure that testing is performed by the approved laboratory.
 - d. Check work procedures for compliance with the APP and the appropriate AHA to ensure that applicable safety requirements are met.
 - e. Review the Cx Plan and ensure all preparatory work items have been completed and documented.
- D. Follow-Up Phase:
- 1. Perform the following for on-going work daily, or more frequently as necessary, until the completion of each DFOW and document in the daily CQC Report:
 - a. Ensure the work is in compliance with Contract requirements.
 - b. Maintain the quality of workmanship required.
 - c. Ensure that testing is performed by the approved laboratory.
 - d. Ensure that rework items are being corrected.
 - e. Assure manufacturers' representatives have performed necessary inspections if required and perform safety inspections.
 - f. Review the Cx Plan and ensure all work items, testing, and documentation has been completed.
- E. Additional Preparatory and Initial Phases:
- 1. Conduct additional preparatory and initial phases on the same DFOW if the quality of on-going work is unacceptable, if there are changes in the applicable QC organization, if there are changes in the on-site production supervision or work crew, if work on a DFOW is resumed after substantial period of inactivity, or if other problems develop.
- F. Notification of Three Phases of Control for Off-Site Work:
- 1. Notify the Contracting Officer at least two weeks prior to the start of the preparatory and initial phases.
- 1.12 SUBMITTAL REVIEW AND APPROVAL:
- A. Procedures for submission, review and approval of submittals are described in SECTION 013300 - SUBMITTAL PROCEDURES.
- 1.13 TESTING:
- A. Except as stated otherwise in the specification sections, perform sampling and testing required under this Contract.
 - B. Accreditation Requirements:
 - 1. Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation. The laboratory's scope of accreditation must include the appropriate ASTM standards (E329, C1077, D3666, D3740, A880, E543) listed in the technical sections of the Specifications. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the Corporate Office.
 - C. Laboratory Accreditation Authorities:
 - 1. Laboratory Accreditation Authorities include the National Voluntary Laboratory Accreditation Program (NVLAP) administered by the National Institute of Standards and Technology at <http://ts.nist.gov/ts/htdocs/210/214/214.htm> , the American Association of State Highway and Transportation Officials (AASHTO) program at <http://www.transportation.org/aashto/home.nsf/frontpage>, International Accreditation Services, Inc. (IAS) at <http://www.iasonline.org>, U. S. Army Corps of Engineers Materials Testing Center (MTC) at <http://www.wes.army.mil/SL/MTC/>, the American Association for Laboratory Accreditation (A2LA) program at <http://www.a2la.org/>, the

SECTION 014500 - QUALITY CONTROL: continued

Washington Association of Building Officials (WABO) at <http://www.wabo.org/> (Approval authority for WABO is limited to projects within Washington State), and the Washington Area Council of Engineering Laboratories (WACEL) at <http://www.wacel.org/labaccred.html> (Approval authority by WACEL is limited to projects within Facilities Engineering Command (FEC) Washington geographical area).

D. Capability Check:

1. The Contracting Officer retains the right to check laboratory equipment in the proposed laboratory and the laboratory technician's testing procedures, techniques, and other items pertinent to testing, for compliance with the standards set forth in this Contract.

E. Test Results:

1. Cite applicable Contract requirements, tests or analytical procedures used. Provide actual results and include a statement that the item tested or analyzed conforms or fails to conform to specified requirements. If the item fails to conform, notify the Contracting Officer immediately. Conspicuously stamp the cover sheet for each report in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements, whichever is applicable. Test results must be signed by a testing laboratory representative authorized to sign certified test reports. Furnish the signed reports, certifications, and other documentation to the Contracting Officer via the QC Manager. Furnish a summary report of field tests at the end of each month, per the paragraph entitled "INFORMATION FOR THE CONTRACTING OFFICER".

F. Test Reports and Monthly Summary Report of Tests:

1. Furnish the signed reports, certifications, and a summary report of field tests at the end of each month to the Contracting Officer. Attach a copy of the summary report to the last daily Contractor Quality Control Report of each month. Provide a copy of the signed test reports and certifications to the OMSI preparer for inclusion into the OMSI documentation.

1.14 QC CERTIFICATIONS:

A. CQC Report Certification:

1. Contain the following statement within the CQC Report: "On behalf of the Contractor, I certify that this report is complete and correct and equipment and material used and work performed during this reporting period is in compliance with the contract drawings and specifications to the best of my knowledge, except as noted in this report."

B. Invoice Certification:

1. Furnish a certificate to the Contracting Officer with each payment request, signed by the QC Manager, attesting that as-built drawings are current, coordinated and attesting that the work for which payment is requested, including stored material, is in compliance with Contract requirements.

C. Completion Certification:

1. Upon completion of work under this Contract, the QC Manager shall furnish a certificate to the Contracting Officer attesting that "the work has been completed, inspected, tested and is in compliance with the Contract." Provide a copy of this final QC Certification for completion to the OMSI preparer for inclusion into the OMSI documentation.

1.15 COMPLETION INSPECTIONS:

A. Punch-Out Inspection:

1. Near the completion of all work or any increment thereof, established by a completion time stated in the Contract Clause entitled "Commencement, Prosecution, and Completion of Work," or stated elsewhere in the Specifications, the QC Manager and the

SECTION 014500 - QUALITY CONTROL: continued

CA must conduct an inspection of the work and develop a "punch list" of items which do not conform to the approved Drawings, Specifications and Contract. Include in the punch list any remaining items on the "Rework Items List", which were not corrected prior to the Punch-Out Inspection. Include within the punch list the estimated date by which the deficiencies will be corrected. Provide a copy of the punch list to the Contracting Officer. The QC Manager, or staff, must make follow-on inspections to ascertain that all deficiencies have been corrected. Once this is accomplished, notify the Government that the facility is ready for the Government "Pre-Final Inspection".

B. Pre-Final Inspection:

1. The Government and QCM will perform this inspection to verify that the facility is complete and ready to be occupied. A Government "Pre-Final Punch List" will be documented by the CQM as a result of this inspection. The QC Manager will ensure that all items on this list are corrected prior to notifying the Government that a "Final" inspection with the Client can be scheduled. Any items noted on the "Pre-Final" inspection must be corrected in a timely manner and be accomplished before the contract completion date for the work, or any particular increment thereof, if the project is divided into increments by separate completion dates.

C. Final Acceptance Inspection:

1. Notify the Contracting Officer at least 14 calendar days prior to the date a final acceptance inspection can be held. State within the notice that all items previously identified on the pre-final punch list will be corrected and acceptable, along with any other unfinished Contract work, by the date of the final acceptance inspection. The Contractor must be represented by the QC Manager, the Project Superintendent, the CA, and others deemed necessary. Attendees for the Government will include the Contracting Officer, other FEAD/ROICC personnel, and personnel representing the Client. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the Contract Clause entitled "Inspection of Construction."

1.16 DOCUMENTATION:

A. Maintain current and complete records of on-site and off-site QC program operations and activities.

B. Construction Documentation:

1. Reports are required for each day that work is performed and must [be attached to]the Contractor Quality Control Report prepared for the same day. Maintain current and complete records of on-site and off-site QC program operations and activities. The forms identified under the paragraph "INFORMATION FOR THE CONTRACTING OFFICER" will be used. Reports are required for each day work is performed. Account for each calendar day throughout the life of the Contract. Every space on the forms must be filled in. Use N/A if nothing can be reported in one of the spaces. The Project Superintendent and the QC Manager must prepare and sign the Contractor Production and CQC Reports, respectively. The reporting of work must be identified by terminology consistent with the construction schedule. In the "remarks" sections of the reports, enter pertinent information including directions received, problems encountered during construction, work progress and delays, conflicts or errors in the drawings or specifications, field changes, safety hazards encountered, instructions given and corrective actions taken, delays encountered and a record of visitors to the work site, quality control problem areas, deviations from the QC Plan, construction deficiencies

SECTION 014500 - QUALITY CONTROL: continued

encountered, meetings held. For each entry in the report(s), identify the Schedule Activity No. that is associated with the entered remark.

- C. Quality Control Validation:
1. Establish and maintain the following in a series of three ring binders. Binders shall be divided and tabbed as shown below. These binders must be readily available to the Contracting Officer during all business hours.
 - a. All completed Preparatory and Initial Phase Checklists, arranged by specification section.
 - b. All milestone inspections, arranged by Activity Number.
 - c. An up-to-date copy of the Testing Plan and Log with supporting field test reports, arranged by specification section.
 - d. Copies of all contract modifications, arranged in numerical order. Also include documentation that modified work was accomplished.
 - e. An up-to-date copy of the Rework Items List.
 - f. Maintain up-to-date copies of all punch lists issued by the QC staff to the Contractor and Sub-Contractors and all punch lists issued by the Government.
 - g. Commissioning documentation including Cx checklists, schedules, tests, and reports.
- D. Reports from the QC Specialist(s):
1. Reports are required for each day that work is performed in their area of responsibility. QC Specialist reports shall include the same documentation requirements as the CQC Report for their area of responsibility. QC Specialist reports are to be prepared, signed and dated by the QC Specialists and shall be attached to the CQC Report prepared for the same day.
- E. Testing Plan and Log:
1. As tests are performed, the CA and the QC Manager will record on the "Testing Plan and Log" the date the test was performed and the date the test results were forwarded to the Contracting Officer. Attach a copy of the updated "Testing Plan and Log" to the last daily CQC Report of each month, per the paragraph "INFORMATION FOR THE CONTRACTING OFFICER". Provide a copy of the final "Testing Plan and Log" to the OMSI preparer for inclusion into the OMSI documentation.
- F. Rework Items List:
1. The QC Manager must maintain a list of work that does not comply with the Contract, identifying what items need to be reworked, the date the item was originally discovered, the date the item will be corrected by, and the date the item was corrected. There is no requirement to report a rework item that is corrected the same day it is discovered. Attach a copy of the "Rework Items List" to the last daily CQC Report of each month. The Contractor is responsible for including those items identified by the Contracting Officer.
- G. As-Built Drawings:
1. The QC Manager is required to ensure the as-built drawings, required by SECTION 017800 - CLOSEOUT SUBMITTALS are kept current on a daily basis and marked to show deviations which have been made from the Contract drawings. Ensure each deviation has been identified with the appropriate modifying documentation (e.g. PC No., Modification No., Request for Information No., etc.). The QC Manager or QC Specialist assigned to an area of responsibility must initial each revision. Upon completion of work, the QC Manager will furnish a certificate attesting to the accuracy of the as-built drawings prior to submission to the Contracting Officer.

SECTION 014500 - QUALITY CONTROL: continued

1.17 NOTIFICATION ON NON-COMPLIANCE:

- A. The Contracting Officer will notify the Contractor of any detected non-compliance with the Contract. Take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders will be made the subject of claim for extension of time for excess costs or damages by the Contractor.

1.18 CONSTRUCTION INDOOR AIR QUALITY (IAQ) MANAGEMENT PLAN:

- A. Submit an IAQ Management Plan within 15 days after Contract award and not less than 10 days before the preconstruction meeting. Revise and resubmit Plan as required by the Contracting Officer. Make copies of the final plan available to all workers on site. Include provisions in the Plan to meet the requirements specified below and to ensure safe, healthy air for construction workers and building occupants.
- B. Requirements During Construction:
 - 1. Provide for evaluation of indoor Carbon Dioxide concentrations in accordance with ASTM D6245. Provide for evaluation of volatile organic compounds (VOCs) in indoor air in accordance with ASTM D6345. Use filters with a Minimum Efficiency Reporting Value (MERV) of 8 in permanently installed air handlers during construction.
 - a. Control Measures:
 - (1) Meet or exceed the requirements of ANSI/SMACNA 008, Chapter 3, to help minimize contamination of the building from construction activities. The five requirements of this manual which must be adhered to are described below:
 - (a) HVAC protection: Isolate return side of HVAC system from surrounding environment to prevent construction dust and debris from entering the duct work and spaces.
 - (b) Source control: Use low emitting paints and other finishes, sealants, adhesives, and other materials as specified. When available, cleaning products shall have a low VOC content and be non-toxic to minimize building contamination. Utilize cleaning techniques that minimize dust generation. Cycle equipment off when not needed. Prohibit idling motor vehicles where emissions could be drawn into building. Designate receiving/storage areas for incoming material that minimize IAQ impacts.
 - (c) Pathway interruption: When pollutants are generated use strategies such as 100% outside air ventilation or erection of physical barriers between work and non-work areas to prevent contamination.
 - (d) Housekeeping: Clean frequently to remove construction dust and debris. Promptly clean up spills. Remove accumulated water and keep work areas dry to discourage the growth of mold and bacteria. Take extra measures when hazardous materials are involved.
 - (e) Scheduling: Control the sequence of construction to minimize the absorption of VOCs by other building materials.
 - b. Moisture Contamination:
 - (1) Remove accumulated water and keep work dry.
 - (2) Use dehumidification to remove moist, humid air from a work area.
 - (3) Do not use combustion heaters or generators inside the building.

SECTION 014500 - QUALITY CONTROL: continued

- (4) Protect porous materials from exposure to moisture.
 - (5) Remove and replace items which remain damp for more than a few hours.
- C. Requirements after Construction:
- 1. After construction ends and prior to occupancy, conduct a building flush-out or test the indoor air contaminant levels. Flush-out must be a minimum two-weeks with MERV-13 filtration media as determined by ASHRAE 52.2 at 100% outside air, or in accordance with LEED Reference Guide. Air contamination testing must be consistent with EPA's current Compendium of Methods for the Determination of Air Pollutants in Indoor Air, and with the LEED Reference Guide. After building flush-out or testing and prior to occupancy, replace filtration media. Filtration media must have a MERV of 13 as determined by ASHRAE 52.2.

PART 2 - PRODUCTS - NOT APPLICABLE.

PART 3 - EXECUTION

3.01 PREPARATION:

- A. Designate receiving/storage areas for incoming material to be delivered according to installation schedule and to be placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. Store and handle materials in a manner as to prevent loss from weather and other damage. Keep materials, products, and accessories covered and off the ground, and store in a dry, secure area. Prevent contact with material that may cause corrosion, discoloration, or staining. Protect all materials and installations from damage by the activities of other trades.

END OF SECTION 014500

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY:

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. DIVISION 01, Section "Summary" for work restrictions and limitations on utility interruptions.
 - 2. DIVISION 31, Section "Dewatering" for disposal of ground water at Project site.
 - 3. DIVISION 32, Section "Asphalt Paving" for construction and maintenance of asphalt pavement for temporary roads and paved areas.
 - 4. DIVISION 32, Section "Concrete Paving" for construction and maintenance of cement concrete pavement for temporary roads and paved areas.

1.03 USE CHARGES:

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's Representatives, Owner's Commissioning Agent, Architect, testing agencies, and authorities having jurisdiction.
- B. Water Service: Pay water-service use charges for water used by all entities for construction operations. Coordinate with Sussex Shores for a temporary meter installation. Invoice must be in the name of the Contractor.
- C. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations. Coordinate with DELMARVA Power for a temporary meter installation. Invoice must be in the name of the Contractor.

1.04 INFORMATIONAL SUBMITTALS:

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.
 - 1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
 - 2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 - 3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS: continued

- E. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
 - 1. Locations of dust-control partitions at each phase of work.
 - 2. HVAC system isolation schematic drawing.
 - 3. Location of proposed air-filtration system discharge.
 - 4. Waste handling procedures.
 - 5. Other dust-control measures.

1.05 QUALITY ASSURANCE:

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.

1.06 PROJECT CONDITIONS:

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Chain-Link Fencing: Minimum 2-inch, 0.148 inch thick, galvanized-steel, chain-link fabric fencing; minimum 8 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch OD line posts and 2-7/8-inch OD corner and pull posts.
- B. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less per ASTM E84 and passing NFPA 701 Test Method 2.
- C. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches.
- D. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.02 TEMPORARY FACILITIES:

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Dedicated Owner's Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other DIVISION 01 Sections. Keep office clean and orderly. Trailer to be no larger than 200 sf. Furnish and equip offices as follows:
 - 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 - 2. Conference room of sufficient size to accommodate meetings of 12 individuals. Provide electrical power service and 120Vac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot-square tack and marker boards.

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS: continued

3. Drinking water.
 4. Separate storage room.
 5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72°F.
 6. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
1. Store combustible materials apart from building.
- 2.03 EQUIPMENT:
- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in DIVISION 01 Section "Closeout Procedures."
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

- 3.01 INSTALLATION, GENERAL:
- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
1. Locate facilities to limit site disturbance as specified in DIVISION 01 Section "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.
- 3.02 TEMPORARY UTILITY INSTALLATION:
- A. General: Install temporary service or connect to existing service.
1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- C. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS: continued

- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
 - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed according to coordination drawings.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 - 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
 - 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
- G. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
 - 1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- H. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Connect temporary service to Owner's existing power source, as directed by Owner. Provide a meter for installation, acceptable to the Owner, for purposes of metering Contractor's power usage at the site.
- I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 - 2. Install lighting for Project identification sign.
- J. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line for each field office.
 - 1. Provide additional telephone lines for the following:
 - a. Provide a dedicated telephone line for each facsimile machine in each field office.
 - 2. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Contractor's emergency after-hours telephone number.
 - e. Architect's office.
 - f. Engineers' offices.

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS: continued

- g. Owner's office.
 - h. Principal subcontractors' field and home offices.
 - 3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.
- 3.03 SUPPORT FACILITIES INSTALLATION:
- A. General: Comply with the following:
 - 1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E136. Comply with NFPA 241.
 - 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
 - B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas as indicated on Drawings.
 - 1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
 - C. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
 - 1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 - 2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to DIVISION 31 Section "Earth Moving."
 - 3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
 - 4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to DIVISION 32 Section "Asphalt Paving."
 - D. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
 - E. Parking: Use designated areas of Owner's existing parking areas for construction personnel.
 - F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.
 - G. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 - 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 - 3. Maintain and touchup signs so they are legible at all times.

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS: continued

- H. Waste Disposal Facilities: Comply with requirements specified in DIVISION 01 Section "Construction Waste Management and Disposal."
- I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- J. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.04 SECURITY AND PROTECTION FACILITIES INSTALLATION:

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Comply with work restrictions specified in DIVISION 01 Section "Summary."
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.
 - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
 - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 - 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
 - 1. Extent of Fence: As indicated on Drawings.
 - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- I. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS: continued

- J. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- K. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
 - 1. Prohibit smoking in construction areas.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 - 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.05 MOISTURE AND MOLD CONTROL:

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 - 1. Protect porous materials from water damage.
 - 2. Protect stored and installed material from flowing or standing water.
 - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 4. Remove standing water from decks.
 - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 - 2. Keep interior spaces reasonably clean and protected from water damage.
 - 3. Periodically collect and remove waste containing cellulose or other organic matter.
 - 4. Discard or replace water-damaged material.
 - 5. Do not install material that is wet.
 - 6. Discard, replace, or clean stored or installed material that begins to grow mold.
 - 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
 - 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 - 2. Use permanent HVAC system to control humidity.
 - 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS: continued

- b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
- c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.06 OPERATION, TERMINATION, AND REMOVAL:

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 - 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.
- C. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.
- D. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- E. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been 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 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 property of Contractor. Owner reserves right to take possession of Project identification signs.
 - 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. 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 temporary entrances, as required by authorities having jurisdiction.
 - 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in DIVISION 01 Section "Closeout Procedures."

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS: continued

3.07 PROJECT SIGN:

A. Provide the following 8- by 4-foot sign:

STATE OF DELAWARE HON. JACK A. MARKELL, GOVERNOR OFFICE OF MANAGEMENT AND BUDGET			
P R O J E C T T I T L E			
HON. ANN VISALL SECRETARY, OFFICE OF MANAGEMENT AND BUDGET	HON. SECRETARY'S NAME SECRETARY, DEPARTMENT OF DEPT. PROJECT IS FOR	BURNS & MCDONNELL ENGINEERING 9400 WARD PARKWAY KANSAS CITY, MO (816) 333-9400 www.burnsmcd.com	XYZ CONTRACTOR 987 OAK LANE DOVER, DELAWARE (302) 555-678 www.xyzcont.com
ESTIMATED COMPLETION DATE: MONTH/YEAR			

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY:

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. DIVISION 01 Section "Alternates" for products selected under an alternate.
 - 2. DIVISION 01 Section "Substitution Procedures" for requests for substitutions.
 - 3. DIVISION 01 Section "References" for applicable industry standards for products specified.

1.03 DEFINITIONS:

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.04 ACTION SUBMITTALS:

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable

SECTION 016000 - PRODUCT REQUIREMENTS: continued

product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

- a. Form of Approval: As specified in DIVISION 01 Section "Submittal Procedures."
- b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

- B. Basis-of-Design Product Specification Submittal: Comply with requirements in DIVISION 01 Section "Submittal Procedures." Show compliance with requirements.

1.05 QUALITY ASSURANCE:

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING:

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
 1. Store products to allow for inspection and measurement of quantity or counting of units.
 2. Store materials in a manner that will not endanger Project structure.
 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 6. Protect stored products from damage and liquids from freezing.
 7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.07 PRODUCT WARRANTIES:

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on

SECTION 016000 - PRODUCT REQUIREMENTS: continued

- product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 3. See DIVISIONS 02 through 33 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in DIVISION 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.01 PRODUCT SELECTION PROCEDURES:

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in DIVISION 01 Section "Substitution Procedures" for proposal of product.
- C. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.02 COMPARABLE PRODUCTS:

- A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not

SECTION 016000 - PRODUCT REQUIREMENTS: continued

satisfied, Architect may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION - NOT APPLICABLE.

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY:

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner-installed products.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
 - 9. Correction of the Work.
- B. Related Requirements:
 - 1. DIVISION 01 Section "Summary" for limits on use of Project site.
 - 2. DIVISION 01 Section "Submittal Procedures" for submitting surveys.
 - 3. DIVISION 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
 - 4. DIVISION 02 Section "Structure Demolition" for demolition and removal of buildings.
 - 5. DIVISION 07 Section "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.03 DEFINITIONS:

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.04 INFORMATIONAL SUBMITTALS:

- A. Qualification Data: For land surveyor.
- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
 - 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 - 3. Products: List products to be used for patching and firms or entities that will perform patching work.
 - 4. Dates: Indicate when cutting and patching will be performed.

SECTION 017300 - EXECUTION: continued

5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.
- D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- E. Certified Surveys: Submit two copies signed by land surveyor.
- F. Final Property Survey: Submit 7 copies showing the Work performed and record survey data.

1.05 QUALITY ASSURANCE:

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 1. Structural Elements: When cutting and patching structural elements, notify Construction Manager of locations and details of cutting and await directions from Construction Manager before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
 - a. Load Bearing Masonry.
 - b. Trusses.
 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Mechanical systems piping and ducts.
 - f. Control systems.
 - g. Communication systems.
 - h. Fire-detection and -alarm systems.
 - i. Electrical wiring systems.
 - j. Operating systems of special construction.
 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.

SECTION 017300 - EXECUTION: continued

- g. Noise and vibration-control elements and systems.
- 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. General: Comply with requirements specified in other Sections.
 - 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with requirements in DIVISION 01 sustainable design requirements Section.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

SECTION 017300 - EXECUTION: continued

- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - 1. Description of the Work.
 - 2. List of detrimental conditions, including substrates.
 - 3. List of unacceptable installation tolerances.
 - 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.02 PREPARATION:

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in DIVISION 01 Section "Project Management and Coordination."

3.03 CONSTRUCTION LAYOUT:

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify and Construction Manager promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify and Construction Manager when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name

SECTION 017300 - EXECUTION: continued

and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by and Construction Manager.

3.04 FIELD ENGINEERING:

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Construction Manager. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Construction Manager before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
 - 1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
 - 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.05 INSTALLATION:

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

SECTION 017300 - EXECUTION: continued

- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.06 CUTTING AND PATCHING:

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in DIVISION 01 Section "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

SECTION 017300 - EXECUTION: continued

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable DIVISION 31 Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.07 PROGRESS CLEANING:

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80°F.
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

SECTION 017300 - EXECUTION: continued

- a. Use containers intended for holding waste materials of type to be stored.
 - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
 - B. Site: Maintain Project site free of waste materials and debris.
 - C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
 - D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
 - E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
 - F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
 - G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in DIVISION 01 Section "Construction Waste Management and Disposal."
 - H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
 - I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
 - J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.
- 3.08 STARTING AND ADJUSTING:
- A. Coordinate startup and adjusting of equipment and operating components with requirements in DIVISION 01 Section "General Commissioning Requirements."
 - B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
 - C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
 - D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - E. Manufacturer's Field Service: Comply with qualification requirements in DIVISION 01 Section "Quality Control."
- 3.09 PROTECTION OF INSTALLED CONSTRUCTION:
- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
 - B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY:

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
 - 1. DIVISION 01, Section "Multiple Contract Summary" for coordination of responsibilities for waste management.
 - 2. DIVISION 01, Section "Sustainable Design Requirements" for LEED® Requirements.
 - 3. DIVISION 02, Section "Structure Demolition" for disposition of waste resulting from demolition of buildings, structures, site improvements, and for disposition of any hazardous waste.
 - 4. DIVISION 04, Section "Unit Masonry" for disposal requirements for masonry waste.
 - 5. DIVISION 04, Section "Stone Masonry" for disposal requirements for excess stone and stone waste.
 - 6. DIVISION 31, Section "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.03 DEFINITIONS:

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.04 PERFORMANCE REQUIREMENTS:

- A. General: Achieve end-of-Project rates for salvage/recycling of a minimum of 75% by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:
 - 1. Demolition Waste:
 - a. Asphalt paving.
 - b. Concrete.

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL: continued

- c. Concrete reinforcing steel.
- d. Brick.
- e. Concrete masonry units.
- f. Wood studs.
- g. Wood joists.
- h. Plywood and oriented strand board.
- i. Wood paneling.
- j. Wood trim.
- k. Structural and miscellaneous steel.
- l. Rough hardware.
- m. Roofing.
- n. Insulation.
- o. Doors and frames.
- p. Door hardware.
- q. Windows.
- r. Glazing.
- s. Metal studs.
- t. Gypsum board.
- u. Acoustical tile and panels.
- v. Carpet.
- w. Carpet pad.
- x. Demountable partitions.
- y. Equipment.
- z. Cabinets.
- aa. Plumbing fixtures.
- bb. Piping.
- cc. Supports and hangers.
- dd. Valves.
- ee. Sprinklers.
- ff. Mechanical equipment.
- gg. Refrigerants.
- hh. Electrical conduit.
- ii. Copper wiring.
- jj. Lighting fixtures.
- kk. Lamps.
- ll. Ballasts.
- mm. Electrical devices.
- nn. Switchgear and panelboards.
- oo. Transformers.
- 2. Construction Waste:
 - a. Masonry and CMU.
 - b. Lumber.
 - c. Wood sheet materials.
 - d. Wood trim.
 - e. Metals.
 - f. Roofing.
 - g. Insulation.
 - h. Carpet and pad.
 - i. Gypsum board.

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL: continued

- j. Piping.
- k. Electrical conduit.
- l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100% of the following uncontaminated packaging materials:
 - (1) Paper.
 - (2) Cardboard.
 - (3) Boxes.
 - (4) Plastic sheet and film.
 - (5) Polystyrene packaging.
 - (6) Wood crates.
 - (7) Plastic pails.

1.05 ACTION SUBMITTALS:

- A. Waste Management Plan: Submit plan within 30 days of date established for the Notice to Proceed.

1.06 INFORMATIONAL SUBMITTALS:

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste and Form CWM-8 for demolition waste'. Include the following information:
 - 1. Material category.
 - 2. Generation point of waste.
 - 3. Total quantity of waste in tons.
 - 4. Quantity of waste salvaged, both estimated and actual in tons.
 - 5. Quantity of waste recycled, both estimated and actual in tons.
 - 6. Total quantity of waste recovered (salvaged plus recycled) in tons.
 - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- G. LEED Submittal: LEED letter template for Credit MR 2, signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met. Retain all waste and recycle haul tickets as backup in the event this LEED credit is audited.
- H. Qualification Data: For waste management coordinator and refrigerant recovery technician.
- I. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL: continued

recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.07 QUALITY ASSURANCE:

- A. Waste Management Coordinator Qualifications: The Contractor's Quality Control Manager (QCM) shall serve as the LEED Construction Waste Management Coordinator and LEED Coordinator. The QCM shall be a LEED Professional and have a record of successful waste management coordination on LEED projects with similar requirements.
- B. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- C. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Waste Management Conference: Conduct conference at Project site to comply with requirements in DIVISION 01 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
 - 1. Review and discuss waste management plan including responsibilities of waste management coordinator, labeling of containers for appropriate materials and training of trade workers.
 - 2. Review requirements for documenting quantities of each type of waste and its disposition.
 - 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - 5. Review waste management requirements for each trade.

1.08 WASTE MANAGEMENT PLAN:

- A. General: Develop a waste management plan according to ASTM E1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work. Use Form CWM-1 for construction waste and Form CWM-2 for demolition waste. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Form CWM-3 for construction waste and Form CWM-4 for demolition waste. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 - 1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
 - 2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL: continued

5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.
- D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Use Form CWM-5 for construction waste and Form CWM-6 for demolition waste. Include the following:
1. Total quantity of waste.
 2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
 3. Total cost of disposal (with no waste management).
 4. Revenue from salvaged materials.
 5. Revenue from recycled materials.
 6. Savings in hauling and tipping fees by donating materials.
 7. Savings in hauling and tipping fees that are avoided.
 8. Handling and transportation costs. Include cost of collection containers for each type of waste.
 9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS - NOT APPLICABLE.

PART 3 - EXECUTION

3.01 PLAN IMPLEMENTATION:

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 1. Comply with operation, termination, and removal requirements in DIVISION 01 Section "Temporary Facilities and Controls."
- B. Waste Management Coordinator: The Contractor's Quality Control Manager (QCM) shall serve as the LEED Construction Waste Management Coordinator and shall be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site for duration of Project.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 1. Distribute waste management plan to everyone concerned within three days of submittal return.
 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 2. Comply with DIVISION 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL: continued

3.02 SALVAGING DEMOLITION WASTE:

- A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 3. Store items in a secure area until installation.
 - 4. Protect items from damage during transport and storage.
 - 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for Sale and Donation: Not permitted on Project site.
- C. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.
- D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.
- E. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- F. Plumbing Fixtures: Separate by type and size.
- G. Lighting Fixtures: Separate lamps by type and protect from breakage.
- H. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.03 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL:

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL: continued

3.04 RECYCLING DEMOLITION WASTE:

1. Asphalt Paving: Grind asphalt to maximum 4-inch size for use as general fill.
Alternately, break up and transport paving to asphalt-recycling facility.
- B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
 1. Pulverize concrete to maximum 1-1/2-inch size for use as satisfactory soil for fill or subbase. Alternatively, break up and transport concrete to a concrete-recycling facility.
- C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
 1. Pulverize masonry to maximum 4-inch size.
 - a. Crush masonry and screen to comply with requirements in DIVISION 31 Section "Earth Moving" for use as general fill or subbase.
 - b. Alternately, break up and transport masonry to a masonry-recycling facility.
 2. Clean and stack undamaged, whole masonry units on wood pallets for reuse or recycling.
- D. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- E. Metals: Separate metals by type.
 1. Structural Steel: Stack members according to size, type of member, and length.
 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- F. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.
- G. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- H. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- I. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.
- J. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
 1. Store clean, dry carpet and pad in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.
- K. Carpet Tile: Remove debris, trash, and adhesive.
 1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.
- L. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.
- M. Conduit: Reduce conduit to straight lengths and store by type and size.

3.05 RECYCLING CONSTRUCTION WASTE:

- A. Packaging:
 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 2. Polystyrene Packaging: Separate and bag materials.
 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL: continued

2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
 - a. Comply with requirements in DIVISION 32 Section "Plants." for use of clean sawdust as organic mulch.
 - C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
 1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
 - a. Comply with requirements in DIVISION 32 Section "Plants." for use of clean ground gypsum board as inorganic soil amendment.
- 3.06 DISPOSAL OF WASTE:
- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - B. Burning: Do not burn waste materials.
 - C. Disposal: Remove waste materials to be returned to the Owner and dispose of at designated spoil areas on Owner's property.
 - D. Disposal: Remove waste materials from Owner's property and legally dispose of them.
- 3.07 ATTACHMENTS:
- A. Form CWM-1 for construction waste identification.
 - B. Form CWM-2 for demolition waste identification.
 - C. Form CWM-3 for construction waste reduction work plan.
 - D. Form CWM-4 for demolition waste reduction work plan.
 - E. Form CWM-5 cost/revenue analysis of construction waste reduction work plan.
 - F. Form CWM-6 cost/revenue analysis of demolition waste reduction work plan.
 - G. Form CWM-7 for construction waste
 - H. Form CWM-8 for demolition waste.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY:

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- B. Related Requirements:
 - 1. Delaware Army National Guard General Requirements and Supplementary General Conditions.
 - 2. DIVISION 01 Section "Execution" for progress cleaning of Project site.
 - 3. DIVISION 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 4. DIVISION 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 5. DIVISION 01 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
 - 6. DIVISIONS 02 through 33 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.03 ACTION SUBMITTALS:

- A. Product Data: For cleaning agents.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.04 CLOSEOUT SUBMITTALS:

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.05 MAINTENANCE MATERIAL SUBMITTALS:

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.06 SUBSTANTIAL COMPLETION PROCEDURES:

- A. Refer to Articles 4.1.6, 9.3, and 9.4 of the General Requirements for further information.
- B. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

SECTION 017700 - CLOSEOUT PROCEDURES: continued

- C. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 2. Submit closeout submittals specified in other DIVISION 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 3. Submit closeout submittals specified in individual DIVISIONS 02 through 33 Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Submit maintenance material submittals specified in individual DIVISIONS 02 through 33 Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Construction Manager. Label with manufacturer's name and model number where applicable.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Construction Manager's signature for receipt of submittals.
 5. Submit test/adjust/balance records.
 6. Submit sustainable design submittals required in DIVISION 01 sustainable design requirements Section and in individual DIVISION 02 through 33 Sections.
 7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- D. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in DIVISION 01 Section "Demonstration and Training."
 6. Advise Owner of changeover in heat and other utilities.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements, including touchup painting.
 10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- E. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the

SECTION 017700 - CLOSEOUT PROCEDURES: continued

Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.
3. Refer to Article 9.8 of the Supplementary General Conditions for further information.

1.07 FINAL COMPLETION PROCEDURES:

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
 1. Submit a final Application for Payment according to DIVISION 01 Section "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.08 LIST OF INCOMPLETE ITEMS (PUNCH LIST):

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 1. Organize list of spaces in sequential order, starting with exterior areas first.
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect and Construction Manager.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in the following format:
 - a. MS Excel electronic file. Architect, through Construction Manager, will return annotated file.

SECTION 017700 - CLOSEOUT PROCEDURES: continued

1.09 SUBMITTAL OF PROJECT WARRANTIES:

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
 - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2 by 11-inch paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
 - 4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.01 FINAL CLEANING:

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.

SECTION 017700 - CLOSEOUT PROCEDURES: continued

- b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. 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.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Wipe surfaces of mechanical and electrical equipment[, elevator equipment,] and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - (1) Clean HVAC system in compliance with NADCA Standard 1992-01.
Provide written report on completion of cleaning.
 - p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
 - q. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in DIVISION 01 Section "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in DIVISION 01 Section "Construction Waste Management and Disposal."

3.02 REPAIR OF THE WORK:

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
 - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.

SECTION 017700 - CLOSEOUT PROCEDURES: continued

2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
5. Refer to Article 12.2.2 of the Supplementary General Conditions for further information.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY:

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.
- B. Related Requirements:
 - 1. DIVISION 01 Section "Multiple Contract Summary" for coordinating operation and maintenance manuals covering the Work of multiple contracts.
 - 2. DIVISION 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 3. DIVISION 01 Section "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.
 - 4. DIVISIONS 02 through 33 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.03 DEFINITIONS:

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.04 CLOSEOUT SUBMITTALS:

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect and Commissioning Authority will comment on whether content of operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
 - 2. Two paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect, through Construction Manager, will return one copy.

SECTION 017823 - OPERATION AND MAINTENANCE DATA: continued

- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.01 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY:

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
 - 1. List of documents.
 - 2. List of systems.
 - 3. List of equipment.
 - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.02 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS:

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for Construction Manager.
 - 7. Name and contact information for Architect.

SECTION 017823 - OPERATION AND MAINTENANCE DATA: continued

8. Name and contact information for Commissioning Authority.
 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2 by 11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
 4. Supplementary Text: Prepared on 8-1/2 by 11-inch white bond paper.
 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.

SECTION 017823 - OPERATION AND MAINTENANCE DATA: continued

- b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.03 EMERGENCY MANUALS:

- A. Content: Organize manual into a separate section for each of the following:
 - 1. Type of emergency.
 - 2. Emergency instructions.
 - 3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 - 1. Fire.
 - 2. Flood.
 - 3. Water leak.
 - 4. Power failure.
 - 5. Water outage.
 - 6. System, subsystem, or equipment failure.
 - 7. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
 - 1. Instructions on stopping.
 - 2. Shutdown instructions for each type of emergency.
 - 3. Operating instructions for conditions outside normal operating limits.
 - 4. Required sequences for electric or electronic systems.
 - 5. Special operating instructions and procedures.

2.04 OPERATION MANUALS:

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 - 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 - 2. Performance and design criteria if Contractor has delegated design responsibility.
 - 3. Operating standards.
 - 4. Operating procedures.
 - 5. Operating logs.
 - 6. Wiring diagrams.
 - 7. Control diagrams.
 - 8. Piped system diagrams.
 - 9. Precautions against improper use.
 - 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
 - 1. Product name and model number. Use designations for products indicated on Contract Documents.
 - 2. Manufacturer's name.
 - 3. Equipment identification with serial number of each component.
 - 4. Equipment function.

SECTION 017823 - OPERATION AND MAINTENANCE DATA: continued

5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.05 PRODUCT MAINTENANCE MANUALS:

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Product Information: Include the following, as applicable:
1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

SECTION 017823 - OPERATION AND MAINTENANCE DATA: continued

2.06 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS:

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.01 MANUAL PREPARATION:

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

SECTION 017823 - OPERATION AND MAINTENANCE DATA: continued

- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original project record documents as part of operation and maintenance manuals.
 - 2. Comply with requirements of newly prepared record Drawings in DIVISION 01 Section "Project Record Documents."
- G. Comply with DIVISION 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY:

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. DIVISION 01 Section "Multiple Contract Summary" for coordinating project record documents covering the Work of multiple contracts.
 - 2. DIVISION 01 Section "Execution" for final property survey.
 - 3. DIVISION 01 Section "Closeout Procedures" for general closeout procedures.
 - 4. DIVISION 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 5. DIVISION 01 Section "Project Management and Coordination" for record drawing format and file location.
 - 6. DIVISIONS 02 through 33 Sections for specific requirements for project record documents of the Work in those Sections.

1.03 CLOSEOUT SUBMITTALS:

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set of marked-up record prints.
 - 2. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal:
 - (1) Submit PDF electronic files of scanned record prints and one of file prints.
 - (2) Submit record digital data files and one set of plots.
 - (3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - (1) Submit PDF electronic files of scanned record prints and two set(s) of prints.
 - (2) Print each drawing, whether or not changes and additional information were recorded.
 - 3. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- B. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
- C. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
 - 1. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy and annotated PDF electronic files and directories of each submittal.

SECTION 017839 - PROJECT RECORD DOCUMENTS: continued

- D. Reports: Submit written report monthly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

PART 2 - PRODUCTS

2.01 RECORD DRAWINGS:

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding archive photographic documentation.
 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Work Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

SECTION 017839 - PROJECT RECORD DOCUMENTS: continued

- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect and Owner's representative. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
 - 1. Format: Same digital data software program, version, and operating system as the original Contract Drawings. Refer to SECTION 013100 for Project Web Site location and file format.
 - 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 - 3. Refer instances of uncertainty to Architect through Construction Manager for resolution.
 - 4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
 - a. See DIVISION 01 Section "Submittal Procedures" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
 - 1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
 - 2. Consult Architect and Construction Manager for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- D. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 - 1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 - 2. Format: Annotated PDF electronic file with comment function enabled.
 - 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 - 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect and Construction Manager.
 - e. Name of Contractor.

2.02 RECORD SPECIFICATIONS:

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.

SECTION 017839 - PROJECT RECORD DOCUMENTS: continued

3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file.

2.03 RECORD PRODUCT DATA:

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- B. Format: Submit record Product Data as an annotated PDF electronic file.
1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.04 MISCELLANEOUS RECORD SUBMITTALS:

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as a PDF electronic file.
1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.01 RECORDING AND MAINTENANCE:

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's and Construction Manager's reference during normal working hours.

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY:

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training video recordings.
- B. Related Requirements:
 - 1. DIVISIONS 02 through 33 Sections for specific requirements for demonstration and training for products in those Sections.

1.03 INFORMATIONAL SUBMITTALS:

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For instructor.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.04 CLOSEOUT SUBMITTALS:

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

SECTION 017900 - DEMONSTRATION AND TRAINING: continued

1.05 QUALITY ASSURANCE:

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in DIVISION 01 Section "Quality Control," experienced in operation and maintenance procedures and training.
- B. Preinstruction Conference: Conduct conference at Project site to comply with requirements in DIVISION 01 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 - 1. Inspect and discuss locations and other facilities required for instruction.
 - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 - 3. Review required content of instruction.
 - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.06 COORDINATION:

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

PART 2 - PRODUCTS

2.01 INSTRUCTION PROGRAM:

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.

SECTION 017900 - DEMONSTRATION AND TRAINING: continued

- g. Maintenance service agreements and similar continuing commitments.
- 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
- 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
- 8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

SECTION 017900 - DEMONSTRATION AND TRAINING: continued

PART 3 - EXECUTION

3.01 PREPARATION:

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in DIVISION 01 Section "Operations and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.02 INSTRUCTION:

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 - 2. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 3. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner, through Construction Manager, with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a written performance-based test.
- F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 017900

SECTION 018113.13 - SUSTAINABLE DESIGN REQUIREMENTS - LEED® FOR NEW CONSTRUCTION AND MAJOR RENOVATIONS

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY:

- A. Section includes general requirements and procedures for compliance with certain USGBC LEED® prerequisites and credits needed for Project to obtain LEED Silver certification based on USGBC's "LEED 2009 for New Construction & Major Renovations."
 - 1. Other LEED prerequisites and credits needed to obtain LEED certification depend on product selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.
 - 2. Additional LEED prerequisites and credits needed to obtain the indicated LEED certification depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.
 - 3. A copy of the LEED Project checklist is attached at the end of this Section for information only.
- B. Related Requirements:
 - 1. DIVISIONS 01 through 33 Sections for LEED requirements specific to the work of each of these Sections. Requirements may or may not include reference to LEED.
 - 2. DIVISION 01 "Construction Waste Management and Disposal" and "General Commissioning Requirements" for additional Contractor-related requirements.

1.03 DEFINITIONS:

- A. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
- B. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.
- C. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.
 - 1. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
 - 2. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.

SECTION 018113.13 - SUSTAINABLE DESIGN REQUIREMENTS - LEED® FOR NEW CONSTRUCTION AND MAJOR RENOVATIONS: continued

1.04 ADMINISTRATIVE REQUIREMENTS:

- A. Respond to questions and requests from Architect and the USGBC/GBCI regarding LEED credits that are the responsibility of the Contractor, that depend on product selection or product qualities, or that depend on Contractor's procedures until the USGBC has made its determination on the project's LEED certification application. Document responses as informational submittals.
- B. Contractor shall be responsible to complete the Construction Submittal LEED Credit Forms and upload supporting documentation to LEED On-line at the completion of the project. When all Construction Phase documentation is uploaded and complete, the Contractor is responsible to pay the LEED Construction Submittal Review fee to the Green Building Certification Institute (GBCI) through LEED On-line and submit the project for the Preliminary Construction Submittal Review. Within 15 business days of receipt of the Preliminary Construction Submittal Review Comments from the GBCI review team, the Contractor shall respond to any questions or requests for clarifications to Construction Credits and submit for the Final Construction Submittal Review. Should any construction credits require a Credit Appeal, the Contractor shall be responsible to pay the Appeal fee to GBCI for the Appeal Review process.
- C. As clarification, the A/E is responsible to complete the Design Phase LEED Credit Forms and upload supporting documentation to LEED Online, pay the review fee to GBCI for the Preliminary Design Submittal Review, respond to review comments from the GBCI Review Team for the Final Design Submittal Review and pay any fees for Design phase credit appeal reviews to GBCI.
- D. Contractor shall be responsible to purchase the project's LEED Certification Plaques upon GBCI final LEED certification award on behalf of the project and to mount the plaque in a location in the building at the owner's direction. Contractor shall be responsible for all costs related to the purchase, delivery to the project site and installation of one plaque with hardware, components for which are available from Green Plaque (www.greenplaque.com). Plaques shall be ordered with the logo, year of certification and certification level, in selections as follow:
 - 1. One (1) 16-inch diameter by 3/4 inches thick Gray Back-Painted Ultra Clear Glass Plaque.
 - 2. One set of aluminum Type AC mounting brackets for the 16-inch diameter plaque (set of three brackets).
 - 3. One (1) 5-inch diameter Clear Laser Etched Glass Plaque, Front-Etched.
- E. Contractor shall include an allowance of \$5,000 for signage or other product to comply with LEED Innovation and Design Credit 1.3 - Educational and Outreach Program. Content of the signage will be provided at project completion.
- F. Contractor shall be responsible to achieve the LEED credits identified as "Contractor Responsibilities" in EXHIBIT 1 - LEED SCORECARD attached at the end of this Section.

1.05 ACTION SUBMITTALS:

- A. LEED submittals are in addition to other submittals required by other Specification Sections. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated LEED requirements.
- B. LEED Documentation Submittals:
 - 1. Prerequisite SS 1: Provide a declaration that the erosion and sedimentation control plan was carried out in accordance with the contract documents and periodic inspection

SECTION 018113.13 - SUSTAINABLE DESIGN REQUIREMENTS - LEED® FOR NEW CONSTRUCTION AND MAJOR RENOVATIONS: continued

- occurred throughout the construction process. Provide date-stamped photos showing the implemented measures and any corrective actions that were taken. Provide a narrative describing the plan implementation.
2. Credit SS 7.1: Solar reflectance index (SRI), or alternately, solar reflectance and emissivity values, for all pervious and non-pervious paving materials.
 - a. Provide photographs and narrative description of process used on existing site concrete pavement to clean and restore it to like-new condition for approximate SRI of 29 or higher.
 3. Credit SS 7.2: Solar reflectance index (SRI) for installed roofing product(s).
 4. Credit MR 2: As stipulated in DIVISION 01, Section "Construction Waste Management and Disposal."
 5. Credit MR 4: Product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating cost for each product having recycled content.
 6. Credit MR 5: Product data for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
 7. Credit MR 7 and Credit ID 1.1: Product data and chain-of-custody certificates for products containing certified wood. Include statement indicating cost for each certified wood product. Provide a copy of the manufacturer's FSC chain of custody certificate.
 8. Credit EQ 3.1:
 - a. Construction indoor-air-quality management plan.
 - b. Product data for temporary filtration media.
 - c. Product data for filtration media used during occupancy.
 - d. Construction Documentation: A minimum of six photographs, date-stamped, at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality management measures, such as protection of ducts, source control, housekeeping, scheduling and on-site stored or installed absorptive materials.
 9. Credit IEQ 3.2:
 - a. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
 - b. Product data for filtration media used during flush-out and during occupancy.
 - c. Report from testing and inspecting agency indicating results of indoor-air-quality testing and documentation showing compliance with indoor-air-quality testing procedures and requirements.
 10. Credit IEQ 4.1: Product data for adhesives and sealants used inside the weatherproofing system indicating VOC content of each product used.
 11. Credit IEQ 4.2: Product data for paints and coatings used inside the weatherproofing system indicating VOC content of each product used.
 12. Credit IEQ 4.3: Product data for carpet, carpet cushion, hard flooring, wall base, adhesives and grouts indicating conformance with required flooring standard or VOC content for each product used.
 13. Credit IEQ 4.4: Product data for products containing composite wood or agrifiber products indicating that they do not contain urea-formaldehyde resin in the composite woods and laminating adhesives.

SECTION 018113.13 - SUSTAINABLE DESIGN REQUIREMENTS - LEED® FOR NEW CONSTRUCTION AND MAJOR RENOVATIONS: continued

14. Credit IEQ 5: Product data for filtration used during construction and installed pre-occupancy, indicating manufacturer, product number and MERV rating.
- 1.06 INFORMATIONAL SUBMITTALS:
- A. Qualification Data: For Contractor's Quality Control Manager (QCM), who shall serve as the LEED Coordinator.
 - B. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:
 1. Furniture.
 2. Plumbing.
 3. Mechanical.
 4. Electrical.
 5. Specialty items such as elevators and equipment.
 6. Wood-based construction materials.
 7. Total material costs for DIVISIONS 3-10, SECTIONS 316000 - FOUNDATIONS, 321000 - PAVING, 323000 - SITE IMPROVEMENTS and 329000 - PLANTING.
 - C. LEED Action Plans: Provide preliminary submittals within 30 days of date established for the Notice to Proceed indicating how the following requirements will be met:
 1. Credit MR 2: Waste management plan complying with DIVISION 01, Section "Construction Waste Management and Disposal."
 2. Credit MR 4: List of proposed materials with recycled content. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.
 3. Credit MR 5: List of proposed regional materials. Identify each regional material, including its source, cost, and the fraction by weight that is considered regional.
 4. Credit MR 7 and Credit ID 1.1: List of proposed certified wood products. Indicate each product containing certified wood, including its source and cost of certified wood products.
 5. Credit IEQ 3.1: Construction indoor-air-quality management plan during construction.
 6. Credit IEQ 3.2: Construction indoor-air-quality management plan pre-occupancy.
 - D. LEED Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with LEED action plans for the following:
 1. Credit MR 2: Waste reduction progress reports complying with DIVISION 01, Section "Construction Waste Management and Disposal."
 2. Credit MR 4: Recycled content.
 3. Credit MR 5: Regional materials.
 4. Credit MR 7: Certified wood products.
- 1.07 QUALITY ASSURANCE:
- A. LEED Coordinator: The Contractor's Quality Control Manager (QCM) shall serve as the LEED Coordinator, LEED Construction Indoor Air Quality Manager and LEED Construction Waste Manager to coordinate all construction-related LEED requirements for the project.

SECTION 018113.13 - SUSTAINABLE DESIGN REQUIREMENTS - LEED® FOR NEW CONSTRUCTION AND MAJOR RENOVATIONS: continued

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL:

- A. Provide products and procedures necessary to obtain LEED credits required in this Section. Although other sections may specify some requirements that contribute to LEED credits, the Contractor shall determine additional materials and procedures necessary to obtain LEED credits indicated.

2.02 RECYCLED CONTENT OF MATERIALS:

- A. Credit MR 4: Building materials shall have recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content for Project constitutes a minimum of 20% of cost of materials used for Project.
 - 1. Cost of post-consumer recycled content plus one-half of pre-consumer recycled content of an item shall be determined by dividing weight of post-consumer recycled content plus one-half of pre-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
 - 2. Do not include furniture, plumbing, mechanical and electrical components, and specialty items such as elevators and equipment in the calculation.

2.03 REGIONAL MATERIALS:

- A. Credit MR 5: Not less than 20% of building materials (by cost) shall be regional materials from within 500 miles of the project site.

2.04 CERTIFIED WOOD:

- A. Credit MR 7: Not less than 95% (by cost) of wood-based materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
 - 1. Wood-based materials include, but are not limited to, the following materials when made from wood, engineered wood products, or wood-based panel products:
 - a. Rough carpentry.
 - b. Miscellaneous carpentry.
 - c. Heavy timber construction.
 - d. Wood decking.
 - e. Metal-plate-connected wood trusses.
 - f. Structural glued-laminated timber.
 - g. Finish carpentry.
 - h. Architectural woodwork.
 - i. Wood paneling.
 - j. Wood veneer wall covering.
 - k. Wood flooring.
 - l. Wood lockers.
 - m. Wood cabinets.
 - n. Furniture.

SECTION 018113.13 - SUSTAINABLE DESIGN REQUIREMENTS - LEED® FOR NEW CONSTRUCTION AND MAJOR RENOVATIONS: continued

2.05 LOW-EMITTING MATERIALS:

- A. Credit IEQ 4.1: For field applications that are inside the weatherproofing system, adhesives and sealants shall comply with the following VOC content limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Wood Glues: 30 g/L.
 2. Metal-to-Metal Adhesives: 30 g/L.
 3. Adhesives for Porous Materials (Except Wood): 50 g/L.
 4. Subfloor Adhesives: 50 g/L.
 5. Plastic Foam Adhesives: 50 g/L.
 6. Carpet Adhesives: 50 g/L.
 7. Carpet Pad Adhesives: 50 g/L.
 8. VCT and Asphalt Tile Adhesives: 50 g/L.
 9. Cove Base Adhesives: 50 g/L.
 10. Gypsum Board and Panel Adhesives: 50 g/L.
 11. Rubber Floor Adhesives: 60 g/L.
 12. Ceramic Tile Adhesives: 65 g/L.
 13. Multipurpose Construction Adhesives: 70 g/L.
 14. Fiberglass Adhesives: 80 g/L.
 15. Contact Adhesive: 80 g/L.
 16. Structural Glazing Adhesives: 100 g/L.
 17. Wood Flooring Adhesive: 100 g/L.
 18. Structural Wood Member Adhesive: 140 g/L.
 19. Special-Purpose Contact Adhesive (contact adhesive that is used to bond melamine-covered board, metal, unsupported vinyl, rubber, or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.
 20. Top and Trim Adhesive: 250 g/L.
 21. Plastic Cement Welding Compounds: 250 g/L.
 22. ABS Welding Compounds: 325 g/L.
 23. CPVC Welding Compounds: 490 g/L.
 24. PVC Welding Compounds: 510 g/L.
 25. Adhesive Primer for Plastic: 550 g/L.
 26. Sheet-Applied Rubber Lining Adhesive: 850 g/L.
 27. Aerosol Adhesive, General-Purpose Mist Spray: 65% by weight.
 28. Aerosol Adhesive, General-Purpose Web Spray: 55% by weight.
 29. Special-Purpose Aerosol Adhesive (All Types): 70% by weight.
 30. Other Adhesives: 250 g/L.
 31. Architectural Sealants: 250 g/L.
 32. Other Sealants: 420 g/L.
 33. Sealant Primers for Nonporous Substrates: 250 g/L.
 34. Sealant Primers for Porous Substrates: 775 g/L.
 35. Modified Bituminous Sealant Primers: 500 g/L.
 36. Other Sealant Primers: 750 g/L.
- B. Credit IEQ 4.2: For field applications that are inside the weatherproofing system, paints and coatings shall comply with the following VOC content limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Flat Paints and Coatings: VOC not more than 50 g/L.
 2. Nonflat Paints and Coatings: VOC not more than 150 g/L.
 3. Dry-Fog Coatings: VOC not more than 400 g/L.

SECTION 018113.13 - SUSTAINABLE DESIGN REQUIREMENTS - LEED® FOR NEW CONSTRUCTION AND MAJOR RENOVATIONS: continued

4. Primers, Sealers, and Undercoaters: VOC not more than 200 g/L.
 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
 6. Zinc-Rich Industrial Maintenance Primers: VOC not more than 340 g/L.
 7. Pretreatment Wash Primers: VOC not more than 420 g/L.
 8. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
 9. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
 10. Floor Coatings: VOC not more than 100 g/L.
 11. Shellacs, Clear: VOC not more than 730 g/L.
 12. Shellacs, Pigmented: VOC not more than 550 g/L.
 13. Stains: VOC not more than 250 g/L.
- C. Credit IEQ 4.3: For hard surface flooring and resilient wall base, provide products certified as low-emitting meeting the following requirements:
1. Carpet and carpet tile shall meet the testing and product requirements of the Carpet and Rug Institute Green Label Plus program.
 2. Carpet cushion shall meet the requirements of the Carpet and Rug Institute Green Label program.
 3. Carpet adhesive meeting the VOC limits of IEQ Credit 4.1, VOC limit of 50 g/L.
 4. Hard surface flooring and resilient wall base shall be certified as compliant with the FloorScore standard by an independent 3rd party.
 - a. Flooring materials complying with this credit include resilient (rubber, vinyl and linoleum), cork, ceramic, laminate and pre-finished wood flooring.
 - b. Mineral-based hard flooring such as porcelain tile and terrazzo are excluded from compliance.
 - c. Unfinished wood flooring products are excluded from compliance.
 5. Floor finishes shall not exceed the VOC limits of South Coast Air Quality Management District (SCAQMD) Rule 1113, effective January 2004.
 6. Tile setting adhesives and grout shall not exceed the VOC limits of SCAQMD Rule 1168, effective July 1, 2005 and amendment of January 7, 2005.
- D. Credit IEQ 4.4: Composite wood, agrifiber products, and laminating adhesives shall not contain added urea-formaldehyde resin.

PART 3 - EXECUTION

3.01 CONSTRUCTION WASTE MANAGEMENT:

- A. Credit MR 2: Comply with DIVISION 01, Section "Construction Waste Management and Disposal."

3.02 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT:

- A. Credit IEQ 3.1: Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in DIVISION 01, Section "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
 2. Replace all air filters immediately prior to occupancy.

SECTION 018113.13 - SUSTAINABLE DESIGN REQUIREMENTS - LEED® FOR NEW CONSTRUCTION AND MAJOR RENOVATIONS: continued

- B. Credit IEQ 3.2: Comply with one of the following requirements:
1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14,000 cu. ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60°F and a relative humidity no higher than 60%.
 - a. Contractor shall identify building operating conditions.
 2. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3,500 cu. ft. of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or the design minimum outside air rate determined in Prerequisite EQ 1, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14,000 cu. ft./sq. ft. of outside air has been delivered to the space.
 - a. Contractor shall identify building operating conditions.
 3. Air-Quality Testing:
 - a. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air," and as additionally detailed in the USGBC's "Green Building Design and Construction Reference Guide."
 - b. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:
 - (1) Formaldehyde: 27 ppb.
 - (2) Particulates (PM10): 50 micrograms/cu. m.
 - (3) Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m.
 - (4) 4-Phenylcyclohexene (4-PH): 6.5 micrograms/cu. m.
 - (5) Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.
 - c. For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting non-complying building areas, take samples from same locations as in the first test.
 - d. Air-sample testing shall be conducted as follows:
 - (1) All measurements shall be conducted prior to occupancy but during normal occupied hours and with building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
 - (2) Building shall have all interior finishes installed including, but not limited to, millwork, doors, paint, carpet, and acoustic tiles. Non-fixed furnishings such as workstations and partitions are encouraged, but not required, to be in place for the testing.
 - (3) Number of sampling locations varies depending on the size of building and number of ventilation systems. For each portion of building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq. ft. or for each contiguous floor area, whichever is larger, and shall include areas with the least ventilation and greatest presumed source strength.

SECTION 018113.13 - SUSTAINABLE DESIGN REQUIREMENTS - LEED® FOR NEW CONSTRUCTION AND MAJOR RENOVATIONS: continued

- (4) Air samples shall be collected between 3 and 6 feet from the floor to represent the breathing zone of occupants, and over a minimum four-hour period.

PART 4 - EXHIBITS

- 4.01 EXHIBIT 1 - LEED SCORECARD: LEED CREDITS AS IDENTIFIED IN EXHIBIT 1, FOLLOWING, ARE CONTRACT REQUIREMENTS AND SHALL BE INCORPORATED IN FULL COMPLIANCE WITH THE LEED REFERENCE GUIDE.

END OF SECTION 018113.13



LEED 2009 for New Construction and Major Renovations
 Delaware ARNG Regional Training Institute
 BID FINAL SUBMITTAL

8/28/2012

SPECIFICATION SECTION 018113.13 -- EXHIBIT 1

15 1 10 RP				Sustainable Sites	REQUIRED ACTION BY CONTRACTOR	
Y	?	N			NOTES:	
Y				Prereq 1 Construction Activity Pollution Prevention	Required	
			1 X	Credit 1 Site Selection	Per Project Validation	
			5	Credit 2 Development Density and Community Connectivity	There are over 10 community services and a residential area with a density of 10+ units/acre within 1/2 mile radius.	
			1	Credit 3 Brownfield Redevelopment	Survey was performed following the NESHAP PLM testing method and identified limited asbestos for demolition. Remediation will be performed by the owner, using a licensed contractor, according to EPA 40-CFR-763 and NESHAP program standards.	
				6	Credit 4.1 Alternative Transportation--Public Transportation	DART may provide a bus stop on the west side of State Route 1, however, it must travel two directions and accommodate at least 2 routes. Cost for sidewalk and shelter renders this credit not achievable.
			1	Credit 4.2 Alternative Transportation--Bicycle/Change Rms	Showers are within 200 yards in nearby buildings--need one male/one female shower. Site design provides a bikerack for 12 bikes for peak occupancy.	
			3	Credit 4.3 Alternative Transportation--LEV/FEV	No additional parking spaces, but will restripe existing lot to the south for ADA and allocate 2 preferred spots for LEV/FEV.	
				2 X	Credit 4.4 Alternative Transportation--Parking Capacity	No additional parking is provided, but parking is outside project boundary.
				1 X	Credit 5.1 Site Development--Protect or Restore Habitat	Must reserve open space for habitat indefinitely
			1	Credit 5.2 Site Development--Maximize Open Space	Open vegetated space exceeds footprint size to achieve the credit.	
			1	X Credit 6.1 Stormwater Design--Quantity Control	47.5% of the existing site imperviousness requires no net increase in post-development conditions, as compared to pre-development conditions with calculations. Site complies within the LOD by decreasing rate and quantity.	
			1	Credit 6.2 Stormwater Design--Quality Control	89.4% of the TSS is treated onsite, achieving this credit	
			1	Credit 7.1 Heat Island Effect--Non-roof	Only new pavement is concrete sidewalks & fire lane, so 87.3% of the hardscape has an SRI >29. Contractor must clean existing concrete to restore SRI.	
			1	Credit 7.2 Heat Island Effect--Roof	Steep slope allows medium dark roof color with minimum 29 SRI	
			1	Credit 8 Light Pollution Reduction	Team will verify security lighting at perimeter. Credit requires timers/occupancy sensors on interior lighting.	

6 0 4 RP				Water Efficiency		
Y	?	N			NOTES:	
Y				Prereq 1 Water Use Reduction--20% Reduction	Project achieves > 20% reduction from EAct/IPC/UPC standards	
			4	Credit 1 Water Efficient Landscaping	Use no irrigation system.	
				2	Credit 2 Innovative Wastewater Technologies	Not achievable.
			2	Credit 3 Water Use Reduction	Project achieves 33.5% reduction if use 0.125 GPF urinals, 1.28 GPF WCs, 0.5 GPM lavs, 1.5 GPM breakroom sink, as designed.	

14 3 18 RP				Energy and Atmosphere		
Y	?	N			NOTES:	
Y				Prereq 1 Fundamental Commissioning of Bldg Energy Systems	Required. Contracted by Owner.	
Y				Prereq 2 Minimum Energy Performance	Required	
Y				Prereq 3 Fundamental Refrigerant Management	Required	
			10	9	Credit 1 Optimize Energy Performance	
			1	1	Improve by 12% for New Buildings	The energy model shows 30.4% energy cost reduction. ECMS include: geothermal heat pump system; high insulation values in envelope; high performance glazing; daylighting and integrated controls; LED lighting with dimmer controls, occupancy sensors and timers; high efficiency HVAC systems and controls, building management system, Energy Star appliances.
			1	1	Improve by 14% for New Buildings	
			1	1	Improve by 16% for New Buildings	
			1	1	Improve by 18% for New Buildings	
			1	1	Improve by 20% for New Buildings	
			1	1	Improve by 22% for New Buildings	
			1	1	Improve by 24% for New Buildings	
			1	1	Improve by 26% for New Buildings	
			1	1	Improve by 28% for New Buildings	
			1	1	Improve by 30% for New Buildings	
					Improve by 32% for New Buildings	
					Improve by 34% for New Buildings	
					Improve by 36% for New Buildings	
					Improve by 38% for New Buildings	
					Improve by 40--48% for New Buildings	
				7 X	Credit 2 On-Site Renewable Energy	Not achievable, as RECs must be retained for the installation that is allocated to this building. The Guard plans to sell the RECs to utility to help meet State RPS.



LEED 2009 for New Construction and Major Renovations
 Delaware ARNG Regional Training Institute
 BID FINAL SUBMITTAL

8/28/2012

SPECIFICATION SECTION 018113.13 -- EXHIBIT 1

2			Credit 3	Enhanced Commissioning	DE ARNG has contracted with Cxa for Cx and ECx services. Achievable based on all R410A refrigerant use. BMCD recommends M&V plan after one year of stable building operation to set building baseline for ongoing performance. DE ARNG Energy Manager will develop M&V Plan and implement.
2			Credit 4	Enhanced Refrigerant Management	
	3		Credit 5	Measurement and Verification	
		2	Credit 6	Green Power	

7	0	7	RP	Materials and Resources		
Y	?	N				Notes:
Y				Prereq 1	Storage and Collection of Recyclables	Required--must accommodate occupant recycling in FFE. Government will need to include recycle bins for the breakroom and training rooms into the FFE.
		3		Credit 1.1	Building Reuse--Maintain Existing Walls, Floors, and Roof	n/a
					Reuse 55%	
					Reuse 75%	
					Reuse 95%	
		1		Credit 1.2	Building Reuse--Maintain 50% of Interior Non-Structural	n/a
2			x	Credit 2	Construction Waste Management	Requiring 75% waste diversion by Contractor in specifications. Existing building demolition diversion can contribute heavily.
					1 50% Recycled or Salvaged	
					1 75% Recycled or Salvaged	
		2		Credit 3	Materials Reuse	Challenging to meet 5% threshold
					Reuse 5%	
					Reuse 10%	
2				Credit 4	Recycled Content	Should be possible with procurement planning. Required of contractor in specifications.
					1 10% of Content	
					1 20% of Content	
2				Credit 5	Regional Materials	Should be possible with procurement planning. Required of contractor in specifications.
					1 10% of Materials	
					1 20% of Materials	
		1		Credit 6	Rapidly Renewable Materials	Challenging to meet 2.5% threshold
1				Credit 7	Certified Wood	50% wood products must be FSC-certified (minimal wood). Required of contractor in specifications.

11	1	3	RP	Indoor Environmental Quality		
Y	?	N				Notes:
Y				Prereq 1	Minimum Indoor Air Quality Performance	Required--design will comply
Y				Prereq 2	Environmental Tobacco Smoke (ETS) Control	Required--must show exterior smoking area with signage and non-smoking policy. Guard sent the no-smoking policy.
1				Credit 1	Outdoor Air Delivery Monitoring	Design includes CO2 monitors in high density spaces; airflow monitors on AHUs
		1		Credit 2	Increased Ventilation	Not achievable
1				Credit 3.1	Construction IAQ Management Plan--During Construction	Required of contractor in specifications.
1				Credit 3.2	Construction IAQ Management Plan--Before Occupancy	Required of contractor in specifications.
1				Credit 4.1	Low-Emitting Materials--Adhesives and Sealants	Required of contractor in specifications.
1				Credit 4.2	Low-Emitting Materials--Paints and Coatings	Required of contractor in specifications.
1				Credit 4.3	Low-Emitting Materials--Flooring Systems	Required of contractor in specifications.
1				Credit 4.4	Low-Emitting Materials--Composite Wood/Agrifiber	Required of contractor in specifications.
1				Credit 5	Indoor Chemical and Pollutant Source Control	Plans show 10' entryway system at main entries (not all); MERV 13 filters; isolated janitor closets. Requires MERV 13 filters by contractor pre-occupancy.
1				Credit 6.1	Controllability of Systems--Lighting	Must have task lighting in all workstations--need Gov't assist to document this credit, which can be easily achieved.
		1		Credit 6.2	Controllability of Systems--Thermal Comfort	Not achievable
1				Credit 7.1	Thermal Comfort--Design	Design will comply and has a DDC BMS
1				Credit 7.2	Thermal Comfort--Verification	Survey occupants on thermal comfort and implement corrections. The Guard will implement the survey from BMCD's sample survey.
		1		Credit 8.1	Daylight and Views--Daylight	Required daylight levels in all office areas, training rooms, classrooms, conference rooms--need to calculate for compliance.
				Credit 8.2	Daylight and Views--Views	To meet requirement, training rooms need views.



6 0 0 RP				Innovation and Design Process	
Y	?	N			
1			Credit 1.1	Exemplary Performance of MRc7-100%	Specifications require 95-100% FSC-Certified new wood products and wood materials be procured for the project.
1			Credit 1.2	Innovation in Design: Reduced Mercury Lighting	Reduced mercury lighting (LED). Lamp recycling is desirable, but not required.
1			Credit 1.3	Innovation in Design: Education & Outreach Program	Education and Outreach: Specs include placeholder for signage allowance in the Contractor's construction budget.
1			Credit 1.4	Exemplary Performance of MRc4-30%	Exemplary performance of a material-related credit (contractor's choice of MRc2, MRc4 or MRc5)
1			Credit 1.5	Innovation in Design: Low-Emitting Systems Furniture	Specify and procure all workstations, task seating and guest seating to meet one of three testing protocols for low emissions. DEARNG Responsibility
1			Credit 2	LEED Accredited Professional	Multiple LEED APs involved
2 0 4				Regional Priority Credits	
Y	?	N			
		1	Credit 1.1	Regional Priority: SSc1	Notes: Projects can only earn 4 of the 6 possible RPs n/a
		1	Credit 1.2	Regional Priority: SSc4.4	Not achievable per LEED MPRs
1			Credit 1.3	Regional Priority: SSc6.1	Achievable
1			Credit 1.4	Regional Priority: MRc2 --50%	Achievable--Requiring 75% of contractor.
		1		Regional Priority: EAc2--1%	n/a
		1		Regional Priority: SSc5.1	n/a
61 5 46				Total Anticipated Certification Level: LEED Gold Certification anticipated	
Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110					

SECTION 019113 GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. ASHRAE Guideline 0-2005 “The Commissioning Process”
- B. U.S. Green Building Council LEED v2009 “Reference Guide for Green Building Design & Construction”

1.2 DESCRIPTION

- A. Summary. Commissioning is a systematic process of ensuring that all building systems perform interactively according to the design intent and the owner’s operational needs. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training. The commissioning process does not take away from, or reduce the responsibility of, the General Contractor and installing subcontractors to provide a finished and fully-functioning product.
- B. Purpose. Commissioning during the construction phase is intended to achieve the following specific objective according to the Contract Documents:
 - 1. Verify that applicable equipment and systems are installed according to the manufacturer’s recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
 - 2. Verify and document proper performance of equipment and systems.
 - 3. Verify that O&M documentation left on site is complete.
 - 4. Verify that the Owner’s operating personnel are adequately trained.

1.3 COORDINATION

- A. Commissioning Team. The members of the commissioning team consist of the designated representative of the Owner, Commissioning Authority (CA), the Architect and Design Engineers (particularly the mechanical engineer), General Contractor (GC), the Mechanical Contractor (MC), the TAB representative, the Electrical Contractor (EC), the Controls Contractor (CC), the Plumbing Contractor (PC) and the Fire Protection Contractor (FPC). If known, the Owner’s building operator/engineer is also a member of the commissioning team.
- B. Management. The CA has been hired by the Owner. The CA directs and coordinates the commissioning activities and is part of the design team. All members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents.
- C. Scheduling. The CA will work with the Cx team according to established protocols to schedule the commissioning activities. The CA will provide sufficient notice to the Cx team for scheduling commissioning activities. The CM will integrate all commissioning activities into

SECTION 019113 GENERAL COMMISSIONING REQUIREMENTS: continued

the master schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

1.4 COMMISSIONING PROCESS

A. Commissioning Process. The following narrative provides a brief overview of the typical commissioning tasks during construction and the general order in which they occur.

1. Commissioning during construction begins with a scoping meeting conducted by the CA where the commissioning process is reviewed with the commissioning team members.
2. Additional meetings will be required throughout construction, scheduled by the CA with necessary parties attending, to plan, scope, coordinate, schedule future activities and resolve problems.
3. Equipment documentation is submitted to the CA during normal submittals, including detailed start-up procedures.
4. The CA works with the GC and the Subcontractors/equipment suppliers in developing startup plans and startup documentation formats.
5. In general, the checkout and performance verification proceeds from simple to complex; from component level to equipment to systems and intersystem levels with pre-functional checklists being completed before functional testing.
6. The Subs, under their own direction, execute and document the pre-functional checklists and perform startup and initial checkout. The CA documents that the checklists and startup were completed according to the approved plans. This will include the CA witnessing start-up of selected equipment.
7. The CA develops specific equipment and system functional performance test procedures. The Subcontractors review the procedures.
8. The procedures are executed by the Subcontractors, under the direction of, and documented by the CA.
9. Items of non-compliance in material, installation or setup are corrected at the Subcontractors' expense and the system retested.
10. The CA reviews the O&M documentation for completeness.
11. Commissioning is completed before Substantial Completion.
12. The CA reviews, pre-approves and witnesses the training provided by the Subcontractors and verifies that it was completed.
13. Deferred testing is conducted, as specified or required.

1.5 RELATED WORK

A. Specific Commissioning (Cx) requirements are given in the following sections of these specifications. All of the following sections apply to the Work of this section:

1. 070910 Building Envelope Environmental Separations – Describes the Cx responsibilities of the General Contractor and the pre-functional and functional testing responsibilities.
2. 213910 Fire Protection Systems Cx – Describes the Cx responsibilities of the Fire Protections Contractor and the pre-functional testing and startup responsibilities.
3. 220910 Plumbing Systems Cx - Describes the Cx responsibilities of the Plumbing Contractor and the pre-functional testing and startup responsibilities.

SECTION 019113 GENERAL COMMISSIONING REQUIREMENTS: continued

4. 230910 Mechanical Systems Cx - Describes the Cx responsibilities of the Mechanical, Controls and TAB Contractors and the pre-functional testing and startup responsibilities of each.
5. 260910 Electrical Systems Cx - Describes the Cx responsibilities of the Electrical Contractor and the pre-functional testing and startup responsibilities.

1.6 RESPONSIBILITIES

A. The responsibilities of various parties in the commissioning process are provided in this section. It is noted that the services for the Architect, MEP Architects/Engineers, and Commissioning Authority are not provided for in this contract. That is, the Contractor is not responsible for providing their services. Their responsibilities are listed here to clarify the commissioning process.

B. All Parties

1. Follow the Commissioning (Cx) Plan.
2. Attend commissioning scoping meeting and additional Cx meetings, as necessary.

C. Mechanical, Electrical and Plumbing Architects/Engineers

Design, Construction and Acceptance Phase

1. Perform normal submittal review, construction observation, as-built drawing preparation, etc., as contracted. One site observation should be completed just prior to system startup.
2. Provide any design narrative and sequences documentation requested by the CA. The architects shall assist (along with the contractors) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
3. Participate in the resolution of system deficiencies identified during commissioning, according to the contract documents.
4. Prepare and submit the final as-built design intent and operating parameters documentation for inclusion in the O&M manuals. Review and approve the O&M manuals.
5. Edit and update one-line diagrams developed as part of the design narrative documentation and those provided by the vendor as shop drawings for the various Mechanical, Electrical, and Plumbing systems.

D. Commissioning Authority (CA)

The CA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CA may assist with problem-solving non-conformance or deficiencies, but ultimately that responsibility resides with the A/E. The primary role of the CA is to develop and coordinate the execution of a testing plan, observe and document performance. The Contractors will provide all tools or the use of tools to start, check-out and functionally test equipment and systems.

Design, Construction and Acceptance Phase

1. Coordinate the commissioning work and, with the A/E, ensure that commissioning activities are being scheduled into the master schedule.
2. Plan and conduct a commissioning scoping meeting, start-up and deficiency meetings as required.
3. Request and review additional information required to perform commissioning tasks, including O&M materials, control sequences, contractor start-up and checkout procedures.
4. Before startup, gather and review the current control sequences and interlocks and write detailed testing procedures.
5. Review and approve normal Contractor submittals applicable to systems being commissioned for compliance with commissioning needs.
6. Write and distribute pre-functional tests and checklists.
7. Perform site visits, as necessary, to observe component and system installations. Attends selected planning and job-site meetings to obtain information on construction progress.
8. Witness all or part of the HVAC/Plumbing piping test and flushing procedure, sufficient to be confident that proper procedures were followed. Document this testing and include the documentation in O&M manuals. Notify the A/E of any deficiencies in results or procedures.
9. Approve pre-functional tests and checklist completion by reviewing pre-functional checklist reports and by selected site observation and spot-checking.
10. Approve systems startup by reviewing start-up reports and by selected site observation.
11. Review TAB execution plan.
12. Analyze any functional performance trend logs and monitoring data to verify performance.
13. Compile and maintain a commissioning record and building systems book(s).
14. Review and approve the preparation of the O&M manuals.
15. Provide a final commissioning report.
16. Complete and submit LEED template letter for credit EA Prerequisite 1 Fundamental Commissioning.
17. Complete and submit LEED template for EA Credit 3 Enhanced Commissioning.

E. Architect/Engineering Firm

Design, Construction and Acceptance Phase

1. Facilitate the coordination of the commissioning work by the CA, and, with the CA, ensure that commissioning activities are being scheduled into the master schedule.
2. Review and approve the final *Construction Commissioning Plan*.
3. Attend a commissioning scoping meeting and other commissioning team meetings as needed.
4. When necessary, observe and witness pre-functional checklists, startup and functional testing of selected equipment
5. Review commissioning progress and deficiency reports.

F. Equipment Suppliers

1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.

SECTION 019113 GENERAL COMMISSIONING REQUIREMENTS: continued

2. Assist in equipment testing per agreements with Subcontractors.
3. Include all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the base bid price to the Contractor. Through the contractors they supply products to, analyze specified products and verify that the architect has specified the newest most updated equipment reasonable for this project's scope.
4. Provide information requested by CA regarding equipment sequence of operation and testing procedures.
5. Review test procedures for equipment installed by authorized factory representatives.

G. Controls & TAB Contractors

1. Controls & TAB Contractors will be responsible to carry out the commissioning requirements specified in Section 230910.

1.7 SYSTEMS TO BE COMMISSIONED

- A. This project will require integrated total building commissioning to include all of the following systems:

Building Envelope
Central Building Automation Systems
Geothermal Wells and Associated Pumps, Piping and Accessories
Water Source Heat Pumps
Dedicated Outdoor Air System
Air Distribution System
Ductless Air Conditioning Units
Unit Heaters
Exhaust Fans
Domestic Hot Water System
Lighting Controls Systems
Fire Protection Systems

PART 2 - PRODUCTS – (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 REPORTING

- A. The CA will provide regular field reports to the Owner as construction and commissioning progresses.

SECTION 019113 GENERAL COMMISSIONING REQUIREMENTS: continued

- B. The CA will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through memos and progress reports.
- C. A final summary report by the CA will be provided to the Owner. All acquired documentation, logs, minutes, reports, deficiency lists, communications, findings, unresolved issues, etc., will be compiled in appendices and provided with the summary report. Pre-functional checklists, functional tests and monitoring reports will not be part of the final report, but will be stored in the Commissioning Record in the O&M manuals.

3.2 START-UP, PREFUNCTIONAL CHECKLISTS AND INITIAL CHECKOUT

- A. The following procedures apply to all equipment to be commissioned, according to Section 1.6, "Systems to be Commissioned".
 - 1. Pre-functional checklist.
 - 2. Start-up: The start-up plan shall consist of:
 - a. The CA's pre-functional checklist.
 - b. The manufacturer's standard start-up procedure
 - c. The manufacturer's standard field checkout sheets.
- B. Execution of Pre-functional Checklists and Startup.
 - 1. The CA shall observe, at minimum, the procedures for each piece of primary equipment, unless there are multiple units. In no case will the number of units witnessed be less than 25% of the total number of identical or very similar units.
 - 2. For lower-level components of equipment, (e.g., unit heaters, sensors, controllers), the CA shall observe a sampling of the pre-functional and start-up procedures. The sampling procedures are identified in the commissioning plan.
 - 3. The Subs and vendors shall execute startup and provide the CA with a signed and dated copy of the completed start-up and pre-functional tests and checklists for 100% of all commissioned equipment.
- C. Deficiencies, Non-Conformance and Approval in Checklists and Startup.
 - 1. The Subs shall clearly list any outstanding items of the initial start-up and pre-functional procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the CA within two days of test completion.
 - 2. The CA reviews the report and submits either a non-compliance report or an approval form to the A/E. The CA shall work with the Subs and vendors to correct and retest deficiencies or uncompleted items. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CA as soon as outstanding items have been corrected and resubmit an updated start-up report and a Statement of Correction on the original non-compliance report. When satisfactorily completed, the CA recommends approval of the execution of the checklists and startup of each system.

SECTION 019113 GENERAL COMMISSIONING REQUIREMENTS: continued

3.3 FUNCTIONAL PERFORMANCE TESTING

- A. This sub-section applies to all commissioning functional testing for all divisions.
- B. The general list of equipment to be commissioned is found in Section 1.6 of this specification
- C. Objectives and Scope. The objective of functional performance testing is to demonstrate that each system is operating according to the documented design intent and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems. In general, each system should be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required.
- D. Development of Test Procedures. Before test procedures are written, the CA shall obtain all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. The CA shall develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Each Sub or vendor responsible to execute a test shall provide assistance to the CA in developing the procedures review. Prior to execution, the CA shall provide a copy of the test procedures to the Sub(s) who shall review the tests for feasibility, safety, equipment and warranty protection. The CA shall review owner-contracted, factory testing or required owner acceptance tests which the CA is not responsible to oversee, including documentation format, and shall determine what further testing or format changes may be required to comply with the *Specifications*. Redundancy of testing shall be minimized.
- E. Coordination and Scheduling. The Subs shall provide sufficient notice to the CA regarding their completion schedule for the pre-functional checklists and startup of all equipment and systems. The CA will schedule functional tests through the A/E and affected Subs. The CA shall direct, witness and document the functional testing of selected equipment and systems. The Subs shall execute the tests.
- F. In general, functional testing is conducted after pre-functional testing and startup has been satisfactorily completed. The control system is sufficiently tested and approved by the CA before it is used for TAB or to verify performance of other components or systems. The air balancing and water balancing is completed and debugged before functional testing of air-related or water-related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.

3.4 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS

- A. Documentation. The CA shall witness and document the results of all functional performance tests using the specific procedural forms developed for that purpose. Prior to testing, these forms are provided to the CA for review and approval and to the Subs for review.
- B. Non-Conformance.
 - 1. The CA will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and reported to the Owner.

SECTION 019113 GENERAL COMMISSIONING REQUIREMENTS: continued

2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CA.
 3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the Owner.
- C. Approval. The CA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the CA.

3.5 OPERATION AND MAINTENANCE MANUALS

- A. Commissioning Record in O&M Manuals.
1. The CA is responsible to compile, organize and index the following commissioning data by equipment into labeled, indexed and tabbed, three-ring binders and deliver it to the Owner. Three copies of the manuals will be provided.
 2. Final Report Details. The final commissioning report shall include an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope and a general description of testing and verification methods. For each piece of commissioned equipment, the report should contain the disposition of the commissioning authority regarding the adequacy of the equipment, documentation and training meeting the contract documents in the following areas: 1) Equipment meeting the equipment specifications, 2) Equipment installation, 3) Functional performance and efficiency, 4) Equipment documentation and design intent, and 5) Operator training. All outstanding non-compliance items shall be specifically listed. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. shall also be listed. Each non-compliance issue shall be referenced to the specific functional test, inspection, trend log, etc. where the deficiency is documented.

3.6 TRAINING OF OWNER PERSONNEL

- A. The GC shall be responsible for training coordination and scheduling, and ultimately for ensuring that training is completed.
- B. The CA shall be responsible for approving the content and adequacy and witnessing of the training of owner personnel for commissioned equipment.

3.7 DEFERRED TESTING

- A. Unforeseen Deferred Tests. If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon approval of the Owner. These tests will be conducted in the same manner as the seasonal tests as soon as possible.
- B. Seasonal Testing. During the warranty period, seasonal testing shall be completed as part of this contract. The CA shall coordinate this activity. Tests will be executed, documented and

SECTION 019113 GENERAL COMMISSIONING REQUIREMENTS: continued

deficiencies corrected by the appropriate Subs, with facilities staff and the CA witnessing. Any final adjustments to the O&M manuals and as-builds due to the testing will be made.

3.8 ENHANCED COMMISSIONING

- A. The CA will review GC submittals applicable to systems being commissioned (see Part 1.6 of this section) for compliance with the Owner's project requirements and basis of design.
- B. The CA will develop a systems manual that provides future operating staff the information needed to understand and optimally operate the commissioned systems.
- C. The CA will verify that the requirements for training operating personnel and building occupants have been completed.
- D. The entire Commissioning Team (see Part 1.3 of this section) will be involved in reviewing the operation of the building with operations and maintenance (O&M) staff and occupants within 10 months after substantial completion. A plan for resolving any outstanding commissioning-related issue will be developed and implemented by this Commissioning Team.

END OF SECTION 019113

DIVISION 02 - EXISTING CONDITIONS

SECTION 024116 - STRUCTURE DEMOLITION

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS:
- A. DIVISION 01 Section "Construction Waste Management and Disposal" for LEED® related requirements for construction waste management.
 - B. DIVISION 01 Section "Summary" for use of the premises and phasing requirements.
 - C. DIVISION 01 Section "Construction Progress Documentation" for preconstruction photographs taken before building demolition.
 - D. DIVISION 23 Sections for demolishing or relocating site mechanical items.
- 1.02 SUMMARY:
- A. Section Includes:
 - 1. Demolition and removal of buildings and site improvements.
 - 2. Removing below-grade construction.
 - 3. Disconnecting, capping or sealing, and removing site utilities.
 - 4. Salvaging items for reuse by Owner.
- 1.03 REFERENCES:
- A. American National Standards Institute:
 - 1. ANSI/ASSE A10.6-2006 - Safety Requirements for Demolition Operations.
 - B. Code of Federal Regulations:
 - 1. 40 CFR 82-2006 - Protection of Stratospheric Ozone.
 - C. NFPA:
 - 1. NFPA 241-2004 - Safeguarding Construction, Alteration, and Demolition Operations.
- 1.04 DEFINITIONS:
- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged.
 - B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Government. Include fasteners or brackets removed with existing construction.
- 1.05 MATERIALS OWNERSHIP:
- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
 - B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Government that may be uncovered during demolition remain the property of Government.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Government.
- 1.06 INFORMATIONAL SUBMITTALS:
- A. Qualification Data: For qualified refrigerant recovery technician.
 - B. Proposed Protection Measures: Submit informational report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, dust control and, noise control. Indicate proposed locations and construction of barriers.

SECTION 024116 - STRUCTURE DEMOLITION: continued

1. Adjacent Buildings: Detail special measures proposed to protect adjacent buildings to remain including means of egress from those buildings.
 - C. Schedule of Building Demolition Activities: Indicate the following:
 1. Detailed sequence of demolition work, with starting and ending dates for each activity.
 2. Temporary interruption of utility services.
 3. Shutoff and capping and/or re-routing of utility services.
 - D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
 - E. Predemolition Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by demolition operations. Submit before the Work begins.
 - F. Landfill Records: Indicate receipt and acceptance of wastes by a landfill facility licensed to accept wastes.
 - G. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- 1.07 QUALITY ASSURANCE:
- A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
 - B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
 - C. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.
 - D. Predemolition Conference: Conduct conference at Project site.
 1. Inspect and discuss condition of construction to be demolished.
 2. Review structural load limitations of existing structures.
 3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Review and finalize protection requirements.
 5. Review procedures for noise control and dust control.
 6. Review procedures for protection of adjacent buildings.
 7. Review items to be salvaged and returned to Government.
- 1.08 PROJECT CONDITIONS:
- A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.
 - B. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.
 1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
 2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.
 - a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.
 - C. Government assumes no responsibility for buildings and structures to be demolished.
 1. Conditions existing at time of inspection for bidding purpose will be maintained by Government as far as practical.

SECTION 024116 - STRUCTURE DEMOLITION: continued

2. Before building demolition, Government will remove the following items:
 - a. Furniture.
 - b. Fixtures including kitchen, audio-visual and teaching stations.
 - c. Kitchen Equipment.
 - d. Computer Equipment, Data Racks and Routers.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 1. Hazardous materials will be removed by Government before start of the Work.
 2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Government. Hazardous materials will be removed by Government under a separate contract.
- E. On-site storage or sale of removed items or materials is not permitted.

1.09 COORDINATION:

- A. Arrange demolition schedule so as not to interfere with Government's on-site operations or operations of adjacent occupied buildings.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS:

- A. Satisfactory Soils: Comply with requirements in DIVISION 31 Section "Earth Moving."

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Verify that utilities have been disconnected and capped before starting demolition operations.
- B. Review Project Record Documents of existing construction provided by Government. Government does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.
- D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

3.02 PREPARATION:

- A. Refrigerant: Remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction before starting demolition.
- B. Existing Utilities: Locate, identify, disconnect, and seal or cap off utilities serving buildings and structures to be demolished as indicated in the Contract Documents.
 1. Government will arrange to shut off indicated utilities when requested by Contractor as required in the execution of the work.
 2. Arrange to shut off indicated utilities with utility companies.
 3. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
 4. Cut off pipe or conduit a minimum of 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.

SECTION 024116 - STRUCTURE DEMOLITION: continued

- C. Existing Utilities: See DIVISIONS 22 and 26 Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.
- D. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of demolition.
- E. Salvaged Items: Comply with the following:
 - 1. Clean salvaged items of dirt and demolition debris.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Government.
 - 4. Transport items to storage area designated by Government.
 - 5. Protect items from damage during transport and storage.

3.03 PROTECTION:

- A. Existing Facilities: Protect adjacent walkways, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.
- B. Existing Utilities: Maintain utility services to remain and protect from damage during demolition operations.
 - 1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Government and authorities having jurisdiction.
 - 2. Provide temporary services during interruptions to existing utilities, as acceptable to Government and authorities having jurisdiction.
 - a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.
- C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in DIVISION 01 Section "Temporary Facilities and Controls."
 - 1. Protect adjacent buildings and facilities from damage due to demolition activities.
 - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
 - 3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
 - 4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
 - 6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
 - 7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.
- D. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.04 DEMOLITION, GENERAL:

- A. General: Demolish indicated buildings and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.

SECTION 024116 - STRUCTURE DEMOLITION: continued

2. Maintain fire watch during and for at least 4 hours after flame cutting operations.
 3. Maintain adequate ventilation when using cutting torches.
 4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Engineering Surveys: During demolition, perform surveys to detect hazards that may result from building demolition activities.
- C. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Government and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
 2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- D. Explosives: Use of explosives is not permitted.

3.05 DEMOLITION BY MECHANICAL MEANS:

- A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.
- B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.
- C. Salvage: Items to be removed and salvaged are indicated on Drawings and as listed below:
1. Door hardware.
 2. Mirrors.
 3. Chalkboards.
 4. Tackboards.
 5. Marker boards.
- D. Below-Grade Construction: Abandon foundation walls and other below-grade construction. Cut below-grade construction flush with grade.
- E. Below-Grade Construction: Demolish foundation walls and other below-grade construction.
1. Remove below-grade construction, including basements, foundation walls, and footings, completely.
- F. Existing Utilities: Demolish and remove existing utilities and below-grade utility structures.
1. Piping: Disconnect piping at unions, flanges, valves, or fittings.
 2. Wiring Ducts: Disassemble into unit lengths and remove plug-in and disconnecting devices.

3.06 DEMOLITION BY EXPLOSIVES:

- A. Explosives: Use of explosives is not permitted.

3.07 DISPOSAL BY BURNING:

- A. Burning of materials of all types on site is prohibited.

SECTION 024116 - STRUCTURE DEMOLITION: continued

3.08 SITE RESTORATION:

- A. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials according to backfill requirements in DIVISION 31 Section "Earth Moving."
- B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.09 REPAIRS:

- A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.10 DISPOSAL OF DEMOLISHED MATERIALS:

- A. Remove demolition waste materials from Project site and legally dispose of them in an EPA-approved landfill acceptable to authorities having jurisdiction. See DIVISION 01 Section "Construction Waste Management and Disposal" for recycling and disposal of demolition waste.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

3.11 CLEANING:

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

END OF SECTION 024116

DIVISION 03 - CONCRETE

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Slabs-on-grade.

1.03 REFERENCES:

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO M 182 (2006) - Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats.
- B. American Concrete Institute:
 - 1. ACI 117 (2006) - Specifications for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301 (2005) - Specifications for Structural Concrete.
 - 3. ACI 302.1R (2004) - Guide for Concrete Floor and Slab Construction.
 - 4. ACI 305R (1999) - Hot Weather Concreting.
 - 5. ACI 306.1 (1990) (Reapproved 2002) - Specification for Cold Weather Concreting.
 - 6. ACI 308.1 (1998) - Specification for Curing Concrete.
 - 7. ACI 318 (2008) - Building Code Requirements for Structural Concrete.
 - 8. ACI CP-1 (2008) - Technical Workbook for ACI Certification of Concrete Field Testing Technician - Grade I.
- C. ASTM International:
 - 1. ASTM A82-07 - Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - 2. ASTM A185-07 - Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - 3. ASTM A615-08 - Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - 4. ASTM C31-06 - Practice for Making and Curing Concrete Test Specimens in the Field.
 - 5. ASTM C33-07 - Specification for Concrete Aggregates.
 - 6. ASTM C39-05 - Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - 7. ASTM C42-04 - Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - 8. ASTM C94-07 - Specification for Ready-Mixed Concrete.
 - 9. ASTM C109-07 - Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch Cube Specimens).
 - 10. ASTM C143-08 - Test Method for Slump of Hydraulic-Cement Concrete.
 - 11. ASTM C150-07 - Specification for Portland Cement.
 - 12. ASTM C171-07 - Specification for Sheet Materials for Curing Concrete.
 - 13. ASTM C172-07a - Practice for Sampling Freshly Mixed Concrete.
 - 14. ASTM C219-07a - Terminology Relating to Hydraulic Cement.

SECTION 033000 - CAST-IN-PLACE CONCRETE: continued

15. ASTM C309-07 - Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 16. ASTM C494-08 - Specification for Chemical Admixtures for Concrete.
 17. ASTM C618-05 - Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
 18. ASTM C881-02 - Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
 19. ASTM C989-06 - Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
 20. ASTM C1017-07 - Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
 21. ASTM C1059-99 (Reapproved 2008) - Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
 22. ASTM C1064-05 - Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
 23. ASTM C1077-07a - Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
 24. ASTM D448-03a - Classification for Sizes of Aggregate for Road and Bridge Construction.
 25. ASTM D1751-04 - Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 26. ASTM D1752-04a - Specification for Preformed Sponge Rubber, Cork, and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
 27. ASTM D4397-02 - Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
 28. ASTM E329-07a - Specification for Agencies Engaged in Construction Inspection and/or Testing.
 29. ASTM E1643-98 (Reapproved 2005) - Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.
- D. Concrete Reinforcing Steel Institute:
1. Manual of Standard Practice, 27th ed., 2001.
- E. National Ready Mixed Concrete Association:
1. Certification of Ready Mixed Concrete Production Facilities, 1997.

1.04 DEFINITIONS:

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag; subject to compliance with requirements.

1.05 ACTION SUBMITTALS:

- A. Product Data: For each type of product indicated.
- B. LEED® Submittals:
1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Data for Credit MR 4: For cast-in-place concrete, submit each concrete mix indicating all mix components, material sourcing locations and percent of each component material, by weight. Submit material cost of concrete for each mix.

SECTION 033000 - CAST-IN-PLACE CONCRETE: continued

3. Product Data for Credit IEQc4.1: For bonding adhesives applied on-site and inside the weatherproofing barrier of the building, submit documentation including manufacturer's printed statement (MSDS Sheet) of VOC content of each product.
4. Product Data for Credit IEQc4.2: For primers and concrete curing compounds applied on-site and inside the weatherproofing barrier of the building, submit documentation including manufacturer's printed statement (MSDS Sheet) of VOC content of each product.
- C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, and supports for concrete reinforcement.

1.06 INFORMATIONAL SUBMITTALS:

- A. Qualification Data: For Installer, manufacturer, and testing agency.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
 1. Cementitious materials.
 2. Admixtures.
 3. Steel reinforcement and accessories.
 4. Curing compounds.
 5. Bonding agents.
 6. Adhesives.
 7. Vapor retarders.
 8. Joint-filler strips.
 9. Repair materials.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Field quality-control reports.

1.07 QUALITY ASSURANCE:

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94 requirements for production facilities and equipment.
 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.
 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency

SECTION 033000 - CAST-IN-PLACE CONCRETE: continued

laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.08 DELIVERY, STORAGE, AND HANDLING:

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.01 FORM-FACING MATERIALS:

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
- B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch minimum.
- C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.02 STEEL REINFORCEMENT:

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25%.
- B. Reinforcing Bars: ASTM A615, Grade 60 (Grade 420), deformed.
- C. Plain-Steel Wire: ASTM A82, as drawn.
- D. Plain-Steel Welded Wire Reinforcement: ASTM A185, plain, fabricated from as-drawn steel wire into flat sheets.

2.03 REINFORCEMENT ACCESSORIES:

- A. Joint Dowel Bars: ASTM A615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.

2.04 CONCRETE MATERIALS:

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C150, Type I, gray. Supplement with the following:
 - a. Fly Ash: ASTM C618, Class F or C.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.

SECTION 033000 - CAST-IN-PLACE CONCRETE: continued

- B. Normal-Weight Aggregates: ASTM C33, Class 4S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal for footings, 3/4 inch nominal for slabs on grade.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C94 and potable.

2.05 ADMIXTURES:

- A. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C494, Type A.
 - 2. Retarding Admixture: ASTM C494, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C494, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C494, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C1017, Type II.

2.06 VAPOR RETARDERS:

- A. Sheet Vapor Retarder: Polyethylene sheet, ASTM D4397, not less than 10 mils thick.
- B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D448, Size 57, with 100% passing a 1-1/2-inch sieve and 0 to 5% passing a No. 8 sieve.

2.07 CURING MATERIALS:

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering. Alternatively, remove compound where incompatible floor covering is indicated.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anti-Hydro International, Inc.; AH Clear Cure WB.
 - b. BASF Construction Chemicals - Building Systems; Kure-N-Seal WB.
 - c. ChemMasters; Safe-Cure & Seal 20.
 - d. Conspec by Dayton Superior; Cure and Seal WB.
 - e. Cresset Chemical Company; Crete-Trete 309-VOC Cure & Seal.
 - f. Dayton Superior Corporation; Safe Cure and Seal (J-18).
 - g. Edoco by Dayton Superior; Spartan Cote WB II.
 - h. Euclid Chemical Company (The), an RPM company; Aqua Cure VOX; Clearseal WB 150.
 - i. Kaufman Products, Inc.; Cure & Seal 309 Emulsion.
 - j. Lambert Corporation; Glazecote Sealer-20.

SECTION 033000 - CAST-IN-PLACE CONCRETE: continued

- k. L&M Construction Chemicals, Inc.; Dress & Seal WB.
 - l. Meadows, W.R., Inc.; Vocomp-20.
 - m. Metalcrete Industries; Metcure.
 - n. Nox-Crete Products Group; Cure & Seal 150E.
 - o. Symons by Dayton Superior; Cure & Seal 150E.
 - p. TK Products, Division of Sierra Corporation; TK-2519 WB.
 - q. Vexcon Chemicals, Inc.; Starseal 309.
- E. Concrete curing compound VOC content shall not exceed the VOC limits of LEED Credit IEQ 4.2 in accordance with the LEED Reference Guide.

2.08 RELATED MATERIALS:

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.
- B. Bonding Agent: ASTM C1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
 - 2. Bonding adhesive VOC content shall not exceed the VOC limits of LEED Credit IEQ 4.1 in accordance with the LEED Reference Guide.

2.09 REPAIR MATERIALS:

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 5,000 psi at 28 days when tested according to ASTM C109.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5,000 psi at 28 days when tested according to ASTM C109.
- C. Primer VOC content shall not exceed the VOC limits of Credit IEQc4.2 in accordance with the LEED Reference Guide.

SECTION 033000 - CAST-IN-PLACE CONCRETE: continued

2.10 CONCRETE MIXTURES, GENERAL:

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Use fly ash, pozzolan and ground granulated blast-furnace slag as needed to reduce the total amount of Portland cement, which would otherwise be used, by not less than 40%. Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:
 - 1. Fly Ash: 25%.
 - 2. Combined Fly Ash and Pozzolan: 25%.
 - 3. Ground Granulated Blast-Furnace Slag: 50%.
 - 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50% Portland cement minimum, with fly ash or pozzolan not exceeding 25%.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15% by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete and concrete with a water-cementitious materials ratio below 0.50.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS:

- A. Footings: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 5,000 psi at 28 days.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.40.
 - 3. Slump Limit: 4 inches, or 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, ± 1 inch.
- B. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 5,000 psi at 28 days.
 - 2. Minimum Cementitious Materials Content: 540 lb/cu. yd.
 - 3. Slump Limit: 4 inches, ± 1 inch.
 - 4. Air Content: Do not allow air content of trowel-finished floors to exceed 3%.

2.12 FABRICATING REINFORCEMENT:

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13 CONCRETE MIXING:

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90°F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90°F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.

SECTION 033000 - CAST-IN-PLACE CONCRETE: continued

2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.01 FORMWORK:

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 1. Class A, 1/8 inch for smooth-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Chamfer exterior corners and edges of permanently exposed concrete.
- H. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- I. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- J. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.02 REMOVING AND REUSING FORMS:

- A. General: Formwork that does not support weight of concrete may be removed after cumulatively curing at not less than 50°F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Contracting Officer's Representative.

3.03 VAPOR RETARDERS:

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E1643 and manufacturer's written instructions.
 1. Lap joints 6 inches and seal with manufacturer's recommended tape.
- B. Granular Course: Place vapor retarder over granular fill after moistening and compacting with mechanical equipment to elevation tolerances of +0 inch or -3/4 inch.

SECTION 033000 - CAST-IN-PLACE CONCRETE: continued

3.04 STEEL REINFORCEMENT:

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.05 JOINTS:

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Contracting Officer's Representative.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Use a bonding agent or epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.06 CONCRETE PLACEMENT:

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Contracting Officer's Representative.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of

SECTION 033000 - CAST-IN-PLACE CONCRETE: continued

- weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 2. Do not use vibrators to transport concrete. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40°F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- F. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90°F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.07 FINISHING FLOORS AND SLABS:

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces to receive trowel finish.
- C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

SECTION 033000 - CAST-IN-PLACE CONCRETE: continued

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-foot long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
- D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Contracting Officer's Representative before application.

3.08 MISCELLANEOUS CONCRETE ITEMS:

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.09 CONCRETE PROTECTING AND CURING:

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

SECTION 033000 - CAST-IN-PLACE CONCRETE: continued

- b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
- a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

3.10 CONCRETE SURFACE REPAIRS:

- A. Defective Concrete: Repair and patch defective areas when approved by Contracting Officer's Representative. Remove and replace concrete that cannot be repaired and patched to Contracting Officer's Representative's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 6. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

SECTION 033000 - CAST-IN-PLACE CONCRETE: continued

- D. Repair materials and installation not specified above may be used, subject to Contracting Officer's Representative's approval.

3.11 FIELD QUALITY CONTROL:

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- B. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Verification of use of required design mixture.
 - 3. Concrete placement, including conveying and depositing.
 - 4. Curing procedures and maintenance of curing temperature.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 2. Slump: ASTM C143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 3. Concrete Temperature: ASTM C1064; one test hourly when air temperature is 40°F and below and when 80°F and above, and one test for each composite sample.
 - 4. Compression Test Specimens: ASTM C31.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - 5. Compressive-Strength Tests: ASTM C39; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 - 6. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 - 7. Test results shall be reported in writing to Contracting Officer's Representative, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 - 8. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Contracting Officer's Representative but will not be used as sole basis for approval or rejection of concrete.
 - 9. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, compressive strengths, or other requirements have not been met, as directed by Contracting Officer's Representative. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed by Contracting Officer's Representative.

SECTION 033000 - CAST-IN-PLACE CONCRETE: continued

10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 033000

DIVISION 04 - MASONRY

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

A. Section Includes:

1. Concrete masonry units.
2. Decorative concrete masonry units.
3. Mortar and grout.
4. Steel reinforcing bars.
5. Masonry joint reinforcement.
6. Ties and anchors.
7. Embedded flashing.
8. Miscellaneous masonry accessories.
9. Cavity-wall insulation.

B. Related Sections:

1. DIVISION 01, Section "Sustainable Design Requirements" for LEED® related requirements for recycled content materials and local/regionally manufactured and sourced materials.
2. DIVISION 05, Section "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
3. DIVISION 05, Section "Metal Fabrications" for furnishing steel lintels and shelf angles for unit masonry.
4. DIVISION 07, Section "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.
5. DIVISION 07, Section "Thermal Insulation" for liquid vapor barrier.

1.03 REFERENCES:

A. American Concrete Institute:

1. ACI 315-1999 - Details and Detailing of Concrete Reinforcement.

B. American Concrete Institute, Structural Engineering Institute of the American Society of Civil Engineers, and The Masonry Society:

1. ACI 530.1/ASCE 6/TMS 602-2005 - Specification for Masonry Structures.

C. ASTM International:

1. ASTM A36-05 - Specification for Carbon Structural Steel.
2. ASTM A82-05a - Specification for Steel Wire, Plain, for Concrete Reinforcement.
3. ASTM A153-05 - Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
4. ASTM A240-07 - Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
5. ASTM A276-06 - Specification for Stainless Steel Bars and Shapes.
6. ASTM A307-04 - Specification for Carbon Steel Bolts and Studs, 60, 000 PSI Tensile Strength.
7. ASTM A563-04 - Specification for Carbon and Alloy Steel Nuts.
8. ASTM A580-06 - Specification for Stainless Steel Wire.

SECTION 042000 - UNIT MASONRY: continued

9. ASTM A615-07 - Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
10. ASTM A641-03 - Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
11. ASTM A653-06a - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
12. ASTM A666-03 - Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
13. ASTM A951-06 - Specification for Steel Wire for Masonry Joint Reinforcement.
14. ASTM A996-06a - Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
15. ASTM A1008-07 - Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
16. ASTM B117-07 - Practice for Operating Salt Spray (Fog) Apparatus.
17. ASTM B370-03 - Specification for Copper Sheet and Strip for Building Construction.
18. ASTM B633-07 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
19. ASTM C90-06b - Specification for Loadbearing Concrete Masonry Units.
20. ASTM C91-05 - Specification for Masonry Cement.
21. ASTM C109-05 - Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch or Cube Specimens).
22. ASTM C126-99 (Reapproved 2005) - Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units.
23. ASTM C140-06 - Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
24. ASTM C143-05a - Test Method for Slump of Hydraulic Cement Concrete.
25. ASTM C144-04 - Specification for Aggregate for Masonry Mortar.
26. ASTM C150-07 - Specification for Portland Cement.
27. ASTM C207-06 - Specification for Hydrated Lime for Masonry Purposes.
28. ASTM C270-07 - Specification for Mortar for Unit Masonry.
29. ASTM C404-06 - Specification for Aggregates for Masonry Grout.
30. ASTM C476-02 - Specification for Grout for Masonry.
31. ASTM C494-05a - Specification for Chemical Admixtures for Concrete.
32. ASTM C568-03 - Specification for Limestone Dimension Stone.
33. ASTM C578-07 - Specification for Rigid, Cellular Polystyrene Thermal Insulation.
34. ASTM C780-06a - Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
35. ASTM C920-05 - Specification for Elastomeric Joint Sealants.
36. ASTM C979-05 - Specification for Pigments for Integrally Colored Concrete.
37. ASTM C1019-05 - Test Method for Sampling and Testing Grout.
38. ASTM C1093-06 - Practice for Accreditation of Testing Agencies for Unit Masonry.
39. ASTM C1314-03b - Test Method for Compressive Strength of Masonry Prisms.
40. ASTM C1329-05 - Specification for Mortar Cement.
41. ASTM C1506-03 - Test Method for Water Retention of Hydraulic Cement-Based Mortars and Plasters.
42. ASTM C1623-06 - Specification for Manufactured Concrete Masonry Lintels.
43. ASTM D226-06 - Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
44. ASTM D1056-07 - Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.

SECTION 042000 - UNIT MASONRY: continued

45. ASTM D2000-06a - Classification System for Rubber Products in Automotive Applications.
 46. ASTM D2287-96 (Reapproved 2001) - Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds.
 47. ASTM D4637-04 - Specification for EPDM Sheet Used in Single-Ply Roof Membrane.
 48. ASTM E119-07 - Test Methods for Fire Tests of Building Construction and Materials.
 49. ASTM E488-96 (Reapproved 2003) - Test Methods for Strength of Anchors in Concrete and Masonry Elements.
 50. ASTM E514-06 - Test Method for Water Penetration and Leakage Through Masonry.
 51. ASTM F593-02 - Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 52. ASTM F594-02 - Specification for Stainless Steel Nuts.
 53. ASTM F836M-02 - Specification for Style 1 Stainless Steel Metric Nuts.
 54. ASTM F1941-00 (Reapproved 2006) - Specification for Electrodeposited Coatings on Threaded Fasteners (Unified Inch Screw Threads (UN/UNR)).
 - D. Indiana Limestone Institute of America, Inc.:
 1. Indiana Limestone Handbook, 21st ed. 2003.
 - E. International Code Council:
 1. International Building Code, 2006.
 - F. National Concrete Masonry Association:
 1. NCMA TEK 8-2A (1998) - Removal of Stains from Concrete Masonry Walls.
 - G. Sheet Metal and Air Conditioning Contractors' National Association:
 1. Architectural Sheet Metal Manual, 2003.
- 1.04 DEFINITIONS:
- A. CMU(s): Concrete masonry unit(s).
 - B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.
- 1.05 PERFORMANCE REQUIREMENTS:
- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
 2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C1314.
- 1.06 SUBMITTALS:
- A. Product Data: For each type of product indicated.
 - B. LEED® Submittals:
 1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
 2. Product Data for Credit MRc4: For products containing recycled content, submit documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content for each product or portion of a product having recycled content. Include statement indicating cost for each product containing recycled content material.

SECTION 042000 - UNIT MASONRY: continued

3. For mortars and grouts used inside the weatherproofing of the building, submit manufacturer's documentation stating that products do not exceed the VOC limits of South Coast Air Quality Management District (SCAQMD) Rule 1168, effective July 1, 2005 and amendment of January 7, 2005.
4. Product Data for Credit IEQc4.1: For adhesives and sealants installed inside the weatherproofing barrier of the building, submit documentation including manufacturer's printed statement (MSDS Sheet) of VOC content of each product.
- C. Shop Drawings: For the following:
 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 2. Stone Trim Units: Show sizes, profiles, and locations of each stone trim unit required.
 3. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
 4. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- D. Samples for Verification: For each type and color of the following:
 1. Exposed CMUs.
 2. Weep holes.
 3. Accessories embedded in masonry.

1.07 INFORMATIONAL SUBMITTALS:

- A. List of Materials Used in Constructing Sample Panels: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
 1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Contracting Officer and approved in writing.
- B. Qualification Data: For testing agency.
- C. Material Certificates: For each type and size of the following:
 1. Masonry units.
 - a. Include data on material properties
 - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 2. Cementitious materials. Include brand, type, and name of manufacturer.
 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 4. Grout mixes. Include description of type and proportions of ingredients.
 5. Reinforcing bars.
 6. Joint reinforcement.
 7. Anchors, ties, and metal accessories.
- D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109 for compressive strength, ASTM C1506 for water retention, and ASTM C91 for air content.
 2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.
- E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units,

SECTION 042000 - UNIT MASONRY: continued

mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

- F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.08 QUALITY ASSURANCE:

- A. Testing Agency Qualifications: Qualified according to ASTM C1093 for testing indicated.
- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- E. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in DIVISION 01, Section "Quality Requirements" for sample panels.
 - 1. Build sample panels for typical exterior and interior walls in sizes approximately 60 inches long by 48 inches high by full thickness. Include in sample panel head, jamb and sill conditions at windows.
 - 2. Clean one-half of exposed faces of panels with masonry cleaner indicated.
 - 3. Protect approved sample panels from the elements with weather-resistant membrane.
 - 4. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Contracting Officer in writing.
 - a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Contracting Officer in writing.

1.09 DELIVERY, STORAGE, AND HANDLING:

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.10 PROJECT CONDITIONS:

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

SECTION 042000 - UNIT MASONRY: continued

1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 2. Protect sills, ledges, and projections from mortar droppings.
 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40°F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.01 MASONRY UNITS, GENERAL:

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.02 CONCRETE MASONRY UNITS:

- A. Regional Materials: CMUs shall be manufactured within 500 miles of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- B. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 2. Provide bull-nose-edged units for outside corners unless otherwise indicated.

SECTION 042000 - UNIT MASONRY: continued

- C. CMUs: ASTM C90 (Type 1).
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1,900 psi.
 - 2. Density Classification: Normal weight.
 - 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
 - 4. Exposed Faces: Provide color and texture matching the range represented by Contracting Officer's sample.
- D. Concrete Building Brick: ASTM C55.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2,800 psi.
 - 2. Density Classification: Normal weight.
 - 3. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high.
- E. Decorative CMUs: ASTM C90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
 - 2. Density Classification: Normal weight.
 - 3. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph.
 - 4. Pattern and Texture:
 - a. Provide the following types and sizes as shown on the drawings:
 - (1) Type 2 - 16-inch by 16-inch units - Ground face, grout filled and polished smooth custom size units. Color number 1, to be selected from manufacturer's standard colors. Basis of Design is Trenwyth, Trendstone Plus, filled and polished ground face masonry units in custom size.
 - (2) Type 3 - 8-inch by 16-inch by 8-inch units - Ground face, grout filled and polished smooth custom size units. Color number 1, to be selected from manufacturer's standard colors. Basis of Design is Trenwyth, Trendstone Plus, filled and polished ground face masonry units in custom size.
 - (3) Type 4 - 8-inch by 16-inch by 4-inch units - Ground face, grout filled and polished smooth units. Color number 2, to be selected from manufacturer's standard colors. Basis of Design is Trenwyth, Trendstone Plus, filled and polished ground face masonry units in 4F or 4FT size/shape.
 - (4) Type 5 - 4-inch by 16-inch by 4-inch units - Ground face, grout filled and polished smooth units. Color number 3, to be selected from manufacturer's standard colors. Basis of Design is Trenwyth, Trendstone Plus, filled and polished ground face masonry units in 44F size/shape.
 - (5) Type 6 - 4-inch by 16-inch by 10-inch units - Ground face, grout filled and polished smooth units. Color number 4, to be selected from manufacturer's standard colors. Basis of Design is Trenwyth, Trendstone Plus, filled and polished ground face masonry units in custom size/shape.
 - (6) Type 7 - 8-inch by 16-inch by 4-inch units - Ground face, grout filled and polished smooth units. Color number 5, to be selected from manufacturer's standard colors. Basis of Design is Trenwyth, Trendstone Plus, filled and polished ground face masonry units in V1 (8 by 8 score) size/shape.
 - b. Or equals with prior approval.
- F. Concrete Facing Brick: ASTM C1634.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3,750 psi.
 - 2. Density Classification: Normal weight.
 - 3. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.

SECTION 042000 - UNIT MASONRY: continued

4. Texture: Ground-face finish.
 - a. Match Contracting Officer's samples.
 5. Colors: As indicated by manufacturer's designations.
- 2.03 CONCRETE AND MASONRY LINTELS:
- A. General: Provide one of the following:
 - B. Concrete Lintels: ASTM C1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than CMUs.
 - C. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in DIVISION 03, Section "Cast-in-Place Concrete," and with reinforcing bars indicated.
 - D. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.
- 2.04 MORTAR AND GROUT MATERIALS:
- A. Regional Materials: Aggregate for mortar and grout, cement, and lime shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
 - B. Portland Cement: ASTM C150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
 - C. Hydrated Lime: ASTM C207, Type S.
 - D. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime containing no other ingredients.
 - E. Masonry Cement: ASTM C91.
 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Capital Materials Corporation; Flamingo Color Masonry Cement.
 - b. Cemex S.A.B. de C.V.; Brikset Type N.
 - c. Essroc, Italcementi Group; Brixment.
 - d. Holcim (US) Inc.; Mortamix Masonry Cement.
 - e. Lafarge North America Inc.; Magnolia Masonry Cement.
 - f. Lehigh Cement Company; Lehigh Masonry Cement.
 - g. National Cement Company, Inc.; Coosa Masonry Cement.
 - F. Aggregate for Mortar: ASTM C144.
 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 2. For joints less than 1/4 inch thick, use aggregate graded with 100% passing the No. 16 sieve.
 - G. Aggregate for Grout: ASTM C404.
 - H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Euclid Chemical Company (The); Accelguard 80.
 - b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.
 - c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.

SECTION 042000 - UNIT MASONRY: continued

- I. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent by same manufacturer.
 - 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. ACM Chemistries; RainBloc for Mortar.
 - b. BASF Aktiengesellschaft; Rheopel Mortar Admixture.
 - c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
- J. Water: Potable.

2.05 REINFORCEMENT:

- A. Uncoated Steel Reinforcing Bars: ASTM A615 or ASTM A996, Grade 60 (Grade 420) with a minimum postconsumer recycled content of 25%.
- B. Masonry Joint Reinforcement, General: ASTM A951.
 - 1. Interior Walls: Hot-dip galvanized, carbon steel.
 - 2. Exterior Walls: Hot-dip galvanized, carbon steel.
 - 3. Wire Size for Side Rods: 0.148-inch diameter.
 - 4. Wire Size for Cross Rods: 0.148-inch diameter.
 - 5. Wire Size for Veneer Ties: 0.148-inch diameter.
 - 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 - 7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.
- C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.
- D. Masonry Joint Reinforcement for Multiwythe Masonry:
 - 1. Ladder type with 1 side rod at each face shell of hollow masonry units more than 4 inches wide, plus 1 side rod at each wythe of masonry 4 inches wide or less.
 - 2. Tab type, either ladder or truss design, with 1 side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.
 - 3. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face. Ties have hooks or clips to engage a continuous horizontal wire in the facing wythe.
- E. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187-inch diameter, stainless-steel continuous wire.

2.06 TIES AND ANCHORS:

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
 - 1. Stainless-Steel Wire: ASTM A580, Type 304.
 - 2. Stainless-Steel Sheet: ASTM A666, Type 304.
- B. Corrugated Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of and an amplitude of 0.06 to 0.10 inch made from 0.062-inch- thick, stainless-steel sheet.
- C. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.
- D. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.

SECTION 042000 - UNIT MASONRY: continued

1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches long may be used for masonry constructed from solid units.
 2. Where wythes do not align, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches.
 3. Wire: Fabricate from 3/16-inch diameter, stainless-steel wire.
 - E. Partition Top anchors: 0.105-inch thick metal plate with 3/8-inch- diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from stainless steel.
 - F. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.
 1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A153.
 - G. Adjustable Masonry-Veneer Anchors:
 1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
 - a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
 2. Stainless-Steel Drill Screws for Steel Studs: Proprietary fastener consisting of carbon-steel drill point and 300 Series stainless-steel shank, complying with ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - (1) Dayton Superior Corporation, Dur-O-Wal Division; Stainless Steel SX Fastener.
 - (2) ITW Buildex; Scots long life Tekes.
- 2.07 MISCELLANEOUS ANCHORS:
- A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.
 - B. Dovetail Slots in Concrete: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.034-inch, galvanized steel sheet.
 - C. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A307, Grade A; with ASTM A563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A153, Class C; of dimensions indicated.
- 2.08 EMBEDDED FLASHING MATERIALS:
- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
 1. Copper: ASTM B370, Temper H00, cold-rolled copper sheet, 16-oz./sq. feet weight or 0.0216 inch thick or ASTM B370, Temper H01, high-yield copper sheet, 12-oz./sq. feet weight or 0.0162 inch thick.
 2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
 3. Fabricate through-wall metal flashing embedded in masonry from copper, with ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.
 - a. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - (1) Cheney Flashing Company; Cheney Flashing (Dovetail).

SECTION 042000 - UNIT MASONRY: continued

- (2) Keystone Flashing Company, Inc.; Keystone 3-Way Interlocking Thruwall Flashing.
 - (3) Sandell Manufacturing Co., Inc.; Mechanically Keyed Flashing.
 4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
 5. Fabricate through-wall flashing with drip edge. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
 6. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
 7. Metal Sealant Stop: Fabricate from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
 8. Metal Expansion-Joint Strips: Fabricate from copper to shapes indicated.
 - B. Flexible Flashing: Use the following unless otherwise indicated:
 1. Asphalt-Coated Copper Flashing: 5-oz./sq. feet copper sheet coated with flexible asphalt. Use only where flashing is fully concealed in masonry.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - (1) Advanced Building Products Inc.; Cop-R-Cote.
 - (2) Dayton Superior Corporation, Dur-O-Wal Division; Copper Coated Thru-Wall Flashing.
 - (3) Hohmann & Barnard, Inc.; H & B C-Coat Flashing.
 - (4) Phoenix Building Products; Type ACC-Asphalt Bituminous Coated.
 - (5) Sandell Manufacturing Co., Inc.; Coated Copper Flashing.
 - C. Application: Unless otherwise indicated, use the following:
 1. Where flashing is indicated to receive counterflashing, use metal flashing.
 2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
 3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge.
 4. Where flashing is fully concealed, use metal flashing.
 - D. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from high-density polyethylene incorporating chemical stabilizers that prevent UV degradation. Cell flashing pans have integral weep spouts that are designed to be built into mortar bed joints and weep collected moisture to the exterior of CMU walls and that extend into the cell to prevent clogging with mortar.
 1. Products: Basis of Design:
 - a. Mortar Net USA, Ltd.; Blok-Flash.
 - b. Or equals with prior approval.
 2. Required to seal joints in sheet metal flashing and trim and remain watertight.
 - E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates. For adhesives and sealants installed inside the weatherproofing barrier of the building, the VOC content of each product shall not exceed the VOC limits of Credit IEQc4.1 in accordance with the LEED Reference Guide.
- 2.09 MISCELLANEOUS MASONRY ACCESSORIES:
 - A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35%; of width and thickness indicated; formulated from neoprene.

SECTION 042000 - UNIT MASONRY: continued

- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D226, Type I (No. 15 asphalt felt).
- D. Weep/Vent Products: Use one of the following unless otherwise indicated:
 - 1. Wicking Material: Absorbent rope, made from UV-resistant synthetic fiber, 1/4 to 3/8 inch in diameter, in length required to produce 2-inch exposure on exterior and 18 inches in cavity. Use only for weeps.
 - 2. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, gray in color.
 - a. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - (1) Advanced Building Products Inc.; Mortar Maze weep vent.
 - (2) Blok-Lok Limited; Cell-Vent.
 - (3) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
 - (4) Heckmann Building Products Inc.; No. 85 Cell Vent.
 - (5) Hohmann & Barnard, Inc.; Quadro-Vent.
 - (6) Wire-Bond; Cell Vent.
 - 3. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.
 - a. Products: Basis of Design:
 - (1) Mortar Net USA, Ltd.; Mortar Net Weep Vents.
 - (2) Or equals with prior approval.
- E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
 - 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Advanced Building Products, Inc.; Mortar Break.
 - b. Archovations, Inc.; CavClear Masonry Mat.
 - c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
 - d. Mortar Net USA, Ltd.; Mortar Net.
 - 2. Materials:
 - a. Strips, full-depth of cavity and 10 inches high, with dovetail shaped notches 7 inches deep that prevent clogging with mortar droppings.
- F. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
 - 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
 - b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
 - c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
 - d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

SECTION 042000 - UNIT MASONRY: continued

2.10 CAVITY-WALL INSULATION:

- A. Extruded-Polystyrene Board Insulation: ASTM C578, Type IV, closed-cell product extruded with an integral skin.
 - 1. Minimum 4 inches thick.
 - 2. Minimum R value of 20.
- B. Adhesive: Type recommended by insulation board manufacturer for application indicated. For adhesives installed inside the weatherproofing barrier of the building, the VOC content of each product shall not exceed the VOC limits of Credit IEQc4.1 in accordance with the LEED Reference Guide.

2.11 MASONRY CLEANERS:

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. Diedrich Technologies, Inc.
 - b. EaCo Chem, Inc.
 - c. ProSoCo, Inc.

2.12 MORTAR AND GROUT MIXES:

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Use Portland cement-lime.
 - 3. For exterior masonry, use Portland cement-lime.
 - 4. For reinforced masonry, use Portland cement-lime mortar.
 - 5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
 - 1. For reinforced masonry, use Type S.
 - 2. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
 - 3. For interior non-load-bearing partitions, Type O may be used instead of Type N.
- D. Grout for Unit Masonry: Comply with ASTM C476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 - 2. Proportion grout in accordance with ASTM C476, Table 1.
 - 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143.

SECTION 042000 - UNIT MASONRY: continued

- E. Interior grout products shall not exceed the VOC limits SCAQMD Rule 1168, effective July 1, 2005 and amendment of January 7, 2005.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 - 2. Verify that foundations are within tolerances specified.
 - 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL:

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
 - 1. Mix units from several pallets or cubes as they are placed.

3.03 TOLERANCES:

- A. Dimensions and Locations of Elements:
 - 1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
 - 2. For location of elements in plan do not vary from that indicated by more than $\pm 1/2$ inch.
 - 3. For location of elements in elevation do not vary from that indicated by more than $\pm 1/4$ inch in a story height or 1/2 inch total.
- B. Lines and Levels:
 - 1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
 - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
 - 3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
 - 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.

SECTION 042000 - UNIT MASONRY: continued

5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
 7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
- C. Joints:
1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
 2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
 3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
 4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
 5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.04 LAYING MASONRY WALLS:

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 1. Install compressible filler in joint between top of partition and underside of structure above.
 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to

SECTION 042000 - UNIT MASONRY: continued

provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.

3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.

3.05 MORTAR BEDDING AND JOINTING:

- A. Lay hollow CMUs as follows:
 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Set stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
 1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
 2. Allow cleaned surfaces to dry before setting.
 3. Wet joint surfaces thoroughly before applying mortar.
- D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
 1. For glazed masonry units, use a nonmetallic jointer 3/4 inch or more in width.
- E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.06 CAVITY WALLS:

- A. Bond wythes of cavity walls together using one of the following methods:
 1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 1.7 sq. feet of wall area spaced not to exceed 16 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 16 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 16 inches o.c. vertically.
 - a. Where bed joints of wythes do not align, use adjustable (two-piece) type ties.
 2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
 - a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
 - b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties.
 3. Header Bonding: Provide masonry unit headers extending not less than 3 inches into each wythe. Space headers not over 8 inches clear horizontally and 16 inches clear vertically.
 4. Masonry Veneer Anchors: Comply with requirements for anchoring masonry veneers.

SECTION 042000 - UNIT MASONRY: continued

- B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.
- C. Parge cavity face of backup wythe in a single coat approximately 3/8 inch thick. Trowel face of parge coat smooth.
- D. Coat cavity face of backup wythe to comply with DIVISION 07, Section "Thermal Insulation" for liquid vapor barrier.
- E. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.
 - 1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.07 MASONRY JOINT REINFORCEMENT:

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.
 - 2. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.08 ANCHORING MASONRY VENEERS:

- A. Anchor masonry veneers to wall framing and concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:
 - 1. Fasten screw-attached anchors through sheathing to wall framing and to masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
 - 2. Insert slip-in anchors in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.
 - 3. Embed tie sections connector sections and continuous wire in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.
 - 4. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
 - 5. Space anchors as indicated, but not more than 16 inches o.c. vertically and 16 inches o.c. horizontally, with not less than 1 anchor for each 2 sq. feet of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 16 inches, around perimeter.

3.09 CONTROL AND EXPANSION JOINTS:

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

SECTION 042000 - UNIT MASONRY: continued

- B. Form control joints in concrete masonry using one of the following methods:
 - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
 - 2. Install preformed control-joint gaskets designed to fit standard sash block.
 - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
 - 4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.
- C. Form expansion joints as follows:
 - 1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
 - 2. Build flanges of factory-fabricated, expansion-joint units into masonry.
 - 3. Build in compressible joint fillers where indicated.
 - 4. Form open joint full depth of wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in DIVISION 07, Section "Joint Sealants."

3.10 LINTELS:

- A. Install steel lintels where indicated.
- B. Provide concrete lintels where shown and where openings of more than 24 inches for block-size units are shown without structural steel or other supporting lintels.
- C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.11 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS:

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
 - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 - 2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 4 inches, and 1-1/2 inches into the inner wythe. Form 1/4-inch hook in edge of flashing embedded in inner wythe.
 - 3. At masonry-veneer walls, extend flashing through veneer, across air space behind insulation, and up face of sheathing or inner wythe of masonry at least 8 inches; with upper edge tucked beneath liquid vapor barrier, lapping at least 4 inches.
 - 4. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
 - 5. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in DIVISION 07, Section "Joint Sealants" for application indicated.

SECTION 042000 - UNIT MASONRY: continued

6. Install metal drip edges with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in DIVISION 07, Section "Joint Sealants" for application indicated.
 7. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
 8. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
 9. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- E. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
1. Use specified weep/vent products to form weep holes.
 2. Space weep/vents 16 inches o.c.
- F. Place pea gravel in cavities as soon as practical to a height equal to height of first course above top of flashing, but not less than 2 inches, to maintain drainage.
1. Fill cavities full height by placing pea gravel in cavities as masonry is laid so that at any point masonry does not extend more than 24 inches above top of pea gravel.
- G. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.
- H. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents.
1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.12 REINFORCED UNIT MASONRY INSTALLATION:

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 2. Limit height of vertical grout pours to not more than 60 inches.

SECTION 042000 - UNIT MASONRY: continued

3.13 SPECIAL INSTALLATION INSTRUCTIONS FOR SURFACES TO RECEIVE LIQUID APPLIED VAPOR BARRIER:

A. Instructions:

1. Liquid applied vapor barrier is specified in SECTION 072100.
2. Surfaces shall be free of contaminants such as grease, oil and wax on surfaces to receive membrane.
3. The concrete masonry surfaces shall be free from projections.
4. Strike mortar joints full and flush to face of concrete block.
5. Fill voids and holes greater than 1/2 inch across with mortar or non-shrink grout.
6. Fill cracks, gaps, and joints exceeding 1/4 inch width with mortar or non-shrink grout.
7. Grind flush or make smooth surface irregularities exceeding 1/4 inch in height or sharp to touch.
8. Fill around penetrations with mortar, or grout and strike flush.
9. If surfaces cannot be made smooth, apply a parge coat (typically one part cement to three parts sand) over surface to receive fluid-applied membrane air barrier.
10. Remove mortar droppings on brick ties, shelf angles, brick shelves and other horizontal obstructions.
11. Fill honeycomb in concrete with non-shrink grout or fill compound.
12. Fill cracks in concrete and masonry exceeding 1/16 inch width and not exceeding 1/8 inch width with mortar or grout.
13. Fill rough gaps around pipe, conduit and similar penetrations with mortar, non-shrink grout or polyurethane foam.

3.14 FIELD QUALITY CONTROL:

- A. Testing and Inspecting: Contracting Officer will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Level 1 special inspections according to the "International Building Code."
 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5,000 sq. feet of wall area or portion thereof.
- E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.
- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.
- G. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for compressive strength.
- H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.
- I. Prism Test: For each type of construction provided, according to ASTM C1314 at 7 days and at 28 days.

3.15 PARGING:

- A. Parge exterior faces of below-grade masonry walls, where indicated, in 2 uniform coats to a total thickness of 3/4 inch. Dampen wall before applying first coat and scarify first coat to ensure full bond to subsequent coat.
- B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot. Form a wash at top of parging and a cove at bottom.

SECTION 042000 - UNIT MASONRY: continued

- C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.16 REPAIRING, POINTING, AND CLEANING:

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Contracting Officer's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.17 MASONRY WASTE DISPOSAL:

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
 - 1. Crush masonry waste to less than 4 inches in each dimension.
 - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in DIVISION 31, Section "Earth Moving."
 - 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Contracting Officer's property.

END OF SECTION 042000

DIVISION 05 - METALS

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Structural steel.
 - 2. Grout.
- B. Related Sections:
 - 1. DIVISION 01 Section "Sustainable Design Requirements" for LEED® related requirements for recycled content materials and local/regionally manufactured and sourced materials.
 - 2. DIVISION 05 Section "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other metal items not defined as structural steel.
 - 3. DIVISION 09 Painting Sections for surface-preparation and priming requirements.

1.03 REFERENCES:

- A. American Institute of Steel Construction:
 - 1. AISC 303 (2005) - Code of Standard Practice for Steel Buildings and Bridges (available at www.aisc.org).
 - 2. AISC 360 (2005) - Specifications for Structural Steel Buildings (available at www.aisc.org).
- B. American Welding Society:
 - 1. AWS D1.1 (2006) - Structural Welding Code - Steel.
- C. ASTM International:
 - 1. ASTM A6-05a - Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
 - 2. ASTM A36-05 - Specification for Carbon Structural Steel.
 - 3. ASTM A123-02 - Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 4. ASTM A325-06 - Specification for Structural Bolts, Steel, Heat Treated, 120/105-ksi Minimum Tensile Strength.
 - 5. ASTM A500-03a - Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - 6. ASTM A563-04a - Specification for Carbon and Alloy Steel Nuts.
 - 7. ASTM A780-01 - Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - 8. ASTM A992-06a - Specification for Structural Steel Shapes.
 - 9. ASTM C1107-05 - Specification for Packaged Dry, Hydraulic-Cement Grout. (Nonshrink).
 - 10. ASTM F436-04 - Specification for Hardened Steel Washers.

SECTION 051200 - STRUCTURAL STEEL FRAMING: continued

- D. Research Council on Structural Connections:
 - 1. Specification for Structural Joints Using ASTM A325 or A490 Bolts, 2004.
- E. SSPC - The Society for Protective Coatings:
 - 1. SSPC-QP 3 (2000) (Revised 2004) - Standard Procedure for Evaluating Qualifications of Shop Painting Applicators.
- 1.04 DEFINITIONS:
 - A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- 1.05 SUBMITTALS:
 - A. Product Data: For each type of product indicated.
 - B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Product Data for Credit MRc5: For products and materials complying with requirements for regional materials, submit documentation indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
 - 3. Product Data for Credit IEQ 4.1: For grout products submit manufacturer's documentation stating that products do not exceed the VOC limits of South Coast Air Quality Management District (SCAQMD) Rule 1168, effective July 1, 2005 and amendment of January 7, 2005.
 - C. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts.
- 1.06 INFORMATIONAL SUBMITTALS:
 - A. Qualification Data: For qualified Installer and fabricator.
 - B. Welding certificates.
 - C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
 - D. Mill test reports for structural steel, including chemical and physical properties.
 - E. Product Test Reports: For the following:
 - 1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 2. Shop primers.
 - 3. Nonshrink grout.
- 1.07 QUALITY ASSURANCE:
 - A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
 - B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

SECTION 051200 - STRUCTURAL STEEL FRAMING: continued

- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."
- E. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC 303.
 - 2. AISC 360.
 - 3. RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts."

1.08 DELIVERY, STORAGE, AND HANDLING:

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Clean and relubricate bolts and nuts that become dry or rusty before use.

1.09 COORDINATION:

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.01 STRUCTURAL-STEEL MATERIALS:

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25%.
- B. W-Shapes: ASTM A992.
- C. Channels, Angles: ASTM A36.
- D. Plate and Bar: ASTM A36.
- E. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B, structural tubing.
- F. Welding Electrodes: Comply with AWS requirements.

2.02 BOLTS, CONNECTORS, AND ANCHORS:

- A. High-Strength Bolts, Nuts, and Washers: ASTM A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade C, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.
- B. Threaded Rods: ASTM A36.
 - 1. Nuts: ASTM A563 hex carbon steel.
 - 2. Washers: ASTM F436, Type 1, hardened carbon steel.
 - 3. Finish: Plain.

SECTION 051200 - STRUCTURAL STEEL FRAMING: continued

2.03 PRIMER:

- A. Primer: Comply with DIVISION 09 Painting Sections.

2.04 GROUT:

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time. Grout product shall not exceed the VOC limits SCAQMD Rule 1168, effective July 1, 2005 and amendment of January 7, 2005.

2.05 FABRICATION:

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel according to ASTM A6 and maintain markings until structural steel has been erected.
 - 4. Mark and match-mark materials for field assembly.
 - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.06 SHOP CONNECTIONS:

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.

2.07 SHOP PRIMING:

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to DIVISION 09 Painting Sections.
- C. Priming: Immediately after surface preparation, apply primer according to DIVISION 09 Painting Sections. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

SECTION 051200 - STRUCTURAL STEEL FRAMING: continued

2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.
- 2.08 GALVANIZING:
- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A123.
 1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
 2. Galvanize lintels and shelf angles located in exterior walls.

PART 3 - EXECUTION

- 3.01 EXAMINATION:
- A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
 - B. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.02 PREPARATION:
- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
- 3.03 ERECTION:
- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
 - B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 2. Weld plate washers to top of baseplate.
 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
 - C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 1. Level and plumb individual members of structure.
 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

SECTION 051200 - STRUCTURAL STEEL FRAMING: continued

- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.04 FIELD CONNECTIONS:

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.05 FIELD QUALITY CONTROL:

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
- D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.06 REPAIRS AND PROTECTION:

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A780.
- B. Touchup Painting: Cleaning and touchup painting are specified in DIVISION 09 Painting Sections.

END OF SECTION 051200

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Roof deck.

1.03 REFERENCES:

- A. American Iron and Steel Institute:
 - 1. North American Specification for the Design of Cold-Formed Steel Structural Members, 2007.
- B. American Welding Society:
 - 1. AWS D1.3 (2008) - Structural Welding Code - Sheet Steel.
- C. ASTM International:
 - 1. ASTM A653-07 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM A780-01 (Reapproved 2006) - Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- D. FM Global:
 - 1. Approval Guide, Building Materials, 2008.
- E. Steel Deck Institute:
 - 1. SDI Publication No. 31 (2007) - Design Manual for Composite Decks, Form Decks, and Roof Decks.

1.04 SUBMITTALS:

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. LEED[®] Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. For products and materials complying with requirements for regional materials, submit documentation indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
- C. Shop Drawings:
 - 1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.05 INFORMATIONAL SUBMITTALS:

- A. Welding certificates.
- B. Product Certificates: For each type of steel deck.
- C. Field quality-control reports.

1.06 QUALITY ASSURANCE:

- A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

SECTION 053100 - STEEL DECKING: continued

- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- C. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1-90 windstorm ratings.

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS:

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25%.

2.02 ROOF DECK:

- 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 or approved equal:
 - 1. ASC Profiles, Inc.; a Blue Scope Steel company.
 - 2. Canam United States; Canam Group Inc.
 - 3. CMC Joist & Deck.
 - 4. Consolidated Systems, Inc.; Metal Dek Group.
 - 5. Cordeck.
 - 6. DACS, Inc.
 - 7. Epic Metals Corporation.
 - 8. Marlyn Steel Decks, Inc.
 - 9. New Millennium Building Systems, LLC.
 - 10. Nucor Corp.; Vulcraft Group.
 - 11. Roof Deck, Inc.
 - 12. Valley Joist; Subsidiary of EBSCO Industries, Inc.
 - 13. Verco Manufacturing Co.
 - 14. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
- B. 1-1/2-Inch Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following or approved equal:
 - 1. Galvanized-Steel Sheet: ASTM A653, Structural Steel (SS), Grade 33, G90 zinc coating.
 - 2. Deck Profile: Type WR, wide rib.
 - 3. Profile Depth: 1-1/2 inches.
 - 4. Design Uncoated-Steel Thickness: 0.0295 inch.
 - 5. Span Condition: Triple span or more.
 - 6. Side Laps: Overlapped.

SECTION 053100 - STEEL DECKING: continued

- C. 3-Inch Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following or approved equal:
 - 1. Galvanized-Steel Sheet: ASTM A653, Structural Steel (SS), Grade 33, G90 zinc coating.
 - 2. Deck Profile: Type 3DR, deep rib.
 - 3. Profile Depth: 3 inches.
 - 4. Design Uncoated-Steel Thickness: 0.0358 inch.
 - 5. Span Condition: Simple span with cantilevers.
 - 6. Side Laps: Overlapped.

2.03 ACCESSORIES:

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Galvanizing Repair Paint: ASTM A780.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL:

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

SECTION 053100 - STEEL DECKING: continued

3.03 ROOF-DECK INSTALLATION:

- A. Fasten roof-deck panels to steel supporting members with self-drilling, No. 12 diameter or larger, carbon-steel screws, and as follows:
 - 1. Spacing: Attach edge and interior ribs of 1-1/2-inch deck units with a minimum of seven fasteners per deck unit at each support (one in each flute).
 - 2. Spacing: Attach edge and interior ribs of 3-inch deck units with a minimum of four fasteners per deck unit at each support (one in each flute).
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding 1/2 of the span or as otherwise indicated, and as follows:
 - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped 2 inches minimum.
- D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Mechanically fasten to substrate to provide a complete deck installation.
 - 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
- E. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.04 FIELD QUALITY CONTROL:

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor and Contracting Officer's Representative.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.05 PROTECTION:

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. This Section includes the following:
 - 1. Exterior non-load-bearing wall framing.
 - 2. Roof trusses.
- B. Related Sections include the following:
 - 1. DIVISION 09 Section "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.03 REFERENCES:

- A. American Iron and Steel Institute:
 - 1. North American Specification for the Design of Cold-Formed Steel Structural Members, 2001.
 - 2. Standard for Cold-Formed Steel Framing - General Provisions, 2001.
 - 3. Standard for Cold-Formed Steel Framing - Truss Design, 2001.
- B. American Welding Society:
 - 1. AWS D1.1-02 - Structural Welding Code - Steel.
 - 2. AWS D1.3-98 - Structural Welding Code - Sheet Steel.
- C. ASTM International:
 - 1. ASTM A36-01 - Specification for Carbon Structural Steel.
 - 2. ASTM A123-02 - Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 3. ASTM A653-02a - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 4. ASTM A780-01 - Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - 5. ASTM A1003-02a - Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Member.
 - 6. ASTM C150-02a - Specification for Portland Cement.
 - 7. ASTM C404-97 - Specification for Aggregates for Masonry Grout.
 - 8. ASTM C1107-02 - Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
 - 9. ASTM C1513-01 - Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections.
 - 10. ASTM E329-02 - Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
 - 11. ASTM E488-96 (Reapproved 2003) - Test Methods for Strength of Anchors in Concrete and Masonry Elements.
 - 12. ASTM E1190-95 (Reapproved 2000) - Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members.
- D. Light Gauge Steel Engineers Association:
 - 1. Technical Note 551e - Design Guide for Permanent Bracing of Cold-Formed Steel Trusses, 1998.

SECTION 054000 - COLD-FORMED METAL FRAMING: continued

1.04 PERFORMANCE REQUIREMENTS:

- A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads: As indicated.
 - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/600 of the wall height where laterally supporting masonry veneer, and 1/240 of the wall height elsewhere.
 - b. Roof Trusses: Vertical deflection of 1/240 of the span.
 - 3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120°F.
 - 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure.
- B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
 - 1. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
 - 2. Roof Trusses: Design according to AISI's "Standard for Cold-Formed Steel Framing - Truss Design."

1.05 SUBMITTALS:

- A. Product Data: For each type of cold-formed metal framing product and accessory indicated.
- B. LEED® Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Product Data for Credit MR 5: For products and materials complying with requirements for regional materials, submit documentation indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
 - 3. Product Data for Credit IEQ 4.1: For grout products installed inside the weatherproofing barrier of the building and installed on site, submit documentation including manufacturer's printed statement (MSDS Sheet) of VOC content of each product.
- C. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
 - 1. For cold-formed metal framing indicated to comply with design loads, include Drawings and structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.06 INFORMATIONAL SUBMITTALS:

- A. Qualification Data: For professional engineer and testing agency.
- B. Welding certificates.

SECTION 054000 - COLD-FORMED METAL FRAMING: continued

- C. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:
 - 1. Steel sheet.
 - 2. Expansion anchors.
 - 3. Power-actuated anchors.
 - 4. Mechanical fasteners.
 - 5. Miscellaneous structural clips and accessories.
- D. Research/Evaluation Reports: For cold-formed metal framing.

1.07 QUALITY ASSURANCE:

- A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E329 to conduct the testing indicated.
- D. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- E. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel," and AWS D1.3, "Structural Welding Code - Sheet Steel."
- F. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
 - 1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
- G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in DIVISION 01 Section "Project Management and Coordination."

1.08 DELIVERY, STORAGE, AND HANDLING:

- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following or approved equal:
 - 1. Allied Studco.
 - 2. AllSteel Products, Inc.
 - 3. California Expanded Metal Products Company.
 - 4. ClarkDietrich Building Systems.

SECTION 054000 - COLD-FORMED METAL FRAMING: continued

5. Consolidated Fabricators Corp.; Building Products Division.
6. Craco Metals Manufacturing, LLC.
7. Custom Stud, Inc.
8. Dale/Incor.
9. Design Shapes in Steel.
10. Formetal Co. Inc. (The).
11. Innovative Steel Systems.
12. MarinoWare; a division of Ware Industries.
13. Quail Run Building Materials, Inc.
14. SCAFCO Corporation.
15. Southeastern Stud & Components, Inc.
16. Steel Construction Systems.
17. Steeler, Inc.
18. Super Stud Building Products, Inc.
19. TrusSteel; an ITW Company.
20. United Metal Products, Inc.

2.02 MATERIALS:

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25%.
- B. Steel Sheet: ASTM A1003, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 1. Grade: As required by structural performance.
 2. Coating: G90 or equivalent.
- C. Steel Sheet for Clips: ASTM A653, structural steel, zinc coated, of grade and coating as follows:
 1. Grade: As required by structural performance.
 2. Coating: G90.

2.03 EXTERIOR NON-LOAD-BEARING WALL FRAMING:

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated on Drawings, punched, with stiffened flanges, and as follows:
 1. Minimum Base-Metal Thickness:
 - a. Unless noted otherwise: 0.0478 inch.
 - b. Elements attached to steel roof deck at overhangs and within 7 feet - 6 inches of exterior wall corners: 0.0747 inch.
 2. Minimum Flange Width: 1-3/8 inches.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 1. Minimum Base-Metal Thickness: Matching steel studs.
 2. Flange Width: 1-1/4 inches.

2.04 ROOF TRUSSES:

- A. Roof trusses shall be pre-engineered and pre-fabricated. Contractor shall not fabricate individual trusses in the field.
- B. Roof Truss Members: Manufacturer's standard-shape steel sections.
 1. Minimum Base-Metal Thickness:
 - a. Unless noted otherwise: 0.0478 inch.

SECTION 054000 - COLD-FORMED METAL FRAMING: continued

- b. Elements attached to steel roof deck at overhangs and within 7 feet - 6 inches of exterior wall corners: 0.0747 inch.
 - 2. Flange Width: 1-5/8 inches minimum.
- 2.05 FRAMING ACCESSORIES:
- A. Fabricate steel-framing accessories from steel sheet, ASTM A1003, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
 - B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 - 1. Supplementary framing, including eave framing.
 - 2. Temporary and permanent bracing, bridging, and solid blocking.
 - 3. Web stiffeners.
 - 4. Anchor clips.
 - 5. End clips.
 - 6. Gusset plates.
 - 7. Stud kickers, knee braces, and girts.
 - 8. Hole reinforcing plates.
 - 9. Backer plates.
- 2.06 ANCHORS, CLIPS, AND FASTENERS:
- A. Steel Shapes and Clips: ASTM A36, zinc coated by hot-dip process according to ASTM A123.
 - B. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E488 conducted by a qualified independent testing agency.
 - C. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E1190 conducted by a qualified independent testing agency.
 - D. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
 - E. Welding Electrodes: Comply with AWS standards.
- 2.07 MISCELLANEOUS MATERIALS:
- A. Galvanizing Repair Paint: ASTM A780.
 - B. Cement Grout: Portland cement, ASTM C150, Type I; and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration. Grout shall not exceed the VOC limits of SCAQMD Rule 1168, effective July 1, 2005 and amendment of January 7, 2005.
 - C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, Portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C1107, with fluid consistency and 30-minute working time. Grout shall not exceed the VOC limits of SCAQMD Rule 1168, effective July 1, 2005 and amendment of January 7, 2005.
 - D. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

SECTION 054000 - COLD-FORMED METAL FRAMING: continued

2.08 FABRICATION:

- A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
 - 4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
 - 1. Spacing: Space individual framing members no more than $\pm 1/8$ inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION:

- A. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of wall at truss or joist locations to ensure a uniform bearing surface on supporting masonry construction.

3.03 INSTALLATION, GENERAL:

- A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

SECTION 054000 - COLD-FORMED METAL FRAMING: continued

- a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- E. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- F. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- G. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
 - 1. Space individual framing members no more than $\pm 1/8$ inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.04 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION:

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to track, unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: As indicated or required by structural design.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
- E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.05 TRUSS INSTALLATION:

- A. Install, bridge, and brace trusses according to Shop Drawings and requirements in this Section.
- B. Truss Spacing: 48 inches maximum.
- C. Do not alter, cut, or remove framing members or connections of trusses.
- D. Erect trusses with plane of truss webs plumb and parallel to each other, align, and accurately position at spacings indicated.
- E. Erect trusses without damaging framing members or connections.
- F. Install continuous bridging and permanently brace trusses as indicated on Shop Drawings and designed according to LGSEA's Technical Note 551e, "Design Guide for Permanent Bracing of Cold-Formed Steel Trusses."

3.06 FIELD QUALITY CONTROL:

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.

SECTION 054000 - COLD-FORMED METAL FRAMING: continued

- C. Testing agency will report test results promptly and in writing to Contractor and Contracting Officer's Representative.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.07 REPAIRS AND PROTECTION:

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Steel framing and supports for folding panel partitions (ABI #2).
 - 2. Steel framing and supports for mechanical and electrical equipment.
 - 3. Steel framing and supports for applications where framing and supports are not specified in other sections.
 - 4. Metal bollards.
 - 5. Loose bearing and leveling plates for applications where they are not specified in other sections.
- B. Products furnished, but not installed, under this Section:
 - 1. Loose steel lintels.
 - 2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
 - 3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other sections.
- C. Related Sections:
 - 1. DIVISION 01, Section "Sustainable Design Requirements" for LEED[®] related requirements for recycled content materials and local/regionally manufactured and sourced materials.
 - 2. DIVISION 03, Section "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
 - 3. DIVISION 04, Section "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
 - 4. DIVISION 05, Section "Structural Steel Framing."
 - 5. DIVISION 05, Section "Metal Fabrications."
 - 6. DIVISION 10, Section "Toilet Compartments."
 - 7. DIVISION 10, Section "Folding Panel Partitions."
 - 8. DIVISION 12, Section "Site Furnishings" for bicycle racks.

1.03 REFERENCES:

- A. American Architectural Manufacturers Association:
 - 1. AAMA 611 - (1998) Voluntary Standards for Anodized Architectural Aluminum.
- B. American Institute of Steel Construction:
 - 1. Specification for Structural Steel Buildings, 2005.
- C. American Welding Society:
 - 1. AWS D1.1/D1.1M - (2006) Structural Welding Code - Steel.
- D. ASME International:
 - 1. ASME B18.2.1 - (1996) Square and Hex Bolts and Screws Inch Series.
 - 2. ASME B18.6.1 - (1981) (Reaffirmed 1997) - Wood Screws (Inch Series).
 - 3. ASME B18.6.3 - (2003) Machine Screws and Machine Screw Nuts.
 - 4. ASME B18.21.1 - (1999) (Reaffirmed 2005) - Lock Washers (Inch Series).
 - 5. ASME B18.21.2M - (1999) (Reaffirmed 2005) - Lock Washers (Metric Series).
 - 6. ASME B18.22.1 - (1965) (Reaffirmed 2003) - Plain Washers.

SECTION 055000 - METAL FABRICATIONS: continued

- E. ASTM International:
1. ASTM A27-05 - Specification for Steel Castings, Carbon, for General Application.
 2. ASTM A36-05 - Specification for Carbon Structural Steel.
 3. ASTM A47-99 - (Reapproved 2004) - Specification for Ferritic Malleable Iron Castings.
 4. ASTM A48-03 - Specification for Gray Iron Castings.
 5. ASTM A53-06a - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 6. ASTM A123-02 - Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 7. ASTM A153-05 - Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 8. ASTM A240-06 - Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 9. ASTM A276-06 - Specification for Stainless Steel Bars and Shapes.
 10. ASTM A283-03 - Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
 11. ASTM A307-04 - Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 12. ASTM A325-06 - Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 13. ASTM A500-03a - Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 14. ASTM A563-04a - Specification for Carbon and Alloy Steel Nuts.
 15. ASTM A653-06 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 16. ASTM A666-03 - Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 17. ASTM A780-01 - Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 18. ASTM A786-05 - Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
 19. ASTM A793-96 (Reapproved 2001) - Specification for Rolled Floor Plate, Stainless Steel
 20. ASTM A1008-06a - Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 21. ASTM B26-05 - Specification for Aluminum-Alloy Sand Castings.
 22. ASTM B633-98 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
 23. ASTM C1107-05 - Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
 24. ASTM D1187-97 (Reapproved 2002) - Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
 25. ASTM E119-05a - Test Methods for Fire Tests of Building Construction and Materials.
 26. ASTM E488-96 (Reapproved 2003) - Test Methods for Strength of Anchors in Concrete and Masonry Elements.
 27. ASTM F593-02 - Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 28. ASTM F594-02 - Specification for Stainless Steel Nuts.
 29. ASTM F738M-02 - Specification for Stainless Steel Metric Bolts, Screws, and Studs.
 30. ASTM F1554-04 - Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

SECTION 055000 - METAL FABRICATIONS: continued

31. ASTM F1941-00 (Reapproved 2006) - Specification for Electrodeposited Coatings on Threaded Fasteners.
 32. ASTM F2329-05 - Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.
- F. Master Painters Institute:
1. MPI#20-2002 - Epoxy Zinc-Rich Primer.
 2. MPI#79-2004 - Alkyd Anti-Corrosive Metal Primer.
- G. Metal Framing Manufacturers Association:
1. MFMA-4-2004 - Metal Framing Standards Publication.
- H. National Association of Architectural Metal Manufacturers:
1. Metal Finishes Manual for Architectural and Metal Products, 1988.
- I. SSPC - The Society for Protective Coatings:
1. SSPC-PA 1 2000 (Revised 2004) - Paint Application Specification No. 1 - Shop, Field, and Maintenance Painting of Steel.
 2. SSPC-Paint 20 2002 (Revised 2004) - Paint Specification No. 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic").
 3. SSPC-SP 3 1982 (Revised 2004) - Surface Preparation Specification No. 3 - Power Tool Cleaning.
 4. SSPC-SP 6/NACE No. 3 2000 (Revised 2004) - Joint Surface Preparation Standard
SSPC-SP 6/NACE No. 3 - Commercial Blast Cleaning.
- 1.04 PERFORMANCE REQUIREMENTS:
- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
1. Temperature Change: 120°F, ambient; 180°F, material surfaces.
- 1.05 SUBMITTALS:
- A. Product Data: For the following:
1. Paint products.
 2. Grout.
- B. LEED® Submittals:
1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 2. Product Data for Credit MRc5: For products and materials complying with requirements for regional materials, submit documentation indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
 3. Product Data for Credit IEQc4.2: For paints and coatings applied on-site and inside the weatherproofing barrier of the building, submit documentation including manufacturer's printed statement (MSDS Sheet) of VOC content of each product.
 4. For grout products submit manufacturer's documentation stating that products do not exceed the VOC limits of South Coast Air Quality Management District (SCAQMD) Rule 1168, effective July 1, 2005 and amendment of January 7, 2005.

SECTION 055000 - METAL FABRICATIONS: continued

- C. Shop Drawings: Show fabrication and installation details for metal fabrications.
 - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.06 INFORMATIONAL SUBMITTALS:

- A. Qualification Data: For qualified professional engineer.
- B. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.
- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.07 QUALITY ASSURANCE:

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code - Steel."
 - 2. AWS D1.2, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.08 PROJECT CONDITIONS:

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.09 COORDINATION:

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.01 METALS, GENERAL:

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.02 FERROUS METALS:

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25%.
- B. Steel Plates, Shapes, and Bars: ASTM A36.
- C. Stainless-Steel Sheet, Strip, and Plate: ASTM A240 or ASTM A666, Type 304.
- D. Stainless-Steel Bars and Shapes: ASTM A276, Type 304.

SECTION 055000 - METAL FABRICATIONS: continued

- E. Steel Tubing: ASTM A500, cold-formed steel tubing.
- F. Steel Pipe: ASTM A53, standard weight (Schedule 40) unless otherwise indicated.
- G. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 - 1. Size of Channels: 1-5/8 by 1-5/8 inches.
 - 2. Material: Galvanized steel, ASTM A653, commercial steel, Type B, with G90 (Z275) coating; 0.108 inch nominal thickness.

2.03 FASTENERS:

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ASTM F568M, Property Class 4.6); with hex nuts, ASTM A563; and, where indicated, flat washers.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A325, Type 3; with hex nuts, ASTM A563, (Grade C3); and, where indicated, flat washers.
- D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F593 (ASTM F738M); with hex nuts, ASTM F594 (ASTM F836M); and, where indicated, flat washers; Alloy Group 1 (A1).
- E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Eyebolts: ASTM A489.
- G. Machine Screws: ASME 18.6.3 (ASME B18.6.7M).
- H. Lag Screws: ASME B18.2.1 (ASME B18.2.3.8M).
- I. Wood Screws: Flat head, ASME B18.6.1.
- J. Plain Washers: Round, ASME B18.22.1.
- K. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).
- L. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488, conducted by a qualified independent testing agency.
- M. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47M malleable iron or ASTM A27 cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329.
- N. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
- O. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

2.04 MISCELLANEOUS MATERIALS:

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

SECTION 055000 - METAL FABRICATIONS: continued

- B. Paints and Coatings: Paints and coatings applied on-site and inside the weatherproofing barrier of the building shall have a VOC content not exceeding the VOC limits of Credit IEQc4.2 in accordance with the LEED Reference Guide.
- C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.
- F. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C1107, specifically recommended by manufacturer for heavy-duty loading applications.
- G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications. Grout products shall not exceed the VOC limits of SCAQMD Rule 1168, effective July 1, 2005 and amendment of January 7, 2005.
- H. Concrete: Comply with requirements in DIVISION 03, Section "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3,000 psi.

2.05 FABRICATION, GENERAL:

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply 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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
 - 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch

SECTION 055000 - METAL FABRICATIONS: continued

embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.06 MISCELLANEOUS FRAMING AND SUPPORTS:

- A. General: Provide steel framing and supports not specified in other sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes recommended by partition manufacturer with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings (ABI #2).
- D. Fabricate supports for toilet partitions from continuous steel beams of sizes recommended by partition manufacturer with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive hanger rods; locate holes where indicated on operable partition Shop Drawings.
- E. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.
 - 1. Provide bearing plates welded to beams where indicated.
 - 2. Drill or punch girders and plates for field-bolted connections where indicated.
- F. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.
 - 1. Unless otherwise indicated, fabricate from Schedule 40 steel pipe.
 - 2. Unless otherwise indicated, provide 1/2-inch baseplates with four 5/8-inch anchor bolts and 1/4-inch top plates.
- G. Galvanize miscellaneous framing and supports where indicated.
- H. Prime miscellaneous framing and supports with zinc-rich primer.

2.07 SHELF ANGLES:

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.
 - 1. Provide mitered and welded units at corners.
 - 2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Galvanize shelf angles located in exterior walls.
- D. Prime shelf angles located in exterior walls with zinc-rich primer.
- E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

SECTION 055000 - METAL FABRICATIONS: continued

2.08 MISCELLANEOUS STEEL TRIM:

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize exterior miscellaneous steel trim.

2.09 METAL BOLLARDS:

- A. Fabricate metal bollards from Schedule 40 steel pipe 1/4-inch wall-thickness rectangular steel tubing.
 - 1. Cap bollards with 1/4-inch thick steel plate.
- B. Prime bollards with zinc-rich primer.

2.10 LOOSE STEEL LINTELS:

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches unless otherwise indicated.
- C. Galvanize loose steel lintels located in exterior walls.
- D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.11 STEEL WELD PLATES AND ANGLES:

- A. Provide steel weld plates and angles not specified in other sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.12 FINISHES, GENERAL:

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.13 STEEL AND IRON FINISHES:

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153 for steel and iron hardware and with ASTM A123 for other steel and iron products.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with zinc-rich primer.
- C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

SECTION 055000 - METAL FABRICATIONS: continued

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL:

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.02 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS:

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for operable partitions securely to and rigidly brace from building structure.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
 - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.
 - 1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.03 INSTALLING METAL BOLLARDS:

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
 - 1. Do not fill removable bollards with concrete.
- B. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. Fill annular space around bollard solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.

SECTION 055000 - METAL FABRICATIONS: continued

- C. Fill bollards solidly with concrete, mounding top surface to shed water.
 - 1. Do not fill removable bollards with concrete.

3.04 ADJUSTING AND CLEANING:

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in DIVISION 09 Painting Sections.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

END OF SECTION 055000

DIVISION 06 - WOOD AND PLASTICS

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Wood blocking, cants, and nailers.
 - 2. Wood furring and grounds.
 - 3. Wood sleepers.
 - 4. Plywood backing panels.

1.03 REFERENCES:

- A. American Forest & Paper Association:
 - 1. WCD 1-2001 - Details for Conventional Wood Frame Construction. (Available in PDF at www.awc.org).
- B. American Wood-Preservers' Association:
 - 1. AWWPA M4-2001 - Care of Preservative-Treated Wood Products.
 - 2. AWWPA U1-2007 - Use Category System - User Specification for Treated Wood.
 - 3. APA - The Engineered Wood Association.
- C. ASME International:
 - 1. ASME B18.2.1-1996 - Square and Hex Bolts and Screws (Inch Series).
 - 2. ASME B18.2.3.8M-1981 (Revised 1999) - Metric Hex Lag Screws.
 - 3. ASME B18.6.1-1981 (Revised 1997) - Wood Screws (Inch Series).
- D. ASTM International:
 - 1. ASTM A153-05 - Specification for Zinc-Coating (Hot-Dip) of Iron and Steel Hardware.
 - 2. ASTM A307-07b - Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 - 3. ASTM A563-07a - Specification for Carbon and Alloy Steel Nuts.
 - 4. ASTM A653 -07 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 5. ASTM B633-07 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
 - 6. ASTM D5664-02 - Test Method for Evaluating the Effects of Fire-Retardant Treatments and Elevated Temperatures on Strength Properties of Fire-Retardant Treated Lumber.
 - 7. ASTM D6841-03 - Practice for Calculating Design Value Treatment Adjustment Factors for Fire-Retardant-Treated Lumber.
 - 8. ASTM E84-08a - Test Method for Surface-Burning Characteristics of Building Materials.
 - 9. ASTM E488-96 (Reapproved 2003) - Test Methods for Strength of Anchors in Concrete and Masonry Elements.
 - 10. ASTM F593-02 - Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - 11. ASTM F594-02 - Specification for Stainless Steel Nuts.
 - 12. ASTM F1667-05 - Specification for Driven Fasteners - Nails, Spikes, and Staples.
- E. Code of Federal Regulations:
 - 1. 40 CFR, Part 59, Subpart D-2002 - National Volatile Organic Compound Emission Standards for Architectural Coatings.

SECTION 061000 - ROUGH CARPENTRY: continued

- F. Forest Stewardship Council:
 - 1. F SC STD-01-001-2004 - FSC Principles and Criteria for Forest Stewardship (available in PDF at www.fsc.org).
 - G. ICC Evaluation Service, Inc.
 - 1. NES NER-272-2004 - Power Driven Staples and Nails for Use in All Types of Building Construction.
 - H. International Code Council:
 - 1. International Building Code, 2006.
 - I. National Lumber Grades Authority:
 - 1. Standard Grading Rules for Canadian Lumber, 2007.
 - J. Northeastern Lumber Manufacturers' Association:
 - 1. Standard Grading Rules for Northeastern Lumber, 2006. (Available in PDF at www.nelma.org).
 - K. The Southern Pine Inspection Bureau:
 - 1. Standard Grading Rules for Southern Pine Lumber, 2002.
 - L. U.S. Department of Commerce, National Institute of Standards and Technology:
 - 1. DOC PS 1-1995 - U.S. Product Standard for Construction and Industrial Plywood.
 - 2. DOC PS 20-2005 - American Softwood Lumber Standard.
 - M. West Coast Lumber Inspection Bureau:
 - 1. Standard No. 17-1996 - Grading Rules for West Coast Lumber.
 - N. Western Wood Products Association:
 - 1. Western Lumber Grading Rules, 2005.
- 1.04 DEFINITIONS:
- A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
 - B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 - 2. NLGA: National Lumber Grades Authority.
 - 3. SPIB: The Southern Pine Inspection Bureau.
 - 4. WCLIB: West Coast Lumber Inspection Bureau.
 - 5. WWPA: Western Wood Products Association.
- 1.05 SUBMITTALS:
- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 - 3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - 4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

SECTION 061000 - ROUGH CARPENTRY: continued

B. LEED® Submittals:

1. Certificates for Credit MR 7: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Provide manufacturer's invoice with each wood product as a line item with cost, type of FSC content (and percentage, as applicable) and manufacturer's chain of custody number.
2. Product Data for Credit IEQc4.4: For plywood products, submit documentation stating that the wood binders contain no added urea formaldehyde. For laminating adhesives used to fabricate on-site and shop-applied composite wood assemblies, submit documentation stating that the composite wood adhesive product contains no added urea formaldehyde.

1.06 INFORMATIONAL SUBMITTALS:

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
 1. Wood-preservative-treated wood.
 2. Power-driven fasteners.
 3. Powder-actuated fasteners.
 4. Expansion anchors.
 5. Metal framing anchors.

1.07 QUALITY ASSURANCE:

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.08 DELIVERY, STORAGE, AND HANDLING:

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

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL:

- A. Certified Wood: Materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship" for the following:
 1. Miscellaneous lumber.
 2. Solid hardwood.
 3. Plywood.
 4. Miscellaneous lumber, including blocking, nailers, furring, sleepers and grounds.
- B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

SECTION 061000 - ROUGH CARPENTRY: continued

1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
- C. Maximum Moisture Content of Lumber: 19% for more than 2-inch nominal thickness.
- 2.02 WOOD-PRESERVATIVE-TREATED LUMBER:
- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
 - B. Kiln-dry lumber after treatment to a maximum moisture content of 19%. Do not use material that is warped or that does not comply with requirements for untreated material.
 - C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 2. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.
- 2.03 MISCELLANEOUS LUMBER:
- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 1. Blocking.
 2. Nailers.
 3. Furring.
 4. Grounds.
 - B. For items of dimension lumber size, provide Construction or No. 2 grade lumber.
- 2.04 PLYWOOD BACKING PANELS:
- A. Equipment Backing Panels: DOC PS 1, Exterior, AC, not less than 3/4-inch nominal thickness.
 1. Plywood backing panels shall contain no added urea-formaldehyde resins or laminating adhesives.
- 2.05 FASTENERS:
- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153.
 - B. Nails, Brads, and Staples: ASTM F1667.
 - C. Power-Driven Fasteners: NES NER-272.
 - D. Wood Screws: ASME B18.6.1.
 - E. Lag Bolts: ASME B18.2.1.

SECTION 061000 - ROUGH CARPENTRY: continued

- F. Bolts: Steel bolts complying with ASTM A307, Grade A; with ASTM A563 hex nuts and, where indicated, flat washers.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.
 - 2. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

2.06 MISCELLANEOUS MATERIALS:

- A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL:

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.
- C. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- D. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- E. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- F. Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.
- G. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
- H. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

SECTION 061000 - ROUGH CARPENTRY: continued

- I. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
 - 1. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
 - 2. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

- 3.02 WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION:
 - A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
 - B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
 - C. Where wood-preserved-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
 - D. Provide permanent grounds of dressed, pressure-preserved-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

- 3.03 WOOD FURRING INSTALLATION:
 - A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
 - B. Furring to Receive Plywood or Hardboard Paneling: Install 1- by 3-inch nominal size furring horizontally at 24 inches o.c.

END OF SECTION 061000

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. This Section includes the following:
 - 1. Plastic-laminate cabinets.
 - 2. Solid-surfacing-material countertops and window sills.
- B. Related Sections include the following:
 - 1. DIVISION 01, Section 018113.13 "Sustainable Design Requirements" for LEED® requirements and LEED documentation submittals pertaining to materials and products provided on this project.
 - 2. DIVISION 06, Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.

1.03 REFERENCES:

- A. American National Standards Institute:
 - 1. ANSI A135.4-2004 - Basic Hardboard.
 - 2. ANSI A208.1-2009 - Particleboard.
 - 3. ANSI A208.2-2009 - Medium Density Fiberboard (MDF) for Interior Applications.
- B. American Wood Protection Association:
 - 1. AWPA N1-2006 - All Millwork Products - Preservative Treatment by Nonpressure Process.
 - 2. AWPA U1-2007 - Use Category System - User Specification for Treated Wood.
- C. ASTM International:
 - 1. ASTM C834-05 - Specification for Latex Sealants.
 - 2. ASTM D570-98 (Reapproved 2005) - Test Method for Water Absorption of Plastics.
 - 3. ASTM D648-07 - Test Method for Deflection Temperature of Plastics under Flexural Load in the Edgewise Position.
 - 4. ASTM D2898-08 - Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing.
 - 5. ASTM D5572-95 (Reapproved 2005) - Specification for Adhesives Used for Finger Joints in Nonstructural Lumber Products.
 - 6. ASTM E84-09 - Test Method for Surface-Burning Characteristics of Building Materials.
- D. Builders Hardware Manufacturers Association:
 - 1. BHMA A156.9-2003 - Cabinet Hardware.
 - 2. BHMA A156.16-2008 - Auxiliary Hardware.
- E. California Department of Health Services:
 - 1. Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, 2004.
- F. Code of Federal Regulations:
 - 1. 40 CFR 59, Subpart D-2002 - National Volatile Organic Compound Emission Standards for Architectural Coatings.

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK: continued

- G. Forest Stewardship Council:
 - 1. FSC STD-01-001-2004 - FSC Principles and Criteria for Forest Stewardship (available in PDF at www.fsc.org).
 - H. Hardwood Plywood & Veneer Association:
 - 1. HPVA HP-1-2004 - American National Standard for Hardwood and Decorative Plywood (ANSI).
 - I. National Electrical Manufacturers Association:
 - 1. NEMA LD 3-2005 - High Pressure Decorative Laminates (available in PDF at www.nema.org).
 - J. National Hardwood Lumber Association:
 - 1. Rules for the Measurement and Inspection of Hardwood & Cypress, 2003. (Available in PDF at www.natlhardwood.org).
 - K. National Lumber Grades Authority:
 - 1. Standard Grading Rules for Canadian Lumber, 2007.
 - L. Northeastern Lumber Manufacturers' Association:
 - 1. Standard Grading Rules for Northeastern Lumber, 2006. (Available in PDF at www.nelma.org).
 - M. Southern Pine Inspection Bureau:
 - 1. Standard Grading Rules for Southern Pine Lumber, 2002.
 - N. U.S. Department of Commerce, National Institute of Standards and Technology:
 - 1. DOC PS 1-1995 - Construction and Industrial Plywood (available in PDF at www.apawood.org and www.nist.gov).
 - 2. DOC PS 20-2005 - American Softwood Lumber Standard (available in PDF at www.alsc.org and www.nist.gov).
 - O. West Coast Lumber Inspection Bureau:
 - 1. Standard No. 17-1996 - Grading Rules for West Coast Lumber.
 - P. Western Wood Products Association:
 - 1. Western Lumber Grading Rules, 2005.
 - Q. Wood Molding & Millwork Producers Association:
 - 1. WMMPA HWM 1-1991 - HWM/Series Hardwood Moulding Patterns.
- 1.04 DEFINITIONS:
- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.
- 1.05 SUBMITTALS:
- A. Product Data: For each type of product indicated, including cabinet hardware and accessories and finishing materials and processes.
 - B. Product Data: For panel products high-pressure decorative laminate adhesive for bonding plastic laminate solid-surfacing material cabinet hardware and accessories and finishing materials and processes.
 - 1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
 - C. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK: continued

2. Certificates for Credit MR 7: Chain-of-custody certificates indicating that interior architectural woodwork complies with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
 3. Product Data for Credit IEQ 4.1: For installation adhesives, documentation including printed statement of VOC content.
 4. Product Data for Credit IEQ 4.4: For composite wood products and laminating adhesives, documentation indicating that product contains no added urea formaldehyde.
 - D. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 1. Show details full size.
 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other sections.
 3. Show locations and sizes of cutouts and holes for plumbing fixtures and other items installed in architectural woodwork.
 - E. Samples:
 1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with 1 sample applied to core material.
 2. Thermoset decorative-panels, 8 by 10 inches, for each type, color, pattern, and surface finish.
 3. Solid-surfacing materials, 6 inches square.
 4. Corner pieces as follows:
 - a. Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
 - b. Miter joints for standing trim.
 5. Exposed cabinet hardware and accessories, one unit for each type and finish.
- 1.06 INFORMATIONAL SUBMITTALS:
- A. Qualification Data: For fabricator.
 - B. Product Certificates: For each type of product, signed by product manufacturer.
 - C. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.
- 1.07 QUALITY ASSURANCE:
- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.
 - B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.
 - C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
 1. Provide AWI Quality Certification Program labels and certificates indicating that woodwork, including installation, complies with requirements of grades specified.
- 1.08 DELIVERY, STORAGE, AND HANDLING:
- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK: continued

1.09 PROJECT CONDITIONS:

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90°F and relative humidity between 25 and 55% during the remainder of the construction period.
- C. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.10 COORDINATION:

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other sections to ensure that interior architectural woodwork can be supported and installed as indicated.
- B. Hardware Coordination: Distribute copies of approved hardware schedule specified in DIVISION 08, Section "Door Hardware (Scheduled by Describing Products)" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Certified Wood: New lumber, plywood and hardwood materials for interior architectural woodwork shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
 - 1. Recycled Content of Solid Surfacing Material, Medium-Density Fiberboard and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25%.
 - 2. Low-Emitting Materials: Composite wood products, including medium-density fiberboard, plywood and particleboard shall contain no added urea formaldehyde.
 - 3. Hardboard: AHA A135.4.
 - 4. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no added urea formaldehyde.
 - 5. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.
 - 6. Softwood Plywood: DOC PS 1, Medium Density Overlay.

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK: continued

- C. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
 - 1. Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semi-exposed edges.
- D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
 - 1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following or approved equal:
 - a. Abet Laminati, Inc.
 - b. Arborite; division of ITW Canada, Inc.
 - c. Formica Corporation.
 - d. Lamin-Art, Inc.
 - e. Nevamar Company, LLC; Decorative Products Div.
 - f. Panolam Industries International Incorporated.
 - g. Westinghouse Electric Corp.; Specialty Products Div.
 - h. Wilsonart International; Div. of Premark International, Inc.
 - 1. Colors and Patterns: As selected by Contracting Officer from manufacturer's full range.
- E. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. ABA Industries.
 - b. Avonite, Inc.
 - c. E. I. du Pont de Nemours and Company.
 - d. Formica Corporation.
 - e. LG Chemical, Ltd.
 - f. Meganite Inc.; a division of the Pyrochem Group.
 - g. Nevamar Company, LLC; Decorative Products Div.
 - h. Samsung; Cheil Industries Inc.
 - i. Swan Corporation (The).
 - j. Transolid, Inc.
 - k. Wilsonart International; Div. of Premark International, Inc.
 - 2. Colors and Patterns: As selected by Contracting Officer from manufacturer's full range.

2.02 CABINET HARDWARE AND ACCESSORIES:

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in DIVISION 08, Section "Door Hardware (Scheduled by Describing Products)."
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 100 degrees of opening, self-closing.
- C. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.
- D. Catches: Magnetic catches, BHMA A156.9, B03141.
- E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
- F. Shelf Rests: BHMA A156.9, B04013; metal.
- G. Drawer Slides: BHMA A156.9, B05091.
 - 1. Standard Duty (Grade 1, Grade 2, and Grade 3): Side mounted and extending under bottom edge of drawer; full-extension type; epoxy-coated steel with polymer rollers.
- H. Door Locks: BHMA A156.11, E07121.

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK: continued

- I. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Satin Stainless Steel: BHMA 630.
 - J. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
- 2.03 MISCELLANEOUS MATERIALS:
- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15% moisture content.
 - B. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15% moisture content.
 - C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
 - D. Laminating Adhesives: Laminating adhesives shall not contain added urea formaldehyde.
 - E. VOC Limits for Installation Adhesives: Installation adhesives shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Wood Glues: 30 g/L.
 - 2. Multipurpose Construction Adhesives: 70 g/L.
 - 3. Top and Trim or Special Purpose Contact Adhesive: 250 g/L.
 - F. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
 - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.
- 2.04 FABRICATION, GENERAL:
- A. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 - 1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch.
 - B. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify Contracting Officer seven days in advance of the dates and times woodwork fabrication will be complete.
 - 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
 - C. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 - 1. Seal edges of openings in countertops with a coat of varnish.
- 2.05 PLASTIC-LAMINATE CABINETS:
- A. Grade: Premium.
 - B. AWI Type of Cabinet Construction: Flush overlay.

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK: continued

- C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 - 1. Horizontal Surfaces Other Than Tops: Grade HGS.
 - 2. Postformed Surfaces: Grade HGP.
 - 3. Vertical Surfaces: Grade HGS.
 - 4. Edges: Grade HGS.
- D. Materials for Semi-exposed Surfaces:
 - 1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.
 - a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018 inch minimum thickness, matching laminate in color, pattern, and finish.
 - b. For semi-exposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade VGS.
 - 2. Drawer Sides and Backs: Solid-hardwood lumber.
 - 3. Drawer Bottoms: Hardwood plywood.
- E. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.
- F. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. As selected by Contracting Officer from laminate manufacturer's full range in the following categories:
 - a. Solid colors, matte finish.
- G. Provide dust panels of 1/4-inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

2.06 SOLID-SURFACING-MATERIAL COUNTERTOPS AND WINDOW SILLS:

- A. Grade: Premium.
- B. Solid-Surfacing-Material Thickness: 1/2 inch minimum.
- C. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:
 - 1. As selected by Contracting Officer from manufacturer's full range.
- D. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate tops with loose backsplashes for field application.
- E. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

PART 3 - EXECUTION

3.01 PREPARATION:

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

3.02 INSTALLATION:

- A. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK: continued

2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 3. Secure backsplashes to walls with adhesive.
 4. Calk space between backsplash and wall with sealant specified in DIVISION 07, Section "Joint Sealants."
- B. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.
 - C. Refer to DIVISION 09 Sections for final finishing of installed architectural woodwork.
- 3.03 ADJUSTING AND CLEANING:
- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
 - B. Clean, lubricate, and adjust hardware.
 - C. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

SECTION 070910 BUILDING ENVELOPE ENVIRONMENTAL SEPARATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The purpose of this section is to specify Division 01 responsibilities in the commissioning (Cx) process.
- B. The systems to be commissioned are listed in Section 019113, Part 1.6.
- C. Commissioning (Cx) requires the participation of Division 01 to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Section 019113. Division 01 shall be familiar with all parts of Section 019113 and the Commissioning Plan issued by the Commissioning Authority (CA) and shall execute all commissioning responsibilities assigned to them in the Contract Documents.
- D. This Section includes building envelope environmental separation commissioning procedures, including substructure, superstructure, exterior enclosure, and roofing construction and associated components, assemblies, and sub-assemblies that protect climate-controlled interior spaces from unconditioned spaces and the exterior environment, as follows:
 - 1. Below-grade construction including foundations, basements, and slab-on-grade that functions as part of the building envelope system, but excluding structural systems and components.
 - 2. Superstructure floor and roof construction that functions as part of the building envelope system.
 - 3. Exterior building envelope construction, above grade, including exterior opaque walls, windows, and doors, including sheathing, framing, and insulation, and interior finish materials attached to the exterior wall.
 - 4. Roofing, including roofing system, roofing insulation, and skylights, hatches, and other roof openings.
 - 5. If part of the OPR includes partitions or walls within the building, surrounding areas with different ambient conditions than the rest of the interior space.
- E. Related Sections:
 - 1. Division 03 through 14 Sections for building envelope commissioning requirements specific to the Work of each Section.

1.2 RESPONSIBILITIES

- A. Architect and design engineers.
 - a. Submit all Record Documents to CA including:
 - Electronic copies of all project Drawings, including title sheet, code analysis, architectural, and shop drawings.

- i. All Specifications in PDF format with addenda.
 - ii. Shop drawings and product cuts, scanned in, approved sheets only.
 - iii. Project schedules baseline and all updates.
 - b. Provide written responses to design review comments from the CA or other parties as requested.
 - c. Attend design, pre-construction, and construction phase coordination meetings.
 - d. Participate in testing procedures meetings.
 - e. Provide resolution for items for which the CA and Contractor may be in disagreement.
- B. Commissioning Authority (CA).
 - a. Review shop drawings, product data, and samples for compliance with Contract Documents.
 - b. Write project specific commissioning plan.
 - c. Review coordination drawings.
 - d. Provide project-specific construction checklists and commissioning process test procedures.
 - e. Participate in project meetings, including design, preconstruction, and construction phase meetings as required.
 - f. Witness systems, assemblies, equipment, and component start-up.
 - g. Review building envelope work for compliance with Contract Documents.
 - i. Maintain list of observed deficiencies and discrepancies.
 - ii. Develop protocols for functional performance testing.
 - h. Compile test data, inspection reports, and certificates and include them in the systems manual and commissioning process report.
- C. Building envelope subcontractors and their subcontractors.
 - a. Attend pre-construction and construction-phase building enclosure coordination meetings.
 - b. Provide schedule and perform field quality control tests and inspections required by the Contract Documents to the CA.
 - c. Submit field quality control testing and inspection reports on building envelope construction to the CA.
 - d. Submit operation and maintenance data for systems, subsystems, and components to the CA.
 - e. Provide cut sheets and shop drawing submittals of commissioned systems to the CA.

- f. Provide input for final commissioning documentation to the CA.
- g. Participate in testing/inspection procedures meetings.
- h. Provide complete set of Coordination Drawings showing the complete coordination and integration of all Work of commissioned systems to the CA.
- i. Permit CA to access locations of installed systems, subsystems, assemblies, and components for testing and inspection.
- j. Provide test data, letters of compatibility, and certificates to CA as required.
- k. Participate in maintenance orientation and inspection.
- l. Participate in operation and maintenance training sessions.
- m. Address current Owner and Architect punchlist items.
- n. Participate in final review at acceptance meeting.

PART 2 – PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 PRE-CONSTRUCTION TESTING

- A. Refer to Division 03 through 14 Sections for mock-up requirements specific to the Work of each Section.

3.2 QUALITY ASSURANCE

- A. Quality Assurance and Control: Specific commissioning quality assurance and quality control requirements for individual construction activities are specified in the Sections that specify those activities. Specified commissioning tests, inspections, and related actions do not limit Contractor's other quality assurance and quality control procedures that facilitate compliance with the Contract Document requirements.

3.3 FUNCTIONAL PERFORMANCE TESTING

- A. Objectives and Scope: The objective of functional performance testing is to demonstrate that each building envelope assembly/system is functioning according to the documented design intent of the Contract Documents and in accordance with the OPR. Functional testing facilitates bringing the material assembly from a state of substantial completion (or completed to facilitate pre-testing) to full operation. Additionally, during the testing process, areas of non-compliant performance are identified and corrected, improving the operation and functioning of the building envelope/assemblies.

- B. Development of Test Procedures: Before specific test protocols and procedures are developed, the CA will request all documentation and a current list of change orders affecting building envelope/assemblies, including an updated points list and parameters. The CA shall develop specific test protocols and procedures to verify and document proper operation of each piece of building envelope/assemblies.
- C. Functional Performance Testing: All functional performance testing of building envelope/assemblies shall be performed by the installing contractor, unless otherwise specified by the CA. Any subcontractor or vendor responsible to execute a test shall provide assistance to the CA in developing the procedures review (answering questions about assemblies and sequences, etc.). Prior to execution, the CA will provide a copy of the test procedures to the General Contractor and subcontractor(s) who will review the tests for feasibility, building envelope/assemblies, and warranty protection.
- D. Test Methods:
1. Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance). The CA may substitute specified methods or require an additional method to be executed, other than what was specified.
 2. Simulated Conditions: Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
- E. Sampling: Multiple identical pieces of assemblies may be functionally tested using a sampling strategy. Significant application differences and significant sequence of functional differences in otherwise identical materials or assemblies invalidates their common identity. A small size or capacity difference, alone, does not constitute a difference. It is noted that no sampling by contractors and their subcontractors is allowed in pre-functional checklist execution.
- F. The Contractors and their subcontractors shall provide sufficient notice to the CA regarding their completion schedule for the construction of the assemblies or exterior enclosure systems. The CA will schedule functional tests through the General Contractor.
- G. If tests cannot be completed because of a deficiency outside the scope of the building envelope; the deficiency shall be documented and reported to Owner. Deficiencies shall be resolved and corrected by Contractor and tests rescheduled.
- I. The CA may recommend solutions to problems found; however, the burden of responsibility to solve, correct, and retest problems is with the General Contractor, subcontractors and their subcontractors and the Architect.

3.4 NON-CONFORMANCE

- A. All deficiencies or non-conformance issues shall be noted and reported by the CA to the General Contractor and Architect.
- B. Corrections of minor deficiencies identified during functional performance testing or inspections may be made at the time of testing/inspection at the discretion of the Architect. In such cases, the deficiency and resolution will be documented.
- C. Failure Due to Manufacturer Defect: If identical pieces (size alone does not constitute a difference) of materials or assemblies fail to perform to the Contract Documents (physically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable by the General Contractor, subcontractor, sub-subcontractor, CA, Architect or Owner.

END OF SECTION 070910

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. This Section Includes:
 - 1. Foam-plastic board insulation.
 - 2. Glass-fiber blanket insulation.
 - 3. Liquid vapor barrier.
 - 4. Nailable roof insulation.
 - 5. Roof vapor retarder.
 - 6. Fire safing.
- B. Related Sections:
 - 1. DIVISION 01, Section "Sustainable Design Requirements" for LEED® related requirements for recycled content materials and local/regionally manufactured and sourced materials.
 - 2. DIVISION 04, Section "Unit Masonry" for insulation installed in cavity walls and masonry cells.

1.03 REFERENCES:

- A. ASTM International:
 - 1. ASTM C552-03 - Specification for Cellular Glass Thermal Insulation.
 - 2. ASTM C578-07 - Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 - 3. ASTM C612-04 - Specification for Mineral Fiber Block and Board Thermal Insulation.
 - 4. ASTM C764-06a - Specification for Mineral Fiber Loose-Fill Thermal Insulation.
 - 5. ASTM C1029-05a - Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation.
 - 6. ASTM C1289-07 - Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
 - 7. ASTM C1320-05 - Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.
 - 8. ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.
 - 9. ASTM D1970 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
 - 10. ASTM D3407 - Standard Test Methods for Joint-Sealants, Hot-Poured, for Concrete and Asphalt Pavements.
 - 11. ASTM D4397-02 - Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
 - 12. ASTM D5116-06 - Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products.
 - 13. ASTM E84-07 - Test Method for Surface Burning Characteristics of Building Materials.
 - 14. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
 - 15. ASTM E136-04 - Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C.
 - 16. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials.
 - 17. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure.

SECTION 072100 - THERMAL INSULATION: continued

18. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

1.04 SUBMITTALS:

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

1.05 INFORMATIONAL SUBMITTALS:

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.
- B. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.06 QUALITY ASSURANCE:

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.01 FOAM-PLASTIC BOARD INSULATION:

- A. Extruded-Polystyrene Board Insulation: ASTM C578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning.
 - d. Pactiv Building Products.
 2. Type X, 15 psi.
- B. Foil-Faced, Polyisocyanurate Board Insulation: ASTM C1289, Type I, Class 1.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. Atlas Roofing Corporation.

SECTION 072100 - THERMAL INSULATION: continued

- b. Dow Chemical Company (The).
- c. Rmax, Inc.

2.02 GLASS-FIBER BLANKET INSULATION:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - 1. CertainTeed Corporation.
 - 2. Guardian Building Products, Inc.
 - 3. Johns Manville.
 - 4. Knauf Insulation.
 - 5. Owens Corning.
- B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25%.
- C. Unfaced, Glass-Fiber Blanket Insulation: ASTM C665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics.
- D. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide cross ventilation between insulated attic spaces and vented eaves.
- E. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
 - 1. Free of Formaldehyde: Insulation manufactured with 100% acrylic binders and no formaldehyde.
 - 2. Low Emitting: Insulation tested according to ASTM D5116 and shown to emit less than 0.05-ppm formaldehyde.

2.03 LIQUID VAPOR BARRIER:

- A. Provide spray applied water based liquid vapor barrier comprised of polymer based on modified asphalt.
 - 1. Basis of Design: Carlisle, Spray-Grade: Barriseal™-S pourable consistency, water-based, polymer-modified asphalt.
 - a. Thickness: 40 mils.
 - b. Permeance: 0.02 perm; ASTM E96.
 - c. Or equals with prior approval.
- B. Provide accessories compatible with the liquid vapor barrier including, but not limited to, the following or approved equal:
 - 1. Transition Membrane: 40-mil thickness self-adhering flashing.
 - 2. Reinforcing Fabric: DCH Reinforcing Fabric woven, white polyester.
 - 3. Sheathing Joint Treatment, select any:
 - a. Four-inch width transition membrane or DCH reinforcing fabric entered over joint and bonded to surface prepared with Contact Adhesive.
 - b. Water based contact adhesive.
 - c. Filler compound, trowel-grade polyurethane.

2.04 NAILABLE ROOF INSULATION:

- A. Composite Insulation: Oriented strand board or wafer board on one major surface of the core foam and fibrous felt or glass fiber mat membrane on the other major surface of the foam core.
 - 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Homasote Company; Thermasote nailbase roof insulation.

SECTION 072100 - THERMAL INSULATION: continued

- b. Atlas Roofing Corporation; AC Foam nailbase insulation.
 - c. Cornell Corporation; Thermacal.
 - d. Johns Manville Corporation; Nailboard.
 - 2. Exterior Nailbase: One layer oriented strand board, 1/2 inch thick, 34 pcf minimum density, R-value of 0.85 minimum.
 - 3. Core Foam: Polyisocyanurate insulation, 4 inches thick, 20 psi minimum compressive strength, 2.0 pcf minimum density, R-value of 25 minimum.
 - 4. Felt Membrane: Asphalt organic felt reinforced with fiberglass, 0.10 lbs/sf nominal weight.
 - 5. Total R-value of 25.0 minimum.
- 2.05 NAILABLE INSULATION FASTENERS:
- A. Insulation Fasteners: Provide fasteners recommended by manufacturer for this specific installation.
 - B. Fasteners shall be low-profile large diameter head type or low-profile with stress plates.
 - 1. Corrosion resistance: Fasteners shall meet FM 4470 Corrosion Test, modified DIN 50018 standard, with a maximum of 15% red rust after 15 wet and dry acidic atmosphere cycles in Kesternich cabinet.
 - 2. Size: As recommended by insulation manufacturer for board thickness required and specified windstorm rating.
 - 3. Wind uplift: Meeting FM Class 1-90 windstorm rating.
 - 4. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - 5. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.
- 2.06 ROOF VAPOR RETARDER:
- A. Laminated building paper made up of two layers black polyethylene reinforced with fiberglass fibers.
 - B. Properties:
 - 1. Water vapor permeance: 2.50 perms maximum.
 - 2. Dry tensile strength: 50 lbs/inch minimum.
 - 3. Puncture resistance: 200 beach units minimum.
- 2.07 FIRE SAFING:
- A. Mineral fiber fire safing: ASTM E84, 4.0 pcf minimum, 2-inch thickness minimum, unfaced mineral fiber.

PART 3 - EXECUTION

- 3.01 PREPARATION:
- A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.
- 3.02 INSTALLATION, GENERAL:
- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
 - B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

SECTION 072100 - THERMAL INSULATION: continued

- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.03 INSTALLATION OF BELOW-GRADE INSULATION:

- A. On vertical surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.

3.04 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION:

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Foam-Plastic Board Insulation: Seal joints between units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
- C. Glass-Fiber or Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
 - 5. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
 - a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.
 - 6. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.
 - a. Exterior Walls: Set units with facing placed toward exterior of construction.
 - b. Interior Walls: Set units with facing placed toward areas of high humidity.

3.05 NAILABLE INSULATION INSTALLATION:

- A. Apply wood nailers of same thickness as nailable insulation to surface of decking at all eaves and rake edges of roof to provide for a starter strip and nailing for trim and fascia.

SECTION 072100 - THERMAL INSULATION: continued

- B. Install roof insulation over metal decking in accordance with manufacturer's recommendations and in compliance with FM 1-28 requirements for FM 1-90 windstorm classification.
- C. Install insulation with panel length parallel to eave/ridge.
- D. Install insulation boards with end joints staggered minimum 24 inches in successive panel rows.
 - 1. Butt edges with 1/8 inch gaps for expansion and contraction.
 - 2. Bear edges of insulation board on metal deck ribs.
 - 3. Position insulation boards so that panel joints do not align with joints in metal decking.
- E. Mechanically attach insulation panels to metal roof decking using mechanical fasteners meeting FM 1-90 windstorm classification. Fasten panels through spacer strips and in fastening patterns complying with windstorm classification requirements and manufacturer's recommendations.
- F. Cover panels with minimum 15# roofing felt attached with corrosion resistant roofing nails.
- G. Do not permit construction of fascia to block or obstruct air circulation path.
- H. Do not leave installed insulation exposed to the weather. Cover with subsequent roofing materials immediately following insulation installation.
- I. Seal exposed insulation edges at end of each work period. Remove edge seals when work resumes.

3.06 INSTALLATION OF INSULATION FOR CONCRETE SUBSTRATES:

- A. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
 - 1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
 - 2. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.
 - 3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.
 - 4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

3.07 LIQUID APPLIED VAPOR BARRIER:

- A. Surface preparation:
 - 1. Surfaces shall be free of contaminants such as grease, oil and wax on surfaces to receive membrane.
 - 2. The concrete masonry surfaces shall be free from projections.
 - 3. Strike mortar joints full and flush to face of concrete block.
 - 4. Fill voids and holes greater than 1/2 inch across with mortar or non-shrink grout.
 - 5. Fill cracks, gaps and joints exceeding 1/4 inch width with mortar or non-shrink grout.
 - 6. Grind flush or make smooth surface irregularities exceeding 1/4 inch in height or sharp to touch.
 - 7. Fill around penetrations with mortar, sealant or other approved fill material and strike flush.
 - 8. If surfaces cannot be made smooth to the satisfaction of the Contracting Officer, it will be the responsibility of the trade to alternatively apply a parge coat (typically one part cement to three parts sand) over surface to receive fluid-applied membrane air barrier.

SECTION 072100 - THERMAL INSULATION: continued

9. Remove mortar droppings on brick ties, shelf angles, brick shelves and other horizontal obstructions.
 10. Fill honeycomb in concrete with non-shrink grout or fill compound.
 11. Fill cracks in concrete and masonry exceeding 1/16-inch width and not exceeding 1/8-inch width with mastic.
 12. Treat cracks in concrete and masonry exceeding 1/8-inch width and not exceeding 1/4-inch width with sheathing joint treatment.
 13. Fill cracks, gaps and joints exceeding 1/4-inch width with tooled joint sealant over backer rod.
 14. Fill rough gaps around pipe, conduit and similar penetrations with mortar, non-shrink grout or polyurethane foam.
 15. Treat sheathing joints by filling with joint sealant and strike flush.
 16. Prepare areas to receive transition membrane with contact adhesive. Contact adhesive shall be provided at manufacturer's recommended coverage rate and visible for 1 inch minimum beyond edge of installed transition membrane.
 17. Install transition membrane according to manufacturer's instructions and drawings.
 18. Apply transition membrane or reinforcing fabric encapsulated in roller-grade product according to manufacturer's instructions and drawings in the following area: joints, changes in plane, changes in substrate, window openings, and transitions to different systems.
 19. Transition membrane or reinforcing fabric shall bear 3 inches minimum onto dissimilar substrates.
- B. Installation:
1. Allow materials used during surface preparation to cure fully before applying product.
 2. Spray-grade product: Dispense in tandem with co-spray according to manufacturer's instructions.
 3. Cured membrane thickness shall measure a minimum of 0.040 inch.
- 3.08 PROTECTION:
- A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 073113 - ASPHALT SHINGLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Asphalt shingles.
 - 2. Underlayment.
- B. Related Sections:
 - 1. DIVISION 01, Section "Sustainable Design Requirements" for LEED® related requirements for recycled content materials and local/regionally manufactured and sourced materials.
 - 2. DIVISION 07, Section "Thermal Insulation" for nailable roof insulation.
 - 3. DIVISION 07, Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, counterflashings and flashings.

1.03 REFERENCES:

- A. Asphalt Roofing Manufacturers Association:
 - 1. Residential Asphalt Roofing Manual, 1997.
- B. ASTM International:
 - 1. ASTM D225-04 - Specification for Asphalt Shingles (Organic Felt) Surfaced with Mineral Granules.
 - 2. ASTM D226-05 - Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
 - 3. ASTM D1079-05 - Terminology Relating to Roofing, Waterproofing, and Bituminous Materials.
 - 4. ASTM D1970-01 - Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
 - 5. ASTM D3161-03b - Test Method for Wind-Resistance of Asphalt Shingles (Fan-Induced Method).
 - 6. ASTM D3462-05 - Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules.
 - 7. ASTM D3909-97b (Reapproved 2004) - Specification for Asphalt Roll Roofing (Glass Felt) Surfaced with Mineral Granules.
 - 8. ASTM D4586-00 - Specification for Asphalt Roof Cement, Asbestos-Free.
 - 9. ASTM D4869-05 (Reapproved 1993) - Specification for Asphalt-Saturated Organic Felt Underlayment Used in Steep Slope Roofing.
 - 10. ASTM E108-04 - Test Methods for Fire Tests of Roof Coverings.
 - 11. ASTM F1667-03 - Specification for Driven Fasteners - Nails, Spikes, and Staples.
- C. National Roofing Contractors Association:
 - 1. The NRCA Roofing and Waterproofing Manual, 5th ed. 2001 (2003 Update).
- D. Sheet Metal and Air Conditioning Contractors' National Association:
 - 1. Architectural Sheet Metal Manual, 2003.
- E. Underwriters Laboratories Inc.:
 - 1. UL 790-2004 - Tests for Fire Resistance of Roof Covering Materials.
 - 2. UL 2218-2002 - Impact Resistance of Prepared Roof Covering Materials.

SECTION 073113 - ASPHALT SHINGLES: continued

1.04 DEFINITION:

- A. Roofing Terminology: See ASTM D1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.05 SUBMITTALS:

- A. Product Data: For each type of product indicated.
- B. Samples: For the following products, of sizes indicated, to verify color selected:
 - 1. Asphalt Shingle: Full size.
 - 2. Ridge Shingles: Full size.
 - 3. Exposed Valley Lining: 12 inches square.
 - 4. Self-Adhering Underlayment: 12 inches square.
- C. LEED Product Submittals: For each type of asphalt shingle product submit documentation relative to manufacturer's calculated Solar Reflectance Index (SRI), calculated from emissivity and solar reflectance, in accordance with SS Credit 7.1 of the LEED Reference Guide.

1.06 INFORMATIONAL SUBMITTALS:

- A. Qualification Data: For qualified Installer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for asphalt shingles.
- C. Research/Evaluation Reports: For each type of asphalt shingle required, from the ICC.
- D. Warranties: Sample of special warranties.

1.07 CLOSEOUT SUBMITTALS:

- A. Maintenance Data: For each type of asphalt shingle to include in maintenance manuals.

1.08 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. Asphalt Shingles: 100 sq. ft. of each type, in unbroken bundles.

1.09 QUALITY ASSURANCE:

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain ridge and hip cap shingles, ridge vents, felt underlayment and from single source from single manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING:

- A. Store roofing materials in a dry, well-ventilated, weathertight location according to asphalt shingle manufacturer's written instructions. Store underlayment rolls on end on pallets or other raised surfaces. Do not double stack rolls.
 - 1. Handle, store, and place roofing materials in a manner to avoid significant or permanent damage to roof deck or structural supporting members.
- B. Protect unused underlayment from weather, sunlight, and moisture when left overnight or when roofing work is not in progress.

1.11 PROJECT CONDITIONS:

- A. Environmental Limitations: Do not deliver or install asphalt shingles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is

SECTION 073113 - ASPHALT SHINGLES: continued

operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1. Install self-adhering sheet underlayment within the range of ambient and substrate temperatures recommended by manufacturer.

1.12 WARRANTY:

- A. Special Warranty: Standard form in which manufacturer agrees to repair or replace asphalt shingles that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Manufacturing defects.
 - b. Structural failures including failure of asphalt shingles to self-seal after a reasonable time.
 2. Material Warranty Period: 25 years from date of Substantial Completion, prorated, with first five years nonprorated.
 3. Wind-Speed Warranty Period: Asphalt shingles will resist blow-off or damage caused by wind speeds up to 150 mph for 10 years from date of Substantial Completion.
 4. Algae-Discoloration Warranty Period: Asphalt shingles will not discolor 10 years from date of Substantial Completion.
 5. Workmanship Warranty Period: 10 years from date of Substantial Completion.
- B. Special Project Warranty: Roofing Installer's Warranty, or warranty form at end of this Section, signed by roofing Installer, covering the Work of this Section, in which roofing Installer agrees to repair or replace components of asphalt shingle roofing that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 GLASS-FIBER-REINFORCED ASPHALT SHINGLES:

- A. Laminated-Strip Asphalt Shingles: ASTM D3462, laminated, multi-ply overlay construction, glass-fiber reinforced, mineral-granule surfaced, and self-sealing.
 1. Basis-of-Design Product: Tamko Roofing Products, Heritage Woodgate Laminated asphalt shingles.
 2. Butt Edge: Straight cut.
 3. Strip Size: Manufacturer's standard.
 4. Algae Resistance: Granules treated to resist algae discoloration.
 5. Color and Blends: As selected by Contracting Officer from manufacturer's full range.
 6. Solar Reflectance Index: Roofing surface material shall have a minimum calculated Solar Reflectance Index (SRI) of 29, calculated from emissivity and solar reflectance values in accordance with Credit SSc7.2 of the LEED Reference Guide.
 7. Or equals with prior approval.

2.02 UNDERLAYMENT MATERIALS:

- A. Felt: ASTM D226, Type I, asphalt-saturated organic felts, nonperforated.

2.03 ACCESSORIES:

- A. Asphalt Roofing Cement: ASTM D4586, Type II, asbestos free.
- B. Roofing Nails: ASTM F1667; aluminum, stainless-steel, copper, or hot-dip galvanized-steel nails, minimum 0.120-inch diameter, barbed shank, sharp-pointed, with a minimum 3/8-inch

SECTION 073113 - ASPHALT SHINGLES: continued

diameter flat head and of sufficient length to penetrate 3/4 inch into solid wood decking or extend at least 1/8 inch through OSB or plywood sheathing.

1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.
- C. Felt Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized-steel wire with low-profile capped heads or disc caps, 1-inch minimum diameter.

2.04 METAL FLASHING AND TRIM:

- A. General: Comply with requirements in DIVISION 07, Section "Sheet Metal Flashing and Trim."
1. Sheet Metal: Copper.
- B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item.
1. Apron Flashings: Fabricate with lower flange a minimum of 4 inches over and 4 inches beyond each side of downslope asphalt shingles and 6 inches up the vertical surface.
 2. Step Flashings: Fabricate with a headlap of 2 inches and a minimum extension of 4 inches over the underlying asphalt shingle and up the vertical surface.
 3. Open-Valley Flashings: Fabricate in lengths not exceeding 10 feet with 1-inch high, inverted-V profile at center of valley and equal flange widths of 10 inches.
 4. Drip Edges: Fabricate in lengths not exceeding 10 feet with 2-inch roof-deck flange and 1-1/2-inch fascia flange with 3/8-inch drip at lower edge.
- C. Vent Pipe Flashings: ASTM B749, Type L51121, at least 1/16 inches thick. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof, and extending at least 4 inches from pipe onto roof.

PART 3 - EXECUTION

3.01 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.
1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.
 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored; and that provision has been made for flashings and penetrations through asphalt shingles.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 UNDERLAYMENT INSTALLATION:

- A. General: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
- B. Single-Layer Felt Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides a minimum of 2 inches over underlying course. Lap ends a minimum of 4 inches. Stagger end laps between succeeding courses at least 72 inches. Fasten with galvanized nails.
1. Install felt underlayment on roof deck not covered by self-adhering sheet underlayment. Lap sides of felt over self-adhering sheet underlayment not less than 3 inches in direction

SECTION 073113 - ASPHALT SHINGLES: continued

to shed water. Lap ends of felt not less than 6 inches over self-adhering sheet underlayment.

2. Install fasteners at no more than 36 inch o.c.

3.03 METAL FLASHING INSTALLATION:

- A. General: Install metal flashings and other sheet metal to comply with requirements in DIVISION 07, Section "Sheet Metal Flashing and Trim."
 1. Install metal flashings according to recommendations in ARMA's "Residential Asphalt Roofing Manual" and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."
- B. Apron Flashings: Extend lower flange over and beyond each side of downslope asphalt shingles and up the vertical surface.
- C. Step Flashings: Install with a headlap of 2 inches and extend over the underlying asphalt shingle and up the vertical surface. Fasten to roof deck only.
- D. Cricket Flashings: Install against the roof-penetrating element extending concealed flange beneath upslope asphalt shingles and beyond each side.
- E. Rake Drip Edges: Install rake drip edge flashings over underlayment and fasten to roof deck.
- F. Eave Drip Edges: Install eave drip edge flashings below underlayment and fasten to roof sheathing.
- G. Pipe Flashings: Form flashing around pipe penetrations and asphalt shingles. Fasten and seal to asphalt shingles as recommended by manufacturer.

3.04 ASPHALT SHINGLE INSTALLATION:

- A. General: Install asphalt shingles according to manufacturer's written instructions, recommendations in ARMA's "Residential Asphalt Roofing Manual," and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."
- B. Install starter strip along lowest roof edge, consisting of an asphalt shingle strip with tabs removed with self-sealing strip face up at roof edge.
 1. Extend asphalt shingles 1/2 inch over fasciae at eaves and rakes.
 2. Install starter strip along rake edge.
- C. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.
- D. Fasten asphalt shingle strips with a minimum of five roofing nails located according to manufacturer's written instructions.
 1. The use of staples for installation of shingles is not permitted.
- E. Ridge Cap Shingles: Maintain same exposure of cap shingles as roofing shingle exposure. Lap cap shingles to shed water away from direction of prevailing winds. Fasten with roofing nails of sufficient length to penetrate sheathing.

3.05 ROOFING INSTALLER'S WARRANTY:

- A. WHEREAS <Insert name> of <Insert address>, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
 1. Contracting Officer: <Insert name of Contracting Officer>.
 2. Address: <Insert address>.
 3. Building Name/Type: <Insert information>.
 4. Address: <Insert address>.
 5. Area of Work: <Insert information>.
 6. Acceptance Date: <Insert date>.

SECTION 073113 - ASPHALT SHINGLES: continued

7. Warranty Period: <Insert time>.
8. Expiration Date: <Insert date>.
- B. AND WHEREAS Roofing Installer has contracted (either directly with Contracting Officer or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
 1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
 - a. Lightning.
 - b. Peak gust wind speed exceeding <Insert wind speed> mph (m/sec).
 - c. Fire.
 - d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition.
 - e. Faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work.
 - f. Vapor condensation on bottom of roofing.
 - g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Contracting Officer.
 2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Contracting Officer or by another responsible party so designated.
 3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
 4. During Warranty Period, if Contracting Officer allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Contracting Officer engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Contracting Officer in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
 5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
 6. Contracting Officer shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.

SECTION 073113 - ASPHALT SHINGLES: continued

7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Contracting Officer from other remedies and resources lawfully available to Contracting Officer in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Contracting Officer or a subcontract with Contracting Officer's General Contractor.
- E. IN WITNESS THEREOF, this instrument has been duly executed this <Insert day> day of <Insert month>, <Insert year>.
1. Authorized Signature: <Insert signature>.
 2. Name: <Insert name>.
 3. Title: <Insert title>.

END OF SECTION 073113

SECTION 075419 - POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Adhered PVC membrane roofing system.
 - 2. Roof insulation.
- B. Section includes the installation of acoustical roof deck rib insulation strips furnished under DIVISION 05, Section "Steel Decking."
- C. Related Sections:
 - 1. DIVISION 01, Section "Sustainable Design Requirements" for LEED[®] related requirements for recycled content materials and local/regionally manufactured and sourced materials.
 - 2. DIVISION 06, Section "Rough Carpentry" for wood nailers, curbs, and blocking.
 - 3. DIVISION 07, Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counterflashings.
 - 4. DIVISION 07, Section "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.03 REFERENCES:

- A. American Society of Civil Engineers/Structural Engineering Institute:
 - 1. ASCE/SEI 7-2005 - Minimum Design Loads for Buildings and Other Structures.
- B. ASTM International:
 - 1. ASTM C728-05 - Specification for Perlite Thermal Insulation Board.
 - 2. ASTM C1177-04 - Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
 - 3. ASTM D41-05 - Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
 - 4. ASTM D312-00 - Specification for Asphalt Used in Roofing.
 - 5. ASTM D1079-05a - Terminology Relating to Roofing and Waterproofing.
 - 6. ASTM D4397-02 - Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
 - 7. ASTM D4434-04 - Specification for Poly(Vinyl Chloride) Sheet Roofing.
 - 8. ASTM D5036-99 (Reapproved 2005) - Practice for Application of Adhered Poly(Vinyl Chloride) Sheet Roofing.
 - 9. ASTM E108-05 - Test Methods for Fire Tests of Roof Coverings.
 - 10. ASTM E119-05a - Test Methods for Fire Tests of Building Construction and Materials.
 - 11. ASTM E1980-01 - Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.
- C. Code of Federal Regulations:
 - 1. 40 CFR 59, Subpart D-2006 - National Volatile Organic Compound Emission Standards for Architectural Coatings.
- D. Cool Roof Rating Council (1738 Excelsior Ave.; Oakland, CA 94602; 866-465-2523; 510-485-7175; www.coolroofs.org):
 - 1. CRRC-1-2005 - Product Rating Program.

SECTION 075419 - POLYVINYL-CHLORIDE (PVC) ROOFING: continued

- E. FM Approvals:
 - 1. FM Approvals 4450-1989 - Approval Standard for Class 1 Insulated Steel Deck Roofs (with 1992 Supplement).
 - 2. FM Approvals 4470-1986 - Approval Standard Class 1 Roof Covers (with 1987 and 1992 Supplements).
 - 3. RoofNav, undated.
 - F. FM Global:
 - 1. FM Global Loss Prevention Data Sheet 1-28-2005 - Design Wind Load.
 - 2. FM Global Loss Prevention Data Sheet 1-29-2005 - Roof Deck Securement and Above-Deck Roof Components.
 - G. National Roofing Contractors Association:
 - 1. The NRCA Roofing and Waterproofing Manual, 5th ed. 2001 (Revised 2006).
 - H. SPRI:
 - 1. SPRI RP-4-2002 - Wind Design Standard for Ballasted Single-Ply Roofing Systems (ANSI).
 - I. U.S. Department of Energy:
 - 1. DOE Roof Products Qualified Product List, undated.
- 1.04 DEFINITIONS:
- A. Roofing Terminology: See ASTM D1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.
- 1.05 PERFORMANCE REQUIREMENTS:
- A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.
 - B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
 - C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.
 - 1. Corner Uplift Pressure: In accordance with FM 1-90.
 - 2. Perimeter Uplift Pressure: In accordance with FM 1-90.
 - 3. Field-of-Roof Uplift Pressure: In accordance with FM 1-90.
 - D. FM Approvals Listing: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system, and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.
 - 1. Fire/Windstorm Classification: Class 1A-120.
 - 2. Hail Resistance: MH.
 - E. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E1980, based on testing identical products by a qualified testing agency.
 - F. Energy Performance: Provide roofing system that is listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.
 - G. Energy Performance: Provide roofing system with initial solar reflectance not less than 0.70 and emissivity not less than 0.75 when tested according to CRRC-1.

SECTION 075419 - POLYVINYL-CHLORIDE (PVC) ROOFING: continued

1.06 SUBMITTALS:

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit SS 7.2: For roof materials, indicating that roof materials comply with Solar Reflectance Index requirement.
 - 2. Product Data for Credit IEQ 4.1: For adhesives and sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
- C. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Base flashings and membrane terminations.
 - 2. Tapered insulation, including slopes.
 - 3. Roof plan showing orientation of steel roof deck and orientation of membrane roofing.
 - 4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
- D. Samples for Verification: For the following products:
 - 1. Sheet roofing, of color specified, including T-shaped side and end lap seam.
 - 2. Roof insulation.
 - 3. Metal termination bars.
 - 4. Six insulation fasteners of each type, length, and finish.

1.07 INFORMATIONAL SUBMITTALS:

- A. Qualification Data: For qualified Installer and manufacturer.
- B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - 1. Submit evidence of compliance with performance requirements.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.
- D. Field quality-control reports.
- E. Warranties: Sample of special warranties.

1.08 CLOSEOUT SUBMITTALS:

- A. Maintenance Data: For roofing system to include in maintenance manuals.

1.09 QUALITY ASSURANCE:

- A. Manufacturer Qualifications: A qualified manufacturer that is FM Approvals approved for membrane roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.
- C. Source Limitations: Obtain components including roof insulation and fasteners for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.
- D. Exterior Fire-Test Exposure: ASTM E108, Class A, for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.
- E. Fire-Resistance Ratings: Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

SECTION 075419 - POLYVINYL-CHLORIDE (PVC) ROOFING: continued

- F. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project Site.
 - 1. Meet with Contracting Officer , Roofing Installer, Roofing System Manufacturer's Representative, Deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
 - 5. Review structural loading limitations of roof deck during and after roofing.
 - 6. Review base flashings, special roofing details, roof drainage, roof penetrations and condition of other construction that will affect roofing system.
 - 7. Review governing regulations and requirements for insurance and certificates if applicable.
 - 8. Review temporary protection requirements for roofing system during and after installation.
 - 9. Review roof observation and repair procedures after roofing installation.

- 1.10 DELIVERY, STORAGE, AND HANDLING:
 - A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
 - B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
 - C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
 - D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

- 1.11 PROJECT CONDITIONS:
 - A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

- 1.12 WARRANTY:
 - A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, roofing accessories and other components of membrane roofing system.
 - 2. Warranty Period: 20 years from date of Substantial Completion.
 - B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of

SECTION 075419 - POLYVINYL-CHLORIDE (PVC) ROOFING: continued

membrane roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PVC MEMBRANE ROOFING:

- A. PVC Sheet: ASTM D4434, Type III, fabric reinforced.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. Carlisle SynTec, Incorporated.
 - b. Cooley Engineered Membranes; Div. of Cooley Group.
 - c. Custom Seal Roofing.
 - d. Duro-Last Roofing, Inc.
 - e. Flex Membranes International, Inc.
 - f. GAF Materials Corporation.
 - g. GenFlex Roofing Systems.
 - h. Johns Manville.
 - i. Mule-Hide Products Co., Inc.
 - j. Sarnafil, Inc.
 - k. Stevens Roofing Systems.
 - l. Versico, Incorporated.
 2. Thickness: 80 mils, nominal.
 3. Exposed Face Color: White, with solar reflectance index of not less than 78.

2.02 AUXILIARY MEMBRANE ROOFING MATERIALS:

- A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.
 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
 2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Plastic Foam Adhesives: 50 g/L.
 - b. Multipurpose Construction Adhesives: 70 g/L.
 - c. Fiberglass Adhesives: 80 g/L.
 - d. Other Adhesives: 250 g/L.
 - e. PVC Welding Compounds: 510 g/L.
 - f. Adhesive Primer for Plastic: 550 g/L
 - g. Sealant Primers for Nonporous Substrates: 250 g/L.
 - h. Sealant Primers for Porous Substrates: 775 g/L.
- B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet membrane.
- C. Bonding Adhesive: Manufacturer's standard, water based.
- D. Slip Sheet: Manufacturer's standard, of thickness required for application.
- E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

SECTION 075419 - POLYVINYL-CHLORIDE (PVC) ROOFING: continued

- F. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick, prepunched.
- G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
- H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.03 ROOF INSULATION:

- A. General: Preformed roof insulation boards manufactured or approved by PVC membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Approvals-approved roof insulation.
- B. Perlite Board Insulation: ASTM C728, rigid, mineral-aggregate thermal insulation board composed of expanded perlite, cellulosic fibers, binders, and waterproofing agents with top surface seal coated.
- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48).
- D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.04 INSULATION ACCESSORIES:

- A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
- C. Modified Asphaltic Insulation Adhesive: Insulation manufacturers recommended modified asphalt, asbestos-free, cold-applied adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- D. Bead-Applied Insulation Adhesive: Insulation manufacturer's recommended bead-applied, low-rise, one- or multicomponent urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- E. Full-Spread Applied Insulation Adhesive: Insulation manufacturer's recommended spray-applied, low-rise, two-component urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.

2.05 ASPHALT MATERIALS:

- A. Roofing Asphalt: ASTM D312, Type III or Type IV.
- B. Asphalt Primer: ASTM D41.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 - 1. Verify that wood-blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

SECTION 075419 - POLYVINYL-CHLORIDE (PVC) ROOFING: continued

2. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in DIVISION 05, Section "Steel Decking."
 - B. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.02 PREPARATION:
- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
 - B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
 - C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- 3.03 INSULATION INSTALLATION:
- A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
 - B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.
 - C. Install tapered insulation under area of roofing to conform to slopes indicated.
 - D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
 1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
 - E. Trim surface of insulation where necessary at scuppers so completed surface is flush and does not restrict flow of water.
 - F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
 1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
 - G. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:
 1. Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. and allow primer to dry.
 2. Set each layer of insulation in adhesive, applied within $\pm 25^{\circ}\text{F}$ of equiviscous temperature.
 3. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
- 3.04 ADHERED MEMBRANE ROOFING INSTALLATION:
- A. Adhere membrane roofing over area to receive roofing and install according to membrane roofing system manufacturer's written instructions.
 1. Install sheet according to ASTM D5036.
 - B. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.
 - C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

SECTION 075419 - POLYVINYL-CHLORIDE (PVC) ROOFING: continued

- D. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.
- E. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeter of roofing.
- F. Apply membrane roofing with side laps shingled with slope of roof deck where possible.
- G. Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.
 - 2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.

3.05 BASE FLASHING INSTALLATION:

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.06 FIELD QUALITY CONTROL:

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- B. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

3.07 PROTECTING AND CLEANING:

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Contracting Officer.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.08 ROOFING INSTALLER'S WARRANTY:

- A. WHEREAS <Insert name> of <Insert address>, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
 - 1. Owner: <Insert name of Owner>.
 - 2. Address: <Insert address>.

SECTION 075419 - POLYVINYL-CHLORIDE (PVC) ROOFING: continued

3. Building Name/Type: <Insert information>.
 4. Address: <Insert address>.
 5. Area of Work: <Insert information>.
 6. Acceptance Date: <Insert date>.
 7. Warranty Period: <Insert time>.
 8. Expiration Date: <Insert date>.
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
 - a. Lightning.
 - b. Peak gust wind speed exceeding <Insert wind speed> mph.
 - c. Fire.
 - d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition.
 - e. Faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work.
 - f. Vapor condensation on bottom of roofing.
 - g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
 2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
 3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
 4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
 5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.

SECTION 075419 - POLYVINYL-CHLORIDE (PVC) ROOFING: continued

6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
 7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.
- E. IN WITNESS THEREOF, this instrument has been duly executed this <Insert day> day of <Insert month>, <Insert year>.
1. Authorized Signature: <Insert signature>.
 2. Name: <Insert name>.
 3. Title: <Insert title>.

END OF SECTION 075419

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

A. Section Includes:

- 1. Manufactured Products:
 - a. Manufactured through-wall flashing and counterflashing.
 - b. Manufactured reglets and counterflashing.
 - c. Splash blocks.
 - d. Metal faced-in-fill panels.
- 2. Formed Products:
 - a. Roof drainage sheet metal fabrications.
 - b. Wall sheet metal fabrications.
 - c. Equipment support flashing.
 - d. Gutters.
 - e. Downspouts.
 - f. Soffit panels.
 - g. Scuppers.
 - h. End dam flashing.

B. Related Sections:

- 1. DIVISION 01, Section "Sustainable Design Requirements" for LEED® related requirements for recycled content materials and local/regionally manufactured and sourced materials.
- 2. DIVISION 06, Section "Rough Carpentry" for wood nailers, curbs, and blocking.
- 3. DIVISION 07, SECTION 073113 - ASPHALT SHINGLES for installing sheet metal flashing and trim integral with roofing.
- 4. DIVISION 07, Section "Roof Specialties" for manufactured roof specialties not part of sheet metal flashing and trim.
- 5. DIVISION 07, Section "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.

1.03 REFERENCES:

A. American Architectural Manufacturers Association:

- 1. AAMA 611-1998 - Voluntary Specification for Anodized Architectural Aluminum.
- 2. AAMA 620-2002 - Voluntary Specification High Performance Organic Coatings on Coil Coated Architectural Aluminum.
- 3. AAMA 621-2002 - Voluntary Specification for High Performance Organic coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates.

B. ASTM International:

- 1. ASTM A153-05 - Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- 2. ASTM A240-05 - Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- 3. ASTM A653-05 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

SECTION 076200 - SHEET METAL FLASHING AND TRIM: continued

4. ASTM A666-03 - Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 5. ASTM A755-03 - Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
 6. ASTM A792-05 - Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 7. ASTM B32-04 - Specification for Solder Metal.
 8. ASTM B209-04 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 9. ASTM B370-03 - Specification for Copper Sheet and Strip for Building Construction.
 10. ASTM C920-02 - Specification for Elastomeric Joint Sealants.
 11. ASTM C1311-02 - Specification for Solvent Release Sealants.
 12. ASTM D226-05 - Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
 13. ASTM D1187-97 (Reapproved 2002) - Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
 14. ASTM D1970-01 - Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
 15. ASTM D2244-02 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
 16. ASTM D4214-98 - Test Methods for Evaluating Degree of Chalking of Exterior Paint Films.
 17. ASTM D4397-02 - Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
 18. ASTM D4586-00 - Specification for Asphalt Roof Cement, Asbestos-Free.
 19. ASTM F2329-05 - Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.
- C. FM Global:
1. FMG Loss Prevention Data Sheet 1-49-2000 - Perimeter Flashing.
- D. Metal Construction Association (104 S. Michigan Ave., Suite 1500, Chicago, IL 60603; (312) 201-0193; www.metalconstruction.org).
1. Guide Specification for Residential Metal Roofing, 1995.
- E. National Association of Architectural Metal Manufacturers:
1. Metal Finishes Manual for Architectural and Metal Products, 1988.
- F. Sheet Metal and Air Conditioning Contractors' National Association:
1. Architectural Sheet Metal Manual, 2003.

1.04 PERFORMANCE REQUIREMENTS:

- A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Fabricate and install roof edge flashing and copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:
1. Wind Zone 2: For velocity pressures of 31 to 45 lbf/sq. ft.: 90-lbf/sq. ft. perimeter uplift force, 120-lbf/sq. ft. corner uplift force, and 45-lbf/sq. ft. outward force.
- C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.

SECTION 076200 - SHEET METAL FLASHING AND TRIM: continued

1. Temperature Change (Range): 120°F, ambient; 180°F, material surfaces.
- 1.05 SUBMITTALS:
- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
 - B. LEED Product Submittals:
 1. For adhesives and sealants installed inside the weatherproofing barrier of the building and installed on site, submit documentation including manufacturer's printed statement (MSDS Sheet) of VOC content of each product.
 2. Product Data for Credit MRc4: For metal products containing recycled content, submit documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content for each product or portion of a product having recycled content. Include statement indicating cost for each product containing recycled content material.
 - C. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:
 1. Identification of material, thickness, weight, and finish for each item and location in Project.
 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
 3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 4. Details of termination points and assemblies, including fixed points.
 5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
 6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
 7. Details of special conditions.
 8. Details of connections to adjoining work.
 9. Detail formed flashing and trim at a scale of not less than 1-1/2 inches per 12 inches.
 - D. Samples: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.
- 1.06 INFORMATIONAL SUBMITTALS:
- A. Qualification Data: For qualified fabricator.
 - B. Warranty: Sample of special warranty.
- 1.07 CLOSEOUT SUBMITTALS:
- A. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.
- 1.08 QUALITY ASSURANCE:
- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
 - B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

SECTION 076200 - SHEET METAL FLASHING AND TRIM: continued

- C. Copper Sheet Metal Standard: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- 1.09 DELIVERY, STORAGE, AND HANDLING:
- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
 - B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.
- 1.10 WARRANTY:
- A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

- 2.01 SHEET METALS:
- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
 - B. Galvanized Steel Sheet: ASTM A653, hot-dip galvanized steel sheet with 0.20% copper, mill phosphatized where indicated for painting; not less than 0.0396 inch thick, unless otherwise indicated or specified.
- 2.02 UNDERLAYMENT MATERIALS:
- A. Polyethylene Sheet: 6-mil thick polyethylene sheet complying with ASTM D4397.
 - B. Felt: ASTM D226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
 - C. Slip Sheet: Building paper, 3-lb/100 sq. ft. minimum, rosin sized.
- 2.03 MISCELLANEOUS MATERIALS:
- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
 - B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.

SECTION 076200 - SHEET METAL FLASHING AND TRIM: continued

- c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
- C. Sealant Tape: Pressure-sensitive, 100% solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- D. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight. For adhesives and sealants installed inside the weatherproofing barrier of the building and installed on site, the VOC content of each product shall not exceed the VOC limits of Credit IEQc4.1 in accordance with the LEED Reference Guide.
- E. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187.
- F. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

2.04 FABRICATION, GENERAL:

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
 - 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 2. Obtain field measurements for accurate fit before shop fabrication.
 - 3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."
- D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.
- E. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
- F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- G. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" and by FMG Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.
- H. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- I. Do not use graphite pencils to mark metal surfaces.

2.05 ROOF DRAINAGE SHEET METAL FABRICATIONS:

- A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch long sections. Furnish

SECTION 076200 - SHEET METAL FLASHING AND TRIM: continued

flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters.

1. Gutter Style: SMACNA designation A.
 2. Expansion Joints: Butt type.
 3. Accessories: Wire ball downspout strainer.
 4. Gutters with Girth up to 15 Inches: Fabricate from the following materials:
 - a. Coil coated galvanized steel, minimum 22 gage.
- B. Downspouts: Fabricate rectangular downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.
1. Fabricated Hanger Style: SMACNA figure designation 1-35A.
 2. Fabricate from the following materials:
 - a. Coil coated galvanized steel, minimum 22 gage.
- C. Scuppers: Fabricate from the following materials:
1. Coil coated galvanized steel, minimum 22 gage.
 2. Minimum size: 4 inches deep by 8 inches wide by 8 inches high.

2.06 LOW-SLOPE ROOF SHEET METAL FABRICATIONS:

- A. Roof-Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96 inch long, but not exceeding 10 foot long, sections. Furnish with 6 inch wide, joint cover plates.

2.07 PRECAST CONCRETE SPLASH BLOCKS:

- A. Splash blocks shall be factory-made units from a plant regularly engaged in producing precast concrete splash blocks.
- B. Concrete shall be minimum 3,000 psi using 1/2 inch to No. 4 nominal-size coarse aggregate, with minimum reinforcement required for handling of the units. Minimum clearance of 3/4 inch shall be maintained between reinforcement and faces of units.
- C. Exposed-to-view surfaces shall be free of surface voids, spalls, cracks, and chipped or broken edges and shall be of uniform appearance and color. Units shall have a smooth dense finish.
- D. Splash blocks shall be 18 inches wide by 36 inches long by 4 inches high. Minimum thickness shall be 2 inches.

2.08 SOFFIT PANELS:

- A. Materials and Finishes:
1. Panel Materials: 0.032 inch, 3105 H14 or equivalent (20 ksi yield strength) aluminum alloy conforming to ASTM B209 and meeting the requirements of AAMA 1402-86.
 2. Texture: Smooth.
 3. Profile: 12 inch wide panels, 3/8 inch deep, with double 5.5 inch wide faces forming V-grooves at 6 inches on center. Other panels providing similar profiles are acceptable.
 4. Supply ventilating soffit panels having perforations: 1/16 inch diameter holes on 5/32 inch staggered centers in a uniform 5 inch wide pattern along entire panel length.
 5. Finish: Factory-applied Kynar® 500/Hylar® 5,000* coating.
- B. Accessories:
1. Flashing and Trim: Flashing and trim shall be of the same material, gauge, finish, and color as the soffit panels and fabricated in accordance with standard SMACNA procedures and details.
 2. Fasteners: Exposed screws shall be aluminum or stainless steel with a neoprene washer.

SECTION 076200 - SHEET METAL FLASHING AND TRIM: continued

3. Screws for attaching panels to supports shall be aluminum or stainless steel sufficient length to penetrate the supporting member by 1 inch.

2.09 METAL FACED IN-FILL PANELS:

- A. Materials and Finishes:
 1. Panel Materials: Laminated components consisting of an exterior metal skin, high-density corrugated polyethylene substrate, insulation core with an interior metal skin 0.032 inch,
 2. Texture: Smooth.
 3. Thickness: 1 inch unless otherwise shown on Drawings.
 4. Supply ventilating soffit panels having perforations: 1/16 inch diameter holes on 5/32 inch staggered centers in a uniform 5 inch wide pattern along entire panel length.
 5. Exterior Finish: Class II Clear Anodized.
 6. Interior Finish: Galvanized Steel.
 7. Basis of Design: Mapes, Inc., Corelite panels.
 - a. Or approved equals.
- B. Accessories:
 1. Flashing and Trim: Flashing and trim shall be of the same material, gauge, finish, and color as the in-fill panels.
 2. Fasteners: Stainless steel.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
 1. Verify compliance with requirements for installation tolerances of substrates.
 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 UNDERLAYMENT INSTALLATION:

- A. General: Install underlayment as indicated on Drawings.
- B. Felt Underlayment: Install felt underlayment with adhesive for temporary anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

3.03 INSTALLATION, GENERAL:

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

SECTION 076200 - SHEET METAL FLASHING AND TRIM: continued

3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
 4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
 5. Install sealant tape where indicated.
 6. Torch cutting of sheet metal flashing and trim is not permitted.
 7. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
1. Coat back side with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
- D. Fastener Sizes: Use fasteners of sizes that will penetrate metal decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Seal joints as shown and as required for watertight construction.
1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70°F, set joint members for 50% movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40°F.
 2. Prepare joints and apply sealants to comply with requirements in DIVISION 07, Section "Joint Sealants."
- F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Pre-tinning is not required for zinc-tin alloy-coated copper.
 2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
 3. Stainless-Steel Soldering: Tin edges of uncoated sheets using solder recommended for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
- G. Rivets: Rivet joints in zinc where indicated and where necessary for strength.
- 3.04 ROOF DRAINAGE SYSTEM INSTALLATION:
- A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.
- B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly

SECTION 076200 - SHEET METAL FLASHING AND TRIM: continued

anchored gutter brackets spaced not more than 36 inches apart. Provide end closures and seal watertight with sealant. Slope to downspouts.

1. Fasten gutter spacers to front and back of gutter.
 2. Loosely lock straps to front gutter bead and anchor to roof deck.
 3. Anchor and loosely lock back edge of gutter to continuous cleat, eave or apron flashing.
 4. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches apart.
 5. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.
- C. Downspouts: Join sections with 1-1/2-inch telescoping joints.
1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c. in between.
 2. Provide elbows at base of downspout to direct water away from building.

3.05 ROOF FLASHING INSTALLATION:

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
- C. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at 24-inch centers.
- D. Copings: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated.
1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch centers.
 2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.
- E. Copings: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.
1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch centers.
 2. Anchor interior leg of coping with screw fasteners and washers at 24-inch centers.
- F. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.
- G. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with sealant. Secure in a waterproof manner by means of snap-in installation and sealant or lead wedges and sealant.
- H. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

SECTION 076200 - SHEET METAL FLASHING AND TRIM: continued

3.06 WALL FLASHING INSTALLATION:

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

3.07 MISCELLANEOUS FLASHING INSTALLATION:

- A. Overhead-Piping Safety Pans: Suspend pans independent from structure above as indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.
- B. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.08 ERECTION TOLERANCES:

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.09 CLEANING AND PROTECTION:

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturers written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.
- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Silicone joint sealants.
 - 2. Urethane joint sealants.
- B. Related Sections:
 - 1. DIVISION 01, Section "Sustainable Design Requirements" for LEED[®] related requirements for low-emitting sealants and sealant primer products.
 - 2. DIVISION 04, Section "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
 - 3. DIVISION 08, Section "Glazing" for glazing sealants.
 - 4. DIVISION 09, Section "Gypsum Board" for sealing perimeter joints.
 - 5. DIVISION 09, Section "Tiling" for sealing tile joints.
 - 6. DIVISION 09, Section "Acoustical Tile Ceilings" for sealing edge moldings at perimeters with acoustical sealant.

1.03 REFERENCES:

- A. ASTM International:
 - 1. ASTM C920-05 - Specification for Elastomeric Joint Sealants.
 - 2. ASTM C1021-01 - Practice for Laboratories Engaged in Testing of Building Sealants.
 - 3. ASTM C1087-00 - Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
 - 4. ASTM C1193-05a - Guide for Use of Joint Sealants.
 - 5. ASTM C1247-98 (Reapproved 2004) - Test Method for Durability of Sealants Exposed to Continuous Immersion in Liquids.
 - 6. ASTM C1248-06 - Test Method for Staining of Porous Substrate by Joint Sealants.
 - 7. ASTM C1311-02 - Specification for Solvent Release Sealants.
 - 8. ASTM C1330-02 - Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
 - 9. ASTM C1521-02a - Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.
 - 10. ASTM E90-04 - Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- B. Code of Federal Regulations:
 - 1. 21 CFR 177.2600-2005 - Rubber Articles Intended for Repeated Use.
 - 2. 40 CFR, Part 59, Subpart D-2003 - National Volatile Organic Compound Emission Standards for Architectural Coatings.

1.04 PRECONSTRUCTION TESTING:

- A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
 - 1. Locate test joints where indicated on Project or, if not indicated, as directed by Contracting Officer.

SECTION 079200 - JOINT SEALANTS: continued

2. Conduct field tests for each application indicated below:
 - a. Each kind of sealant and joint substrate indicated.
3. Notify Contracting Officer seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
 - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
 - (1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.05 SUBMITTALS:

- A. Product Data: For each joint-sealant product indicated.
- B. LEED Submittals:
 1. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, documentation including printed statement of VOC content.
- C. Samples: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- D. Joint-Sealant Schedule: Include the following information:
 1. Joint-sealant application, joint location, and designation.
 2. Joint-sealant manufacturer and product name.
 3. Joint-sealant formulation.
 4. Joint-sealant color.

1.06 INFORMATIONAL SUBMITTALS:

- A. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- B. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- D. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- E. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- F. Field-Adhesion Test Reports: For each sealant application tested.

SECTION 079200 - JOINT SEALANTS: continued

G. Warranties: Sample of special warranties.

1.07 QUALITY ASSURANCE:

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.
 - 2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.

1.08 PROJECT CONDITIONS:

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

1.09 WARRANTY:

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL:

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Architectural Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Liquid-Applied Joint Sealants: Comply with ASTM C920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 - 1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

SECTION 079200 - JOINT SEALANTS: continued

- D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C1248 and have not stained porous joint substrates indicated for Project.
- E. Colors of Exposed Joint Sealants: As selected by Contracting Officer from manufacturer's full range.

2.02 SILICONE JOINT SEALANTS:

- A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C920, Type S, Grade NS, Class 100/50, for Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Dow Corning Corporation; 790.
 - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
 - c. May National Associates, Inc.; Bondaflex Sil 290.
 - d. Pecora Corporation; 301 NS.
 - e. Sika Corporation, Construction Products Division; SikaSil-C990.
 - f. Tremco Incorporated; Spectrem 1.
- B. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C920, Type S, Grade NS, Class 50, for Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. BASF Building Systems; Omniseal 50.
 - b. Dow Corning Corporation; 756 SMS.
 - c. GE Advanced Materials - Silicones; SilGlaze II SCS2800.
 - d. May National Associates, Inc.; Bondaflex Sil 295.
 - e. Pecora Corporation; 864.
 - f. Polymeric Systems, Inc.; PSI-641.
 - g. Sika Corporation, Construction Products Division; SikaSil-C995.
 - h. Tremco Incorporated; Spectrem 2.
- C. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C920, Type S, Grade NS, Class 25, for Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Dow Corning Corporation; 799.
 - b. GE Advanced Materials - Silicones; UltraGlaze SSG4000.
 - c. May National Associates, Inc.; Bondaflex Sil 200 GPN.
 - d. Polymeric Systems, Inc.; PSI-631.
 - e. Schnee-Morehead, Inc.; SM5731 Poly-Glaze Plus.
 - f. Tremco Incorporated; Proglaze SSG.
- D. Single-Component, Nonsag, Acid-Curing Silicone Joint Sealant: ASTM C920, Type S, Grade NS, Class 25, for Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Bostik, Inc.; Chem-Calk 1200.
 - b. Dow Corning Corporation; 999-A.
 - c. GE Advanced Materials - Silicones; Contractors SCS1000.
 - d. May National Associates, Inc.; Sil 100 GC.
 - e. Pecora Corporation; 860.
 - f. Polymeric Systems, Inc.; PSI-601.

SECTION 079200 - JOINT SEALANTS: continued

- g. Schnee-Morehead, Inc.; SM5732 Polyglaze.
 - h. Tremco Incorporated; Proglaze.
- E. Single-Component, Nonsag, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C920, Type S, Grade NS, Class 100/50, for Use T.
 - 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Dow Corning Corporation; 790.
 - b. May National Associates, Inc.; Bondaflex Sil 728 NS.
 - c. Pecora Corporation; 301 NS.
 - d. Tremco Incorporated; Spectrem 800.
- F. Single-Component, Pourable, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C920, Type S, Grade P, Class 100/50, for Use T.
 - 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Dow Corning Corporation; 890-SL.
 - b. May National Associates, Inc.; Bondaflex Sil 728 SG.
 - c. Pecora Corporation; 300 SL.
 - d. Tremco Incorporated; Spectrem 900 SL.
- G. Multicomponent, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C920, Type M, Grade NS, Class 50, for Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Tremco Incorporated; Spectrem 4TS.
- H. Multicomponent, Pourable, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C920, Type M, Grade P, Class 100/50, for Use T.
 - 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Dow Corning Corporation; FC Parking Structure Sealant.
 - b. May National Associates, Inc.; Bondaflex Sil 728 RCS.
- I. Mildew-Resistant, Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C920, Type S, Grade NS, Class 25, for Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Pecora Corporation; 898.
- J. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C920, Type S, Grade NS, Class 25, for Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. BASF Building Systems; Omniplus.
 - b. Dow Corning Corporation; 786 Mildew Resistant.
 - c. GE Advanced Materials - Silicones; Sanitary SCS1700.
 - d. May National Associates, Inc.; Bondaflex Sil 100 WF.
 - e. Tremco Incorporated; Tremsil 200 Sanitary.

2.03 URETHANE JOINT SEALANTS:

- A. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C920, Type S, Grade NS, Class 100/50, for Use NT.

SECTION 079200 - JOINT SEALANTS: continued

1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Sika Corporation, Construction Products Division; Sikaflex - 15LM.
 - b. Tremco Incorporated; Vulkem 921.
- B. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C920, Type S, Grade NS, Class 50, for Use NT.
 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Pacific Polymers International, Inc.; Elasto-Thane 230 LM Type II.
 - b. Polymeric Systems, Inc.; PSI-901.
- C. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C920, Type S, Grade NS, Class 25, for Use NT.
 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. BASF Building Systems; Sonolastic NP1.
 - b. Bostik, Inc.; Chem-Calk 900.
 - c. May National Associates, Inc.; Bondaflex PUR 25.
 - d. Pacific Polymers International, Inc.; Elasto-Thane 230 Type II.
 - e. Pecora Corporation; Dynatrol I-XL.
 - f. Polymeric Systems, Inc.; Flexiprene 1000.
 - g. Schnee-Morehead, Inc.; Permathane SM7100.
 - h. Sika Corporation, Construction Products Division; Sikaflex - 1a.
 - i. Tremco Incorporated; Dymonic.

2.04 LATEX JOINT SEALANTS:

- A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. BASF Building Systems; Sonolac.
 - b. Bostik, Inc.; Chem-Calk 600.
 - c. May National Associates, Inc.; Bondaflex 600.
 - d. Pecora Corporation; AC-20+.
 - e. Schnee-Morehead, Inc.; SM 8200.
 - f. Tremco Incorporated; Tremflex 834.

2.05 SOLVENT-RELEASE-CURING JOINT SEALANTS:

- A. Acrylic-Based Joint Sealant: ASTM C1311.
 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Schnee-Morehead, Inc.; Acryl-R Acrylic Sealant.
 - b. Tremco Incorporated; Mono 555.
- B. Butyl-Rubber-Based Joint Sealant: ASTM C1311.
 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Bostik, Inc.; Chem-Calk 300.
 - b. Pecora Corporation; BC-158.
 - c. Tremco Incorporated; Tremco Butyl Sealant.

SECTION 079200 - JOINT SEALANTS: continued

2.06 PREFORMED JOINT SEALANTS:

- A. Preformed Silicone Joint Sealants: Manufacturer's standard sealant consisting of precured low-modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral-curing silicone sealant for bonding extrusions to substrates.
 - 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Dow Corning Corporation; 123 Silicone Seal.
 - b. GE Advanced Materials - Silicones; UltraSpan US1100.
 - c. May National Associates, Inc.; Bondaflex Silbridge 300.
 - d. Pecora Corporation; Sil-Span.
 - e. Sealex, Inc.; ImmerSeal.
- B. Preformed Foam Joint Sealant: Manufacturer's standard preformed, precompressed, open-cell foam sealant manufactured from urethane foam with minimum density of 10 lb./cu. ft. and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit joint widths indicated; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.
 - 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Dayton Superior Specialty Chemicals; Polytite Standard.
 - b. EMSEAL Joint Systems, Ltd.; Emseal 25V.
 - c. Sandell Manufacturing Co., Inc.; Polyseal.
 - d. Schul International, Inc.; Sealtite.
 - e. Willseal USA, LLC; Willseal 150.

2.07 JOINT SEALANT BACKING:

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.08 MISCELLANEOUS MATERIALS:

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

SECTION 079200 - JOINT SEALANTS: continued

PART 3 - EXECUTION

3.01 EXAMINATION:

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

3.02 PREPARATION:

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, 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 after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - d. Exterior insulation and finish systems.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by 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 or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS:

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

SECTION 079200 - JOINT SEALANTS: continued

1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile per Figure 8A in ASTM C1193, unless otherwise indicated.
 4. Provide flush joint profile where indicated per Figure 8B in ASTM C1193.
 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
- G. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:
1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
 2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch. Hold edge of sealant bead 1/4 inch inside masking tape.
 3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
 4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.
- H. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.

3.04 FIELD QUALITY CONTROL:

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 10 tests for the first 1,000 feet of joint length for each kind of sealant and joint substrate.
 - b. Perform 1 test for each 1,000 feet of joint length thereafter or 1 test per each floor per elevation.

SECTION 079200 - JOINT SEALANTS: continued

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.
- 3.05 CLEANING:
- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.
- 3.06 PROTECTION:
- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.
- 3.07 JOINT-SEALANT SCHEDULE:
- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
 1. Joint Locations:
 - a. Control and expansion joints in brick pavers.
 - b. Isolation and contraction joints in cast-in-place concrete slabs.
 - c. Tile control and expansion joints.
 - d. Joints between different materials listed above.
 2. Urethane Joint Sealant: Single component, nonsag, traffic grade.

SECTION 079200 - JOINT SEALANTS: continued

- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Control and expansion joints in unit masonry.
 - c. Joints in dimension stone cladding.
 - d. Joints in glass unit masonry assemblies.
 - e. Joints between different materials listed above.
 - f. Perimeter joints between materials listed above and frames of doors, windows and louvers.
 - 2. Silicone Joint Sealant: Single component, nonsag, neutral curing, Class 100/50.
 - a. Other joints as indicated.
- C. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Sealant Location:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - 2. Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, Silicone.
 - 3. Joint-Sealant Color: As selected by Contracting Officer from manufacturer's full range of colors.

END OF SECTION 079200

DIVISION 08 - DOORS AND WINDOWS

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Standard hollow metal doors and frames.
- B. Related Sections:
 - 1. DIVISION 01 Section "Sustainable Design Requirements" for LEED® related requirements for recycled content materials and local/regionally manufactured and sourced materials.
 - 2. DIVISION 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
 - 3. DIVISION 08 Section "Door Hardware" for door hardware for hollow metal doors.
 - 4. DIVISION 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

1.03 REFERENCES:

- A. ASTM International:
 - 1. ASTM A153 -09 - Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 2. ASTM A653 -09 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 3. ASTM A879 - Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.
 - 4. ASTM A1008 -09 - Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 - 5. ASTM A1011 -09a - Specification for Steel, Sheet and Strip, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
 - 6. ASTM C143 -08 - Test Method for Slump of Hydraulic Cement Concrete.
 - 7. ASTM C476-09 - Specification for Grout for Masonry.
 - 8. ASTM C665-06 - Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - 9. ASTM C1363-05 - Test Method for the Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus.
 - 10. ASTM E136-09 - Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C.
- B. Builders Hardware Manufacturers Association:
 - 1. BHMA A156.115 (2006) - Hardware Preparation in Steel Doors and Steel Frames (ANSI).
- C. Hollow Metal Manufacturers Association; Division of National Association of Architectural Metal Manufacturers:
 - 1. NAAMM-HMMA 803 (2008) - Hollow Metal Manual - Steel Tables.
 - 2. NAAMM-HMMA 840 (2007) - Installation and Storage of Hollow Metal Doors and Frames.

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES: continued

3. NAAMM-HMMA 860 (1992) - Guide Specifications for Hollow Metal Doors and Frames (ANSI).
 - D. NFPA:
 1. NFPA 80 (2007) - Fire Doors and Other Opening Protectives (ANSI).
 2. NFPA 252 (2008) - Fire Tests of Door Assemblies (ANSI).
 - E. Steel Door Institute:
 1. SDI 111C (2009) - Recommended Louver Details for Standard Steel Doors.
 2. SDI A250.3 (2007) - Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames (ANSI).
 3. SDI A250.4 (2001) - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcings (ANSI).
 4. SDI A250.6 (2003) - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames (ANSI).
 5. SDI A250.8 (2003) (Reapproved 2008) - Recommended Specifications for Standard Steel Doors and Frames (ANSI).
 6. SDI A250.10 (2004) - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames (ANSI).
 7. SDI A250.11 (2001) - Recommended Erection Instructions for Steel Frames (ANSI).
 - F. Underwriters Laboratories Inc.:
 1. UL 9 (2009) - Fire Tests of Window Assemblies.
 2. UL 10C (2009) - Positive Pressure Fire Tests of Door Assemblies.
 3. UL 1784 (2004) - Air Leakage Tests for Door Assemblies.
- 1.04 DEFINITIONS:
- A. Minimum Thickness: Minimum thickness of base metal without coatings.
 - B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.
- 1.05 SUBMITTALS:
- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, and finishes.
 - B. Shop Drawings: Include the following:
 1. Elevations of each door design.
 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 4. Locations of reinforcement and preparations for hardware.
 5. Details of each different wall opening condition.
 6. Details of anchorages, joints, field splices, and connections.
 7. Details of accessories.
 8. Details of moldings, removable stops, and glazing.
 9. Details of conduit and preparations for power, signal, and control systems.
 - C. Samples for Initial Selection: For units with factory-applied color finishes.
 - D. Samples for Verification:
 1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.
 2. For the following items, prepared on Samples about 12 by 12 inches to demonstrate compliance with requirements for quality of materials and construction:
 - a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES: continued

- b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow metal panels and glazing if applicable.
- E. Other Submittals:
 - 1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.
- F. LEED Submittals:
 - 1. Product Data for Credit MRc4: For products containing recycled content, submit documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content for each product or portion of a product having recycled content. Include statement indicating cost for each product containing recycled content material.
 - 2. Product Data for Credit MRc5: For products and materials complying with requirements for regional materials, submit documentation indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
- 1.06 INFORMATIONAL SUBMITTALS:
 - A. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.
 - B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.
- 1.07 QUALITY ASSURANCE:
 - A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.
 - B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252.
 - 1. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450°F above ambient after 30 minutes of standard fire-test exposure.
- 1.08 DELIVERY, STORAGE, AND HANDLING:
 - A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Provide additional protection to prevent damage to finish of factory-finished units.
 - B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
 - C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.
 - 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.
- 1.09 PROJECT CONDITIONS:
 - A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.
- 1.10 COORDINATION:
 - A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES: continued

bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - 1. Amweld Building Products, LLC.
 - 2. Benchmark; a division of Therma-Tru Corporation.
 - 3. Ceco Door Products; an Assa Abloy Group company.
 - 4. Curries Company; an Assa Abloy Group company.
 - 5. Deansteel Manufacturing Company, Inc.
 - 6. Firedoor Corporation.
 - 7. Fleming Door Products Ltd.; an Assa Abloy Group company.
 - 8. Habersham Metal Products Company.
 - 9. Karpen Steel Custom Doors & Frames.
 - 10. Kewanee Corporation (The).
 - 11. Mesker Door Inc.
 - 12. Pioneer Industries, Inc.
 - 13. Security Metal Products Corp.
 - 14. Steelcraft; an Ingersoll-Rand company.
 - 15. Windsor Republic Doors.

2.02 MATERIALS:

- A. Cold-Rolled Steel Sheet: ASTM A1008, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Frame Anchors: ASTM A591, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008 or ASTM A1011, hot-dip galvanized according to ASTM A153, Class B.
- C. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153.
- D. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.
- E. Grout: ASTM C476, except with a maximum slump of 4 inches, as measured according to ASTM C143.
- F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- G. Glazing: Comply with requirements in DIVISION 08 Section "Glazing."
- H. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.03 STANDARD HOLLOW METAL DOORS:

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES: continued

1. Design: Flush panel.
 2. Core Construction: Manufacturer's standard Kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
 - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
 - b. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 4.0°F by h by sq. ft./Btu when tested according to ASTM C1363.
 - (1) Locations: Exterior doors.
 3. Vertical Edges for Single-Acting Doors: Beveled edge.
 - a. Beveled Edge: 1/8 inch in 2 inches.
 4. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch radius.
 5. Top and Bottom Edges: Closed with flush or inverted 0.042 inch thick, end closures or channels of same material as face sheets.
 6. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless).
- C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless).
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.04 STANDARD HOLLOW METAL FRAMES:

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from metallic-coated steel sheet.
1. Fabricate frames with mitered or coped corners.
 2. Fabricate frames as full profile welded unless otherwise indicated.
 3. Frames for Level 3 Steel Doors: 0.053-inch thick steel sheet.
- C. Interior Frames: Fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated.
1. Fabricate frames with mitered or coped corners.
 2. Fabricate frames as full profile welded unless otherwise indicated.
 3. Frames for Level 3 Steel Doors: 0.053-inch thick steel sheet.
 4. Frames for Wood Doors: 0.067-inch thick steel sheet.
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.05 FRAME ANCHORS:

- A. Jamb Anchors:
1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES: continued

2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
 - B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
- 2.06 STOPS AND MOLDINGS:
- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.
 - B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.
 - C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.
- 2.07 ACCESSORIES:
- A. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.
- 2.08 FABRICATION:
- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
 - B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
 - C. Hollow Metal Doors:
 1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 2. Glazed Lites: Factory cut openings in doors.
 3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
 - D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - (1) Two anchors per jamb up to 60 inches high.
 - (2) Three anchors per jamb from 60 to 90 inches high.
 - (3) Four anchors per jamb from 90 to 120 inches high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - (1) Three anchors per jamb up to 60 inches high.

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES: continued

- (2) Four anchors per jamb from 60 to 90 inches high.
- (3) Five anchors per jamb from 90 to 96 inches high.
- (4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
- c. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
6. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in DIVISION 08 Section "Door Hardware."
 1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series Specifications for preparation of hollow metal work for hardware.
 4. Coordinate locations of conduit and wiring boxes for electrical connections with DIVISION 26 Sections.
- G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
 2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 3. Provide loose stops and moldings on inside of hollow metal work.
 4. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.09 STEEL FINISHES:

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES: continued

- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION:

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
 - 1. Squareness: $\pm 1/16$ inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: $\pm 1/16$ inch, measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: $\pm 1/16$ inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4. Plumbness: $\pm 1/16$ inch, measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.03 INSTALLATION:

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
 - 1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable glazing stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
 - 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 - 5. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: $\pm 1/16$ inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES: continued

- b. Alignment: $\pm 1/16$ inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: $\pm 1/16$ inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: $\pm 1/16$ inch, measured at jambs at floor.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
- 1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: $1/8$ inch $\pm 1/16$ inch.
 - b. Between Edges of Pairs of Doors: $1/8$ inch $\pm 1/16$ inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum $3/8$ inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum $3/4$ inch.
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- D. Glazing: Comply with installation requirements in DIVISION 08 Section "Glazing" and with hollow metal manufacturer's written instructions.
- 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.04 ADJUSTING AND CLEANING:

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this Section.
- B. DIVISION 01 Section "Sustainable Design Requirements" for LEED® related requirements for recycled content materials, certified wood and local regionally manufactured and sourced materials.

1.02 SUMMARY:

- A. Section Includes:
 - 1. Solid-core doors with wood-veneer faces.
 - 2. Factory finishing flush wood doors.
- B. Related Sections:

1.03 REFERENCES:

- A. American Hardboard Association (This association no longer exists, but its publications are available from the Composite Panel Association. The publication below is available in PDF at www.pbmdf.com):
- B. Architectural Woodwork Institute:
 - 1. Architectural Woodwork Quality Standards Illustrated. 8th ed. Version 1.0, 2003.
- C. Door and Hardware Institute:
 - 1. DHI A115-W (Various Dates) - Wood Door Hardware Standards, Hardware Preparation.
 - 2. DHI-WDHS-3 (1996) - Recommended Locations for Architectural Hardware for Wood Flush Doors.
- D. Forest Stewardship Council:
 - 1. FSC STD-01-001 (2004) - FSC Principles and Criteria for Forest Stewardship (available in PDF at www.fsc.org).
- E. International Conference of Building Officials:
 - 1. UBC Standard 7-2 (1997) - Fire Tests of Door Assemblies.
- F. NFPA:
 - 1. NFPA 80-99 - Fire Doors and Fire Windows.
 - 2. NFPA 252-03 - Fire Tests of Door Assemblies.
- G. Underwriters Laboratories Inc.:
 - 1. UL 10B (2001) - Fire Tests of Door Assemblies.
 - 2. UL 10C (2001) - Positive Pressure Fire Tests of Door Assemblies.
- H. Window & Door Manufacturers Association (Formerly - National Wood Window and Door Association):
 - 1. WDMA I.S.1-A-04 - Architectural Wood Flush Doors.
 - 2. WDMA I.S.10-99 - Specification for Testing Cellulosic Materials for Use in Fenestration Products.
 - 3. WDMA TM-6-88 - Test Method for Determining the Performance of Adhesive Bonds in Doors Under Accelerated Aging Conditions.
- I. Woodwork Institute:
 - 1. Manual of Millwork, 2003.

1.04 SUBMITTALS:

- A. Product Data: For each type of door indicated. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.

SECTION 081416 - FLUSH WOOD DOORS: continued

- B. LEED Submittals:
 - 1. Certificates for Credit MR 7: Chain-of-custody certificates indicating that flush wood doors comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
 - 2. Product Data for Credit IEQ 4.4: For laminating adhesives and composite wood products, documentation indicating that product contains no added urea formaldehyde.
- C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
 - 1. Indicate dimensions and locations of mortises and holes for hardware.
 - 2. Indicate dimensions and locations of cutouts.
 - 3. Indicate requirements for veneer matching.
 - 4. Indicate doors to be factory finished and finish requirements.
 - 5. Indicate fire-protection ratings for fire-rated doors.
- D. Samples:
 - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.

1.05 INFORMATIONAL SUBMITTALS:

- A. Warranty: Sample of special warranty.

1.06 QUALITY ASSURANCE:

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Source Limitations: Obtain flush wood doors from single manufacturer.
- C. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated."
 - 1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.
- D. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252.

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.08 PROJECT CONDITIONS:

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and

SECTION 081416 - FLUSH WOOD DOORS: continued

maintaining temperature between 60 and 90°F and relative humidity between 25 and 55% during the remainder of the construction period.

1.09 WARRANTY:

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42- by 84-inch section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
 - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - 1. Algoma Hardwoods, Inc.
 - 2. Ampco, Inc.
 - 3. Buell Door Company Inc.
 - 4. Chappell Door Co.
 - 5. Eagle Plywood & Door Manufacturing, Inc.
 - 6. Eggers Industries.
 - 7. Graham; an Assa Abloy Group company.
 - 8. Haley Brothers, Inc.
 - 9. Ideal Architectural Doors & Plywood.
 - 10. Ipik Door Company.
 - 11. Lambton Doors.
 - 12. Marlite.
 - 13. Marshfield Door Systems, Inc.
 - 14. Mohawk Flush Doors, Inc.; a Masonite company.
 - 15. Oshkosh Architectural Door Company.
 - 16. Poncraft Door Company.
 - 17. Vancouver Door Company.
 - 18. VT Industries Inc.

2.02 DOOR CONSTRUCTION, GENERAL:

- A. Certified Wood: Fabricate doors with cores not less than 70% of wood products produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certified wood door component products shall include door core material, plywood, veneer, blocking and lumber materials.
- B. Low-Emitting Materials: Fabricate doors with laminating adhesives and composite wood products that do not contain added urea formaldehyde.
- C. WDMA I.S.1-A Performance Grade: Heavy Duty.
- D. WDMA I.S.1-A Performance Grade:
 - 1. Heavy Duty unless otherwise indicated.

SECTION 081416 - FLUSH WOOD DOORS: continued

- E. Particleboard-Core Doors:
 - 1. Particleboard: ANSI A208.1, Grade LD-2, made with binder containing no added urea-formaldehyde resin.
 - 2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
- F. Structural-Composite-Lumber-Core Doors:
 - 1. Structural Composite Lumber: WDMA I.S.10.
 - a. Screw Withdrawal, Face: 700 lbf.
 - b. Screw Withdrawal, Edge: 400 lbf.
- G. Fire-Protection-Rated Doors: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
 - 1. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
 - a. Finish steel edges and astragals to match door hardware (locksets or exit devices).
- H. Mineral-Core Doors:
 - 1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
 - 2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
 - 3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

2.03 VENEERED-FACED DOORS FOR TRANSPARENT FINISH:

- A. Interior Solid-Core Doors:
 - 1. Grade: Premium, with Grade AA faces.
 - 2. Species: Select white maple.
 - 3. Cut: Rotary cut.
 - 4. Match between Veneer Leaves: Book match.
 - 5. Assembly of Veneer Leaves on Door Faces: Center-balance match.
 - 6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
 - 7. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 10 feet or more.
 - 8. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
 - 9. Exposed Vertical and Top Edges: Same species as faces or a compatible species.
 - 10. Core: Particleboard.
 - 11. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering. Faces are bonded to core using a hot press.
 - 12. Construction: Seven plies, either bonded or nonbonded construction.
 - 13. WDMA I.S.1-A Performance Grade: Heavy Duty.

2.04 LIGHT FRAMES:

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads as follows unless otherwise indicated.
 - 1. Wood Species: Same species as door faces.
 - 2. Profile: Recessed tapered beads.

SECTION 081416 - FLUSH WOOD DOORS: continued

3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.
- 2.05 FABRICATION:
- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 1. Comply with requirements in NFPA 80 for fire-rated doors.
 - B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 - C. Openings: Cut and trim openings through doors in factory.
 1. Light Openings: Trim openings with moldings of material and profile indicated.
 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in DIVISION 08 Section "Glazing."
- 2.06 FACTORY FINISHING:
- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
 - B. Finish doors at factory.
 - C. Transparent Finish:
 1. Grade: Premium.
 2. Finish: AWI catalyzed polyurethane system.
 3. Staining: As selected by Contracting Officer from manufacturer's full range.
 4. Effect: Open-grain finish.
 5. Sheen: Satin.

PART 3 - EXECUTION

- 3.01 EXAMINATION:
- A. Examine doors and installed door frames before hanging doors.
 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 2. Reject doors with defects.
 - B. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.02 INSTALLATION:
- A. Hardware: For installation, see DIVISION 08 Section "Door Hardware."
 - B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

SECTION 081416 - FLUSH WOOD DOORS: continued

- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - 1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
 - a. Comply with NFPA 80 for fire-rated doors.
 - 2. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
 - 3. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.03 ADJUSTING:

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this Section.
- B. DIVISION 01, Section "Sustainable Design Requirements" for LEED® related requirements for recycled content materials and local/regionally manufactured and sourced materials.

1.02 SUMMARY:

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

1.03 REFERENCES:

- A. American Architectural Manufacturers Association:
 - 1. AAMA 611(1998) - Voluntary Specification for Anodized Architectural Aluminum.
- B. American Association of State Highway and Transportation Officials:
 - 1. AASHTO H20 (2002) - Contained in Standard Specifications for Highway Bridges, 17th Edition.
- C. American National Standards Institute:
 - 1. ANSI H35.2 (2006) - Dimensional Tolerances for Aluminum Mill Products.
 - 2. ANSI H35.2M (2006) - Dimensional Tolerances for Aluminum Mill Products.
- D. ASTM International:
 - 1. ASTM A36-08 - Specification for Carbon Structural Steel.
 - 2. ASTM A153-08 - Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 3. ASTM A283-03 (Reapproved 2007) - Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
 - 4. ASTM A653-08 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 5. ASTM A666-03 - Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - 6. ASTM A786-05 - Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
 - 7. ASTM A793-96 (Reapproved 2001) - Specification for Rolled Floor Plate, Stainless Steel.
 - 8. ASTM A879-06 - Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.
 - 9. ASTM A1008-08a - Specifications for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 - 10. ASTM B209-07 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 11. ASTM B221-08 - Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 12. ASTM B632-08 - Specification for Aluminum-Alloy Rolled Tread Plate.
 - 13. ASTM F2329-05 - Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.
- E. National Association of Architectural Metal Manufacturers:
 - 1. Metal Finishes Manual for Architectural and Metal Products, 1988.

SECTION 083113 - ACCESS DOORS AND FRAMES: continued

- F. Underwriters Laboratories Inc.:
 - 1. UL 10B (2008) - Fire Tests of Door Assemblies.

- 1.04 ALLOWANCES:
 - A. Access doors and frames are part of an access door and frame allowance.

- 1.05 SUBMITTALS:
 - A. Product Data: For each type of product.
 - 1. Include construction details, fire ratings, materials, individual components and profiles, and finishes.
 - B. Shop Drawings:
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Detail fabrication and installation of access doors and frames for each type of substrate.
 - C. Samples: For each door face material, at least 3 by 5 inches in size, in specified finish.
 - D. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.
 - E. LEED Submittals:
 - 1. Product Data for Credit MRc4: For products containing recycled content, submit documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content for each product or portion of a product having recycled content. Include statement indicating cost for each product containing recycled content material.
 - 2. Product Data for Credit MRc5: For products and materials complying with requirements for regional materials, submit documentation indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

PART 2 - PRODUCTS

- 2.01 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS:
 - A. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equal:
 - 1. Access Panel Solutions.
 - 2. Acudor Products, Inc.
 - 3. Alfab, Inc.
 - 4. Babcock-Davis.
 - 5. Cendrex Inc.
 - 6. Elmdor/Stoneman Manufacturing Co.; Div. of Acorn Engineering Co.
 - 7. Jensen Industries; Div. of Broan-Nutone, LLC.
 - 8. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
 - 9. Karp Associates, Inc.
 - 10. Larsen's Manufacturing Company.
 - 11. Maxam Metal Products Limited.
 - 12. Metropolitan Door Industries Corp.
 - 13. MIFAB, Inc.
 - 14. Milcor Inc.
 - 15. Nystrom, Inc.
 - 16. Williams Bros. Corporation of America (The).

SECTION 083113 - ACCESS DOORS AND FRAMES: continued

- B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.
- C. Flush Access Doors with Concealed Flanges for exterior openings:
 - 1. Basis of Design:
 - a. Metropolitan Door Industries.
 - b. Model PAL, insulated aluminum door and frame.
 - c. Size: 8 inches by 8 inches.
 - d. Finish: Prime painted for field finish.
 - e. Accessories: Keyed outside, keyed inside.
- D. Flush access doors with concealed flanges for interior openings:
 - 1. Basis of design:
 - a. Milcor, M Access Door.
 - b. Size: 16 inches by 36 inches (custom size).
 - c. Finish: Prime painted for field finish.
 - d. Accessories: Keyed outside.

2.02 FABRICATION:

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 - 1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
 - 2. Provide mounting holes in frames for attachment of units to metal or wood framing.
 - 3. Provide mounting holes in frame for attachment of masonry anchors.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 - 1. Cylinder locks, furnish two keys per lock and key all locks alike.

2.03 FINISHES:

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Steel and Metallic-Coated-Steel Finishes:
 - 1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

SECTION 083113 - ACCESS DOORS AND FRAMES: continued

PART 3 - EXECUTION

3.01 EXAMINATION:

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

3.02 INSTALLATION:

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.03 ADJUSTING:

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

END OF SECTION 083113

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. This Section Includes:
 - 1. Exterior and interior storefront framing.
 - 2. Exterior and interior manual-swing entrance doors and door-frame units.
- B. Related Sections:
 - 1. DIVISION 01, Section "Sustainable Design Requirements" for LEED[®] related requirements for recycled content materials and local/regionally manufactured and sourced materials.
 - 2. DIVISION 08, Section "Automatic Entrances" for automatic entrances.

1.03 REFERENCES:

- A. American Architectural Manufacturers Association:
 - 1. AAMA 501.1 (2005) - Standard Test Method for Water Penetration of Windows, Curtain Walls, and Doors Using Dynamic Pressure.
 - 2. AAMA 501.2 (2003) - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems.
 - 3. AAMA 501.4 (2000) (Revised 2001) - Recommended Static Test Method for Evaluating Curtain Wall and Storefront Systems Subjected to Seismic and Wind Induced Interstory Drifts.
 - 4. AAMA 501.5 (2005) - Test Method for Thermal Cycling of Exterior Walls.
 - 5. AAMA 506 (2000) (Revised 2003) - Voluntary Specifications for Hurricane Impact and Cycle Testing of Fenestration Products.
 - 6. AAMA 611 (1998) - Voluntary Specification for Anodized Architectural Aluminum.
 - 7. AAMA 701 (2000) - Voluntary Specifications for Pile Weatherstripping.
 - 8. AAMA 1503 (1998) - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
 - 9. AAMA 2603 (2002) - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
 - 10. AAMA 2604 (2002) - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
 - 11. AAMA 2605 (2002) - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing High Performance Organic Coatings on Aluminum Extrusions and Panels.
- B. American Welding Society:
- C. AWS A5.10 (1999) - Specification for Bare Aluminum and Aluminum-Alloy Welding Electrodes and Rods.
 - 1. AWS D1.2 (2003) - Structural Welding Code - Aluminum.
- D. ASTM International:
 - 1. ASTM A36-05 - Specification for Carbon Structural Steel.
 - 2. ASTM A123-02 - Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 3. ASTM A153-04 - Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

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4. ASTM A240-05 - Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
5. ASTM A1008-04b - Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
6. ASTM A1011-04a - Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM B209-04 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
8. ASTM B221-05 - Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
9. ASTM B308-02 - Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
10. ASTM B429-02 - Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
11. ASTM C920-02 - Specification for Elastomeric Joint Sealants.
12. ASTM C1184-00a - Specification for Structural Silicone Sealants.
13. ASTM C1401-02 - Guide for Structural Sealant Glazing.
14. ASTM D2000-04 - Classification System for Rubber Products in Automotive Applications.
15. ASTM D2287-96 (2001) - Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds.
16. ASTM E90-04 - Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
17. ASTM E283-04 - Test Method for Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen.
18. ASTM E330-02 - Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
19. ASTM E331-04 - Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
20. ASTM E413-04 - Standard Classification for Rating Sound Insulation.
21. ASTM E699-03 - Practice for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating of Building Components.
22. ASTM E783-02 - Test Method for Field Measurement of Air Leakage through Installed Exterior Windows and Doors.
23. ASTM E1105-00 - Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform or Cyclic Static Air Pressure Difference.
24. ASTM E1332-90 (Reapproved 2003) - Standard Classification for Determination of Outdoor-Indoor Transmission Class.
25. ASTM E1886-05 - Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
26. ASTM E1996-05 - Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.
27. ASTM F1642-04 (Reapproved 2010) - Test Method for Glazing and Glazing Systems Subject to Airblast Loadings.
28. ASTM F2248-09 - Practice for Specifying an Equivalent 3-Second Duration Design Loading for Blast Resistant Glazing Fabricated with Laminated Glass.

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- E. Builders Hardware Manufacturers Association:
 - 1. BHMA A156.1 (2000) - Butts and Hinges (ANSI).
 - 2. BHMA A156.3 (2001) - Exit Devices (ANSI).
 - 3. BHMA A156.4 (2000) - Door Controls - Closers (ANSI).
 - 4. BHMA A156.5 (2001) - Auxiliary Locks & Associated Products (ANSI).
 - 5. BHMA A156.6 (2001) - Architectural Door Trim (ANSI).
 - 6. BHMA A156.8 (2000) - Door Controls - Overhead Stops and Holders (ANSI).
 - 7. BHMA A156.16 (2002) - Auxiliary Hardware (ANSI).
 - 8. BHMA A156.21 (2001) - Thresholds (ANSI).
 - F. International Code Council:
 - 1. ICC/ANSI A117.1 (2003) - Accessible and Usable Buildings and Facilities.
 - G. SSPC - The Society for Protective Coatings:
 - 1. SSPC-Paint 12 (1982) - Paint Specification No. 12 - Cold-Applied Asphalt Mastic (Extra Thick Film).
 - 2. SSPC-PS Guide No. 12.00 (2002) (Revised 2004) - Guide to Zinc-Rich Coating Systems.
 - 3. SSPC-SP COM (2004) - Surface Preparation Specifications - Surface Preparation Commentary for Steel and Concrete Substrates.
 - H. Underwriters Laboratories, Inc.:
 - 1. UL 305 (1997) - Panic Hardware.
 - I. U.S. Architectural & Transportation Barriers Compliance Board:
 - 1. Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities. Adopted in 2004.
 - J. Department of Defense Unified Facilities Criteria (UFC):
 - 1. 4-010-01 - DoD Minimum Antiterrorism Standards for Buildings.
 - 2. 4-010-02 - DoD Minimum Antiterrorism Standoff Distances for Buildings (FOUO).
- 1.04 DEFINITIONS:
- A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."
- 1.05 PERFORMANCE REQUIREMENTS:
- A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
 - 1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
 - 2. Dimensional tolerances of building frame and other adjacent construction.
 - 3. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferring to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
 - d. Glazing-to-glazing contact.
 - e. Noise or vibration created by wind and by thermal and structural movements.
 - f. Loosening or weakening of fasteners, attachments, and other components.
 - g. Sealant failure.
 - h. Failure of operating units.

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS: continued

- B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Structural Loads:
 - 1. Wind Loads:
 - a. Basic Wind Speed: 150 mph.
 - b. Importance Factor: 1.1.
 - c. Exposure Category: D.
 - 2. Seismic Loads: As listed on the Structural Drawings.
- D. Deflection of Framing Members:
 - 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed $L/175$ of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to $3/4$ inch, whichever is less.
 - 2. Deflection Parallel to Glazing Plane: Limited to $L/360$ of clear span or $1/8$ inch, whichever is smaller.
- E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E330 as follows:
 - 1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
 - 2. When tested at 150% of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2% of span.
 - 3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.
- F. Windborne-Debris-Impact-Resistance Performance: Provide aluminum-framed systems that pass missile-impact and cyclic-pressure tests when tested according to ASTM E1886 and testing information in ASTM E1996.
 - 1. Large-Missile Impact: For aluminum-framed systems located within 30 feet of grade.
- G. Story Drift: Provide aluminum-framed systems that accommodate design displacement of adjacent stories indicated.
 - 1. Test Performance: Meet criteria for passing, based on building occupancy type, when tested according to AAMA 501.4 at design displacement and 1.5 times design displacement.
- H. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft.
- I. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E331 at a minimum static-air-pressure difference of 20% of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.
- J. Water Penetration under Dynamic Pressure: Provide aluminum-framed systems that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20% of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.
 - 1. Maximum Water Leakage: According to AAMA 501.1. Water leakage does not include water controlled by flashing and gutters that is drained to exterior and water that cannot damage adjacent materials or finishes.
- K. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures.

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Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120°F, ambient; 180°F, material surfaces.
 2. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
 - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180°F.
 - b. Low Exterior Ambient-Air Temperature: 0°F.
 3. Interior Ambient-Air Temperature: 75°F.
- L. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.
- M. Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.57 Btu/sq. ft. by height by °F when tested according to AAMA 1503.
- N. Blast Resistance:
1. Provide aluminum-framed entrances and storefronts with framing members capable of withstanding a uniform static pressure applied to all glazing surfaces equal to the equivalent 3-second duration design loading determined in accordance with ASTM F2248 using explosive weight I as specified in UFC 4-010-02 and a standoff distance of 148 ft.
 - a. Framing members shall restrict edge deflections of glazing panes to 1/160 of the supported edge length, as determined in accordance with UFC 4-010-01, at allowable stress levels under the equivalent 3-second duration design loading.
 2. Provide aluminum-framed entrance and storefront connections to surrounding structural elements, hardware and associated connections, and glazing stop connections capable of withstanding a uniform static pressure applied to all glazing surfaces equal to two times the equivalent 3-second duration design loading determined in accordance with ASTM F2248 using explosive weight I as specified in UFC 4-010-02 and a standoff distance of 148 ft.
 - a. Design of connections shall be based upon allowable stress levels. Allowable fastener loads shall be as recommended by the manufacturer for the materials to which glazing systems are being connected.
 - b. Connections shall be capable of preventing the frame from being dislodged from the supporting structural elements, as demonstrated by calculation or testing in accordance with UFC 4-010-01.
 3. As an alternative to the requirements specified above, provide aluminum-framed entrances and storefronts that have been tested in accordance with ASTM F1642 and received a hazard rating of Very Low or better for the peak pressure and positive phase impulse that correspond to each of the following:
 - a. Explosive weight I as specified in UFC 4-010-02 at a standoff distance of 148 ft.
 - b. Explosive weight II as specified in UFC 4-010-02 at a standoff distance of 82 ft.
- 1.06 SUBMITTALS:
- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.

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- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For adhesives and sealants used inside of the weatherproofing system, documentation including printed statement of VOC content.
 - 2. Product Data for Credit MRc4: For products containing recycled content, submit documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content for each product or portion of a product having recycled content. Include statement indicating cost for each product containing recycled content material.
 - 3. Product Data for Credit MRc5: For products and materials complying with requirements for regional materials, submit documentation indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
- C. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
 - 2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
- D. Samples: For each type of exposed finish required, in manufacturer's standard sizes.
- E. Other Action Submittals:
 - 1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- F. Blast Testing or Analysis Reports: Submit one or more of the following as necessary to demonstrate compliance with all specified requirements for blast resistance.
 - 1. Static test results in accordance with ASTM E330.
 - 2. Airblast test results in accordance with ASTM F1642.
 - 3. Structural analysis data prepared by or under the supervision of a professional engineer experienced in the design of blast-resistant glazing systems.

1.07 INFORMATIONAL SUBMITTALS:

- A. Qualification Data: For qualified Installer.
- B. Seismic Qualification Certificates: For aluminum-framed systems, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
- C. Welding certificates.
- D. Preconstruction Test Reports: For sealant.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.
- F. Source quality-control reports.
- G. Quality-Control Program for Structural-Sealant-Glazed System: Include reports.
- H. Field quality-control reports.
- I. Warranties: Sample of special warranties.

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1.08 CLOSEOUT SUBMITTALS:

- A. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

1.09 QUALITY ASSURANCE:

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated.
- C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.
- D. Quality-Control Program for Structural-Sealant-Glazed System: Develop quality control program specifically for Project. Document quality-control procedures and verify results for aluminum-framed systems. Comply with ASTM C1401 recommendations including, but not limited to, system material-qualification procedures, preconstruction sealant-testing program, procedures for system fabrication and installation, and intervals of reviews and checks.
- E. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
 - 1. Do not revise intended aesthetic effects, as judged solely by Contracting Officer, except with Contracting Officer's approval. If revisions are proposed, submit comprehensive explanatory data to Contracting Officer for review.
- F. Preconstruction Sealant Testing: For structural-sealant-glazed systems, perform sealant manufacturer's standard tests for compatibility with and adhesion of each material that will come in contact with sealants and each condition required by aluminum-framed systems.
 - 1. Test a minimum five samples each of metal, glazing, and other material.
 - 2. Prepare samples using techniques and primers required for installed systems.
 - 3. For materials that fail tests, determine corrective measures necessary to prepare each material to ensure compatibility with and adhesion of sealants including, but not limited to, specially formulated primers. After performing these corrective measures on the minimum number of samples required for each material, retest materials.
- G. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
- H. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.
- I. Structural-Sealant Glazing: Comply with ASTM C1401, "Guide for Structural Sealant Glazing" for design and installation of structural-sealant-glazed systems.
- J. Structural-Sealant Joints: Design reviewed and approved by structural-sealant manufacturer.
- K. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."

1.10 PROJECT CONDITIONS:

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

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1.11 WARRANTY:

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Adhesive or cohesive sealant failures.
 - e. Water leakage through fixed glazing and framing areas.
 - f. Failure of operating components.
 - 2. Warranty Period: 10 years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

1.12 MAINTENANCE SERVICE:

- A. Entrance Door Hardware:
 - 1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Contracting Officer's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
 - 2. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.
- B. Structural-Sealant-Glazed Systems:
 - 1. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of structural-sealant-glazed system Installer. Include quarterly preventive maintenance, repair or replacement to ensure long-term performance and durability of structural-sealant-glazed system as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original system.
 - 2. Continuing Maintenance Proposal: From Installer to Contracting Officer, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - 1. Arcadia, Inc.
 - 2. Arch Aluminum & Glass Co., Inc.

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3. CMI Architectural.
4. Commercial Architectural Products, Inc.
5. EFCO Corporation.
6. ES Windows, LLC.
7. Kawneer North America; an Alcoa company.
8. Leed Himmel Industries, Inc.
9. Pittco Architectural Metals, Inc.
10. TRACO.
11. Tubelite.
12. United States Aluminum.
13. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.
14. YKK AP America Inc.

2.02 MATERIALS:

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 1. Sheet and Plate: ASTM B209.
 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.
 3. Extruded Structural Pipe and Tubes: ASTM B429.
 4. Structural Profiles: ASTM B308.
 5. Welding Rods and Bare Electrodes: AWS A5.10.
- B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
 1. Structural Shapes, Plates, and Bars: ASTM A36.
 2. Cold-Rolled Sheet and Strip: ASTM A1008.
 3. Hot-Rolled Sheet and Strip: ASTM A1011.
- C. Basis of Design:
 1. Basis of Design is Trident Windows Model ES System 7525 as manufacturer by ES Windows, LLC.
 - a. Frame Depth: 7-1/2 inches.
 - b. Sight Line: 2-1/2 inches.
 - c. Outside glazed with shear block and pressure plate.
 - d. Framing Spans: Horizontal.

2.03 FRAMING SYSTEMS:

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 1. Construction: Thermally broken.
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Plane: Center.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 2. Reinforce members as required to receive fastener threads.

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3. Use exposed fasteners with countersunk Phillips screw heads, fabricated from stainless steel.
 - D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A123 or ASTM A153.
 - E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
 - F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.
 1. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 2.04 GLAZING SYSTEMS:
- A. Glazing: As specified in DIVISION 08, Section "Glazing."
 - B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
 - C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.
 - D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.
 - E. Glazing Sealants: For structural-sealant-glazed systems, as recommended by manufacturer for joint type, and as follows:
 1. Structural Sealant: ASTM C1184, single-component neutral-curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by a structural-sealant manufacturer for use in aluminum-framed systems indicated.
 - a. Sealants used inside the weatherproofing system shall have a VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Color: Color match to framing members.
 2. Weatherseal Sealant: ASTM C920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; single-component neutral-curing formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and aluminum-framed-system manufacturers for this use.
 - a. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Color: Matching structural sealant.
- 2.05 ENTRANCE DOOR SYSTEMS:
- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
 1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
 2. Door Design: Medium stile; 3-1/2 inch nominal width.

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3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.
- B. Entrance Door Hardware: As specified in DIVISION 08, Section "Door Hardware," except as indicated below.

2.06 ENTRANCE DOOR HARDWARE:

- A. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door to comply with requirements in this Section.
 1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products complying with BHMA standard referenced.
 2. Opening-Force Requirements:
 - a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion and not more than 15 lbf to open the door to its minimum required width.
 - b. Accessible Interior Doors: Not more than 5 lbf to fully open door.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:
 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
 2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.
- C. Butt Hinges: BHMA A156.1, Grade 1, radius corner.
 1. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while entrance door is closed.
 2. Exterior Hinges: Stainless steel, with stainless-steel pin.
 3. Quantities:
 - a. For doors up to 87 inches high, provide 3 hinges per leaf.
 - b. For doors more than 87 and up to 120 inches high, provide 4 hinges per leaf.
- D. Automatic and Self-Latching Flush Bolts: BHMA A156.3, Grade 1.
- E. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- F. Cylinders: As specified in DIVISION 08, Section "Door Hardware."
 1. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE" to be furnished by Contracting Officer.
- G. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- H. Operating Trim: BHMA A156.6.
- I. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to meet field conditions and requirements for opening force.
- J. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.

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- K. Weather Stripping: Manufacturer's standard replaceable components.
 - 1. Compression Type: Made of ASTM D2000, molded neoprene, or ASTM D2287, molded PVC.
- L. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- M. Silencers: BHMA A156.16, Grade 1.
- N. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch.

2.07 ACCESSORY MATERIALS:

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in DIVISION 07, Section "Joint Sealants."
 - 1. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24). Structural glazing sealants shall have a VOC content of 100 g/L or less.
- B. Miscellaneous Trim and Covers: Provide miscellaneous trim and covers for closure/in-fill at beams, columns, tubes and voids as shown on the Drawings.
 - 1. Material: Minimum 18-gauge aluminum.
 - 2. Finish: Match entrance framing.
 - 3. Sizes/Configurations: As shown on the Drawings.
- C. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

2.08 FABRICATION:

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 6. Provisions for field replacement of glazing from exterior.
 - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.
- F. Storefront Framing: Fabricate components for assembly using shear-block system.
- G. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 - 1. At exterior doors, provide compression weather stripping at fixed stops.

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS: continued

2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
- H. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
 1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
 2. At exterior doors, provide weather sweeps applied to door bottoms.
- I. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- J. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.
- K. Frames: Adhere glazing to its supporting frame by one of the following methods:
 1. Use structural silicone sealant with a bead width that is at least equal to, but not larger than two times, the nominal thickness of the laminated glass pane. Sealant shall be applied to both sides of the glass for single pane glazing or to the inboard side only for insulating glass units.
 2. Use glazing tape with a width that is at least equal to two times, but not larger than four times, the nominal thickness of the laminated glass pane.

2.09 ALUMINUM FINISHES:

- A. High-Performance Organic Finish: 3-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70% PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 1. Color and Gloss: As selected by Contracting Officer from manufacturer's full range.

PART 3 - EXECUTION

3.01 EXAMINATION:

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

3.02 INSTALLATION:

- A. General:
 1. Comply with manufacturer's written instructions.
 2. Do not install damaged components.
 3. Fit joints to produce hairline joints free of burrs and distortion.
 4. Rigidly secure nonmovement joints.
 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
 6. Seal joints watertight unless otherwise indicated.
- B. Metal Protection:
 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS: continued

- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Set continuous sill members and flashing in full sealant bed as specified in DIVISION 07, Section "Joint Sealants" to produce weathertight installation.
- E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- F. Install glazing as specified in DIVISION 08, Section "Glazing."
 - 1. Structural-Sealant Glazing:
 - a. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
 - b. Install weatherseal sealant according to DIVISION 07, Section "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.
- G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
 - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- H. Install perimeter joint sealants as specified in DIVISION 07, Section "Joint Sealants" to produce weathertight installation.

3.03 ERECTION TOLERANCES:

- A. Install aluminum-framed systems to comply with the following maximum erection tolerances:
 - 1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
 - 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
- B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

3.04 ADJUSTING:

- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
 - 1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch, measured to the leading door edge.

END OF SECTION 084113

SECTION 085113 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this Section.
- B. DIVISION 01, Section "Sustainable Design Requirements" for LEED® related requirements for recycled content materials and local/regionally manufactured and sourced materials and low-emitting sealants.

1.02 SUMMARY:

- A. Section includes aluminum windows for exterior locations.
- B. Related Requirements:
 - 1. DIVISION 08, Section "Aluminum-Framed Entrances and Storefronts" for coordinating finish among aluminum fenestration units.

1.03 REFERENCES:

- A. American Architectural Manufacturers Association:
 - 1. AAMA 502-2008 - Voluntary Specification for Field Testing of Newly Installed Fenestration Products.
 - 2. AAMA 611-1998 - Voluntary Specification for Anodized Architectural Aluminum.
 - 3. AAMA 613-2008 - Voluntary Performance Requirements and Test Procedures for Organic Coatings on Plastic Profiles.
 - 4. AAMA 623-2007 - Voluntary Specification, Performance Requirements and Test Procedures for Organic Coatings on Fiber Reinforced Thermoset Profiles.
 - 5. AAMA 902-2007 - Voluntary Specification for Sash Balances.
 - 6. AAMA 907-2005 - Voluntary Specifications for Corrosion Resistant Coatings on Carbon Steel Components.
 - 7. AAMA 1503-2009 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
 - 8. AAMA 2603-2002 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
 - 9. AAMA 2604-2005 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
 - 10. AAMA 2605-2005 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- B. American Architectural Manufacturers Association/Window & Door Manufacturers Association/Canadian Standards Association:
 - 1. AAMA/WDMA/CSA 101/I.S.2/A440-2008 - NAFS - North American Fenestration Standard/Specification for Windows, Doors, and Skylights.
- C. ASTM International:
 - 1. ASTM C1036-06 - Specification for Flat Glass.
 - 2. ASTM E90-04 - Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - 3. ASTM E405-04 - Test Methods for Wear Testing Rotary Operators for Windows.
 - 4. ASTM E413-04 - Classification for Rating Sound Insulation.
 - 5. ASTM E1332-90 (Reapproved 2003) - Classification for Determination of Outdoor-Indoor Transmission Class.

SECTION 085113 - ALUMINUM WINDOWS: continued

6. ASTM E1886-05 - Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
 7. ASTM E1996-08 - Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.
 8. ASTM E2190-08 - Specification for Insulating Glass Unit Performance and Evaluation.
 9. ASTM E2112-07 - Practice for Installation of Exterior Windows, Doors and Skylights.
 10. ASTM F1642-04 (Reapproved 2010) - Test Method for Glazing and Glazing Systems Subject to Airblast Loadings.
 11. ASTM F2248-09 - Practice for Specifying an Equivalent 3-Second Duration Design Loading for Blast Resistant Glazing Fabricated with Laminated Glass.
- D. Forest Stewardship Council:
1. FSC STD-01-001-2004 - FSC Principles and Criteria for Forest Stewardship (available in PDF at www.fsc.org).
 2. FSC STD-40-004-2008 - FSC Standard for Chain of Custody Certification (available in PDF at www.fsc.org).
- E. National Association of Architectural Metal Manufacturers:
1. Metal Finishes Manual, 2006.
- F. National Fenestration Rating Council:
1. NFRC 100-2004 (Revised 2008) - Procedure for Determining Fenestration Product U-Factors.
 2. NFRC 200-2004 (Revised 2008) - Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visual Transmittance at Normal Incidence.
- G. Department of Defense Unified Facilities Criteria (UFC):
1. 4-010-01 - DoD Minimum Antiterrorism Standards for Buildings.
 2. 4-010-02 - DoD Minimum Antiterrorism Standoff Distances for Buildings (FOUO).
- 1.04 SUBMITTALS:
- A. Product Data: For each type of product.
1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.
- B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
- C. Samples: For each exposed product and for each color specified, 2 by 4 inches in size.
- D. Samples for Initial Selection: For units with factory-applied color finishes.
1. Include similar Samples of hardware and accessories involving color selection.
- E. Samples for Verification: For aluminum windows and components required, showing full range of color variations for finishes, and prepared on Samples of size indicated below:
1. Exposed Finishes: 2 by 4 inches.
 2. Exposed Hardware: Full-size units.
- F. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.
- G. Blast Testing or Analysis Reports: Submit one or more of the following as necessary to demonstrate compliance with all specified requirements for blast resistance.
1. Static test results in accordance with ASTM E330.
 2. Airblast test results in accordance with ASTM F1642.
 3. Structural analysis data prepared by or under the supervision of a professional engineer experienced in the design of blast-resistant glazing systems.

SECTION 085113 - ALUMINUM WINDOWS: continued

H. LEED Submittals:

1. Product Data for Credit MRc4: For products containing recycled content, submit documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content for each product or portion of a product having recycled content. Include statement indicating cost for each product containing recycled content material.
2. Product Data for Credit MRc5: For products and materials complying with requirements for regional materials, submit documentation indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
3. Product Data for Credit IEQc4.1: For adhesives and sealants installed inside the weatherproofing barrier of the building and installed on site, submit documentation including manufacturers printed statement (MSDS Sheet) of VOC content of each product.

1.05 INFORMATIONAL SUBMITTALS:

- A. Qualification Data: For manufacturer and Installer.
- B. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For manufacturer's warranties.

1.06 QUALITY ASSURANCE:

- A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports, and calculations.
- B. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.

1.07 WARRANTY:

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Failure to meet performance requirements.
 - b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
 - c. Faulty operation of movable sash and hardware.
 - d. Deterioration of materials and finishes beyond normal weathering.
 - e. Failure of insulating glass.
 2. Warranty Period:
 - a. Window: 10 years from date of Substantial Completion.
 - b. Glazing Units: 10 years from date of Substantial Completion.
 - c. Aluminum Finish: 10 years from date of Substantial Completion.

SECTION 085113 - ALUMINUM WINDOWS: continued

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equal:
 - 1. All Seasons Window & Door Mfg., Inc.; All Seasons Commercial Division, Inc.
 - 2. Boyd Aluminum Manufacturing.
 - 3. Custom Window Company.
 - 4. DeSCo Architectural, Inc.
 - 5. EFCO Corporation; a Pella company.
 - 6. ES Windows, LLC.
 - 7. EXTECH Exterior Technologies, Inc.
 - 8. Fleetwood Windows & Doors.
 - 9. Gerkin Windows and Doors.
 - 10. Graham Architectural Products Corp.
 - 11. Kawneer North America; an Alcoa company.
 - 12. Mannix Exterior Wall Systems, Inc.
 - 13. Peerless Products, Inc.
 - 14. Quaker Windows Products Co.
 - 15. Thermal Windows, Inc.
 - 16. TRACO.
 - 17. Wausau Window and Wall Systems.
 - 18. Winco.
 - 19. YKK AP America, Inc.
- B. Source Limitations: Obtain aluminum windows from single source from single manufacturer.
- C. Basis of Design:
 - 1. Basis of Design is Trident Windows Model ES System 7525 as manufactured by ES Windows LLC.
 - a. Framed Depth: 7-1/2 inches.
 - b. Sightline: 2-1/2 inches.
 - c. Outside glazed with shear block and pressure plate.

2.02 WINDOW PERFORMANCE REQUIREMENTS:

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
 - 1. Window Certification: AMMA certified with label attached to each window.
- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
 - 1. Minimum Performance Class: HC.
 - 2. Minimum Performance Grade: 50.
- C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.30 Btu/sq. ft. by h by degree F.
- D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.40.
- E. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.
- F. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering

SECTION 085113 - ALUMINUM WINDOWS: continued

- calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change: 120°F, ambient; 180°F material surfaces.
- G. Sound Transmission Class (STC): Rated for not less than 26 STC when tested for laboratory sound transmission loss according to ASTM E90 and determined by ASTM E413.
- H. Outside-Inside Transmission Class (OITC): Rated for not less than 22 OITC when tested for laboratory sound transmission loss according to ASTM E90 and determined by ASTM E1332.
- I. Windborne-Debris Resistance: Capable of resisting impact from windborne debris based on testing glazed windows identical to those specified, according to ASTM E1886 and testing information in ASTM E1996 and requirements of authorities having jurisdiction.
- J. Blast Resistance:
1. Provide aluminum windows with framing members capable of withstanding a uniform static pressure applied to all glazing surfaces equal to the equivalent 3-second duration design loading determined in accordance with ASTM F2248 using explosive weight I as specified in UFC 4-010-02 and a standoff distance of 148 ft.
 - a. Framing members shall restrict edge deflections of glazing panes to 1/160 of the supported edge length, as determined in accordance with UFC 4-010-01, at allowable stress levels under the equivalent 3-second duration design loading.
 2. Provide aluminum window connections to surrounding structural elements, hardware and associated connections, and glazing stop connections capable of withstanding a uniform static pressure applied to all glazing surfaces equal to two times the equivalent 3-second duration design loading determined in accordance with ASTM F2248 using explosive weight I as specified in UFC 4-010-02 and a standoff distance of 148 ft.
 - a. Design of connections shall be based upon allowable stress levels. Allowable fastener loads shall be as recommended by the manufacturer for the materials to which glazing systems are being connected.
 - b. Connections shall be capable of preventing the frame from being dislodged from the supporting structural elements, as demonstrated by calculation or testing in accordance with UFC 4-010-01.
 3. As an alternative to the requirements specified above, provide aluminum windows that have been tested in accordance with ASTM F1642 and received a hazard rating of Very Low or better for the peak pressure and positive phase impulse that correspond to each of the following:
 - a. Explosive weight I as specified in UFC 4-010-02 at a standoff distance of 148 ft.
 - b. Explosive weight II as specified in UFC 4-010-02 at a standoff distance of 82 ft.

2.03 ALUMINUM WINDOWS:

- A. Operating Types: Provide the following operating types in locations indicated on Drawings:
1. Fixed.
- B. Frames: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.
1. Thermally Improved Construction: Fabricate frames with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.
- C. Glass: Clear annealed glass, ASTM C1036, Type 1, Class 1, q3.
1. Kind: Fully tempered.
- D. Insulating-Glass Units: ASTM E2190, certified through IGCC as complying with requirements of IGCC. See SECTION 088000 - GLAZING.
- E. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

SECTION 085113 - ALUMINUM WINDOWS: continued

- F. Structural Silicone Sealant: For adhesives and sealants installed inside the weatherproofing barrier of the building and installed on Site, the VOC content of each product shall not exceed 100 g/L VOC in accordance with the LEED Reference Guide.

2.04 ACCESSORIES:

- A. Subsills: Thermally broken, extruded-aluminum subsills.
- B. Interior Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
- C. Panning Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
- D. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminum receptor system that anchors windows in place.

2.05 FABRICATION:

- A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- B. Glaze aluminum windows in the factory.
- C. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- D. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.
- E. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design wind loads of window units.
- F. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.
- G. Frames: Adhere glazing to its supporting frame by one of the following methods:
 - 1. Use structural silicone sealant with a bead width that is at least equal to, but not larger than two times, the nominal thickness of the laminated glass pane. Sealant shall be applied to both sides of the glass for single pane glazing or to the inboard side only for insulating glass units.
 - 2. Use glazing tape with a width that is at least equal to two times, but not larger than four times, the nominal thickness of the laminated glass pane.

2.06 GENERAL FINISH REQUIREMENTS:

- A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.07 ALUMINUM FINISHES:

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

SECTION 085113 - ALUMINUM WINDOWS: continued

- B. High-Performance Organic Finish (Three-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: Conversion coatings; Organic Coating: Manufacturer's standard three-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70% polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: As selected by Contracting Officer from full range of industry colors and color densities.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.
- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.03 ADJUSTING, CLEANING, AND PROTECTION:

- A. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
 - 1. Keep protective films and coverings in place until final cleaning.
- B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- C. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 085113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this Section.
- B. DIVISION 01, Section "Sustainable Design Requirements" for LEED® related requirements for recycled content materials and local/regionally manufactured and sourced materials.

1.02 SUMMARY:

- A. Section includes:
 - 1. Mechanical door hardware for the following:
 - a. Swinging doors.
 - 2. Cylinders for door hardware specified in other Sections.
- B. Related Sections:
 - 1. DIVISION 06, Section "Interior Architectural Woodwork" for cabinet door hardware provided as part of architectural woodwork.
 - 2. DIVISION 08, Section "Hollow Metal Doors and Frames".
 - 3. DIVISION 08, Section "Aluminum Frames" for door silencers provided as part of aluminum frames.
 - 4. DIVISION 08, Section "Flush Wood Doors" provided as part of labeled fire-rated assemblies.
 - 5. DIVISION 08, Section "Aluminum-Framed Entrances and Storefronts" for entrance door hardware, including cylinders.

1.03 REFERENCES:

- A. American National Standards Institute:
 - 1. ANSI/SDI A250.6-2003 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
 - 2. ANSI/SDI A250.8-2003 - Recommended Specifications for Standard Steel Doors and Frames.
- B. ASTM International:
 - 1. ASTM E283-04 - Test Method for Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen.
- C. Builders Hardware Manufacturers Association:
 - 1. BHMA A156.1-2006 - Butts and Hinges (ANSI).
 - 2. BHMA A156.2-2003 - Bored and Preassembled Locks & Latches (ANSI).
 - 3. BHMA A156.3-2001 - Exit Devices (ANSI).
 - 4. BHMA A156.4-2000 - Door Controls - Closers (ANSI).
 - 5. BHMA A156.5-2001 - Auxiliary Locks and Associated Products (ANSI).
 - 6. BHMA A156.6-2005 - Architectural Door Trim (ANSI).
 - 7. BHMA A156.13-2005 - Mortise Locks & Latches Series 1000 (ANSI).
 - 8. BHMA A156.16-2002 - Auxiliary Hardware (ANSI).
 - 9. BHMA A156.17-2004 - Self Closing Hinges & Pivots (ANSI).
 - 10. BHMA A156.18-2006 - Materials and Finishes (ANSI).
 - 11. BHMA A156.21-2006 - Thresholds (ANSI).
 - 12. BHMA A156.22-2005 - Door Gasketing and Edge Seal Systems (ANSI).
 - 13. BHMA A156.26-2006 - Continuous Hinges (ANSI).
 - 14. BHMA A156.28-2000 - Recommended Practices for Keying Systems (ANSI).

SECTION 087100 - DOOR HARDWARE: continued

15. BHMA A156.29-2001 - Exit Locks, Exit Locks with Alarms, Exit Alarms, Alarms for Exit Devices (ANSI).
 - D. Door and Hardware Institute:
 1. DHI WDHS.2-96 - Recommended Fasteners for Wood Doors.
 2. DHI WDHS.3-96 - Recommended Locations for Architectural Hardware for Wood Flush Doors.
 3. Sequence and Format for the Hardware Schedule, 1996.
 - E. Federal Government Publication:
 1. U.S. Architectural & Transportation Barriers Compliance Board, Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines. Washington, DC - U.S. Architectural & Transportation Barriers Compliance Board, Adopted in 2004. Published in the Federal Register (available in PDF at www.access-board.gov).
 - F. Hollow Metal Manufacturers Association; Division of National Association of Architectural Metal Manufacturers:
 1. HMMA 831-1997 - Recommended Hardware Locations for Custom Hollow Metal Doors and Frames.
 - G. International Code Council/American National Standards Institute:
 1. ICC/ANSI A117.1-2003 - Accessible and Usable Buildings and Facilities.
 - H. National Electrical Manufacturers Association:
 1. NEMA LD 3-2005 - High Pressure Decorative Laminates (ANSI).
 - I. NFPA:
 1. NFPA 80-2007 - Fire Doors and Fire Windows.
 2. NFPA 252-2008 - Methods of Fire Tests of Door Assemblies.
 - J. Underwriters Laboratories Inc.:
 1. UL 10C-01 - Positive Pressure Fire Tests of Door Assemblies.
 2. UL 1784-01 - Air Leakage Tests for Door Assemblies.
- 1.04 SUBMITTALS:
- A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
 - B. Samples: For exposed door hardware of each type required, in each finish specified, prepared on Samples of size indicated below. Tag Samples with full description for coordination with the door hardware schedule. Submit Samples before, or concurrent with, submission of door hardware schedule.
 1. Sample Size: Full-size units or minimum 2- by 4-inch Samples for sheet and 4-inch long Samples for other products.
 - a. Full-size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.
 - C. Other Action Submittals:
 1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door

SECTION 087100 - DOOR HARDWARE: continued

- hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
- b. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.
 - c. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
 - d. Content: Include the following information:
 - (1) Identification number, location, hand, fire rating, size, and material of each door and frame.
 - (2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - (3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - (4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - (5) Fastenings and other pertinent information.
 - (6) Explanation of abbreviations, symbols, and codes contained in schedule.
 - (7) Mounting locations for door hardware.
 - (8) List of related door devices specified in other Sections for each door and frame.
2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Contracting Officer's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.
3. LEED Submittals:
- a. Product Data for Credit MRc4: For each hardware product type submit documentation indicating recycled content and statement indicating cost for each product containing recycled content material.
 - b. Product Data for Credit MRc5: For each hardware product type submit documentation indicating location and distance from Project of material manufacturer and point of extraction.
- 1.05 INFORMATIONAL SUBMITTALS:
- A. Qualification Data: For Installer and Architectural Hardware Consultant.
 - B. Product Certificates: For electrified door hardware, from the manufacturer.
 - 1. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
 - C. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
 - D. Warranty: Special warranty specified in this Section.
- 1.06 CLOSEOUT SUBMITTALS:
- A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

SECTION 087100 - DOOR HARDWARE: continued

1.07 QUALITY ASSURANCE:

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor and Contracting Officer about door hardware and keying.
 - 1. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as follows:
 - 1. For door hardware, an Architectural Hardware Consultant (AHC).
- C. Source Limitations: Obtain each type of door hardware from a single manufacturer.
 - 1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- D. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.
- E. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- F. Accessibility Requirements: For door hardware on doors in an accessible route, comply with ICC/ANSI A117.1.
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
 - 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
 - b. Sliding or Folding Doors: 5 lbf applied parallel to door at latch.
 - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
 - 4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.
- G. Keying Conference: Conduct conference at Project site to comply with requirements in DIVISION 01, Section "Project Management and Coordination." In addition to Contracting Officer and Contractor, conference participants shall also include Installer's Architectural Hardware Consultant and Contracting Officer's security consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
 - 1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2. Preliminary key system schematic diagram.
 - 3. Requirements for key control system.
 - 4. Requirements for access control.

SECTION 087100 - DOOR HARDWARE: continued

5. Address for delivery of keys.
- 1.08 DELIVERY, STORAGE, AND HANDLING:
- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
 - B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
 - C. Deliver keys to manufacturer of key control system for subsequent delivery to Contracting Officer.
 - D. Deliver keys and permanent cores to Contracting Officer by registered mail or overnight package service.
- 1.09 COORDINATION:
- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in DIVISION 03.
 - B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
 - C. Security: Coordinate installation of door hardware, keying, and access control with Contracting Officer's security consultant.
 - D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- 1.10 WARRANTY:
- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fails in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 2. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.
 - a. Exit Devices: Two years from date of Substantial Completion.
 - b. Manual Closers: 10 years from date of Substantial Completion.
 - c. Concealed Floor Closers: Five years from date of Substantial Completion.
- 1.11 MAINTENANCE SERVICE:
- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Contracting Officer's continued adjustment, maintenance, and removal and replacement of door hardware.
 - B. Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Provide parts and

SECTION 087100 - DOOR HARDWARE: continued

supplies that are the same as those used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.01 SCHEDULED DOOR HARDWARE:

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
 - 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.
 - 2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.

2.02 HINGES:

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. Baldwin Hardware Corporation.
 - b. Bommer Industries, Inc.
 - c. Cal-Royal Products, Inc.
 - d. Hager Companies.
 - e. IVES Hardware; an Ingersoll-Rand company.
 - f. Lawrence Hardware Inc.
 - g. McKinney Products Company; an ASSA ABLOY Group company.
 - h. PBB, Inc.
 - i. Stanley Commercial Hardware; Div. of The Stanley Works.

2.03 LOCKS AND LATCHES:

- A. Best Lock 92K or 93K Locksets, no substitutions:
 - 1. 7-pin cores.
 - 2. 2-3/4 inch backset.
 - 3. Lever Style: 14, Curve Return.
 - 4. Finish: 626, Satin Chrome.
 - 5. Functions as indicated in accordance with ANSI A156.2.
- B. Best Lock Functions:
 - 1. AB - Entrance.
 - 2. D - Storeroom.
 - 3. L - Privacy.
 - 4. N - Passage.
 - 5. R - Classroom.

SECTION 087100 - DOOR HARDWARE: continued

2.04 ELECTRIC STRIKES:

- A. Von Duprin 6211.

2.05 SURFACE BOLTS:

- A. Surface Bolts: BHMA A156.16.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. Burns Manufacturing Incorporated.
 - b. Don-Jo Mfg., Inc.
 - c. Door Controls International, Inc.
 - d. IVES Hardware; an Ingersoll-Rand company.
 - e. Trimco.

2.06 MANUAL FLUSH BOLTS:

- A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.
 - b. Burns Manufacturing Incorporated.
 - c. Don-Jo Mfg., Inc.
 - d. Door Controls International, Inc.
 - e. Hiawatha, Inc.
 - f. IVES Hardware; an Ingersoll-Rand company.
 - g. Trimco.

2.07 AUTOMATIC AND SELF-LATCHING FLUSH BOLTS:

- A. Automatic and Self-Latching Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. Cal-Royal Products, Inc.
 - b. Door Controls International, Inc.
 - c. IVES Hardware; an Ingersoll-Rand company.
 - d. Trimco.

2.08 EXIT DEVICES AND AUXILIARY ITEMS:

- A. Exit Devices and Auxiliary Items: BHMA A156.3.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.
 - b. Arrow USA; an ASSA ABLOY Group company.
 - c. Cal-Royal Products, Inc.
 - d. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
 - e. Detex Corporation.
 - f. Door Controls International, Inc.
 - g. DORMA Architectural Hardware; Member of The DORMA Group North America.
 - h. Dor-O-Matic; an Ingersoll-Rand company.
 - i. K2 Commercial Hardware; a Black & Decker Corp. company.

SECTION 087100 - DOOR HARDWARE: continued

- j. Monarch Exit Devices & Panic Hardware; an Ingersoll-Rand company.
- k. Precision Hardware, Inc.; Division of Stanley Security Solutions, Inc.
- l. Rutherford Controls Int'l. Corp.
- m. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
- n. Von Duprin; an Ingersoll-Rand company.
- o. Yale Security Inc.; an ASSA ABLOY Group company.

2.09 KEYING:

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
 - 1. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.
- B. Keys: Nickel silver.
 - 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: "DO NOT DUPLICATE."
 - 2. Quantity: In addition to one extra key blank for each lock, provide the following:
 - a. Cylinder Change Keys: Three.
 - b. Master Keys: Five.
 - c. Grand Master Keys: Five.
 - d. Great-Grand Master Keys: Five.

2.10 KEY CONTROL SYSTEM:

- A. Key Control Cabinet: BHMA A156.5; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, 2 sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150% of the number of locks.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. American Key Boxes and Cabinets.
 - b. GE Security, Inc.
 - c. HPC, Inc.
 - d. Lund Equipment Co., Inc.
 - e. MMF Industries.
 - f. Tri Palm International.
 - 2. Wall-Mounted Cabinet: Cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.

2.11 OPERATING TRIM:

- A. Operating Trim: BHMA A156.6; stainless steel, unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. Burns Manufacturing Incorporated.
 - b. Don-Jo Mfg., Inc.
 - c. Forms + Surfaces.
 - d. Hager Companies.
 - e. Hiawatha, Inc.
 - f. IVES Hardware; an Ingersoll-Rand company.
 - g. Rockwood Manufacturing Company.

SECTION 087100 - DOOR HARDWARE: continued

h. Trimco.

2.12 ACCESSORIES FOR PAIRS OF DOORS:

- A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release.
- B. Astragals: BHMA A156.22.

2.13 SURFACE CLOSERS:

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. Arrow USA; an ASSA ABLOY Group company.
 - b. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
 - c. DORMA Architectural Hardware; Member of The DORMA Group North America.
 - d. Dor-O-Matic; an Ingersoll-Rand company.
 - e. K2 Commercial Hardware; a Black & Decker Corp. company.
 - f. LCN Closers; an Ingersoll-Rand company.
 - g. Norton Door Controls; an ASSA ABLOY Group company.
 - h. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
 - i. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
 - j. Yale Security Inc.; an ASSA ABLOY Group company.

2.14 MECHANICAL STOPS AND HOLDERS:

- A. Wall- and Floor-Mounted Stops: BHMA A156.16; stainless steel base metal.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. Architectural Builders Hardware Mfg., Inc.
 - b. Baldwin Hardware Corporation.
 - c. Burns Manufacturing Incorporated.
 - d. Cal-Royal Products, Inc.
 - e. Don-Jo Mfg., Inc.
 - f. Door Controls International, Inc.
 - g. Hager Companies.
 - h. Hiawatha, Inc.
 - i. IVES Hardware; an Ingersoll-Rand company.
 - j. Rockwood Manufacturing Company.
 - k. Stanley Commercial Hardware; Div. of The Stanley Works.
 - l. Trimco.

2.15 THRESHOLDS:

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. Hager Companies.

SECTION 087100 - DOOR HARDWARE: continued

- b. M-D Building Products, Inc.
- c. National Guard Products.
- d. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
- e. Reese Enterprises, Inc.
- f. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
- g. Sealeze; a unit of Jason Incorporated.
- h. Zero International.

2.16 FABRICATION:

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Contracting Officer.
 - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
 - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 - 2. Fire-Rated Applications:
 - a. Wood or Machine Screws: For the following:
 - (1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
 - (2) Strike plates to frames.
 - (3) Closers to doors and frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - (1) Surface hinges to doors.
 - (2) Closers to doors and frames.
 - (3) Surface-mounted exit devices.
 - 3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
 - 4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
 - 5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.17 FINISHES:

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations

SECTION 087100 - DOOR HARDWARE: continued

in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION:

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

3.03 INSTALLATION:

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in DIVISION 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches of door height greater than 90 inches.
- E. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as indicated in keying schedule.
 - 2. Furnish permanent cores to Contracting Officer for installation.
- F. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

SECTION 087100 - DOOR HARDWARE: continued

- G. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in DIVISION 07, Section "Joint Sealants."
- H. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- I. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- J. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- K. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.04 FIELD QUALITY CONTROL:

- A. Independent Architectural Hardware Consultant: Contracting Officer will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
 - 1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.05 ADJUSTING:

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

3.06 CLEANING AND PROTECTION:

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

3.07 DEMONSTRATION:

- A. Engage a factory-authorized service representative to train Contracting Officer's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to DIVISION 01, Section "Demonstration and Training."

SECTION 087100 - DOOR HARDWARE: continued

3.08 DOOR HARDWARE SCHEDULE:

HS-1

4 pair	Hinges
2 each	Push/Pull
2 each	Closer with electric opener
1 each	Deadbolt
2 sets	Weatherstrip
2 each	Sweep
2 each	Push Button Opener
2 each	Exit Device

HS-2

4 pair	Hinges
2 sets	Push/Pull
2 each	Closer

HS-3

2 pair	Hinges
1 each	Lockset (Office Function)
1 each	Wall Stop (Omit at Door 108)

HS-4

2 pair	Hinges
1 each	Lockset (Storeroom Function)
1 set	Fire Seal
1 each	Closer

HS-5

2 pair	Hinges
1 each	Lockset (Classroom Function)
1 each	Closer
1 each	Wall Stop

HS-6

2 pair	Hinges
1 each	Lockset (Storeroom Function)
1 each	Closer
1 set	Weatherstrip
1 each	Sweep
1 each	Rain Drip

SECTION 087100 - DOOR HARDWARE: continued

HS-7

2 pair	Hinges
1 each	Lockset (Storeroom Function)
1 each	Closer
1 each	Wall Stop
1 each	Electric Strike

HS-8

4 pair	Hinges
1 each	Lockset (Storeroom Function)
1 each	Closer
1 each	Manual Flush Bolt
1 set	Weatherstrip
1 each	Sweep
1 each	Rain Drip
1 each	Astragal

HS-9

2 pair	Hinges
1 each	Closer
1 each	Rim Cylinder
1 each	Exit Device
1 set	Weatherstrip

HS-9A

2 pair	Hinges
1 each	Closer
1 set	Push/Pull

HS-10

2 pair	Hinges
1 each	Lockset (Storeroom Function)
1 each	Kick Plate
1 each	Wall Stop

HS-11

2 pair	Hinges
1 set	Push/Pull
1 each	Closer
1 each	Kick Plate

SECTION 087100 - DOOR HARDWARE: continued

HS-12

2 pair	Hinges
1 each	Rim Cylinder
1 each	Exit Device
1 each	Closer
1 set	Fire Seal
1 each	Kick Plate

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Windows.
 - 2. Doors.
 - 3. Storefront framing.
- B. Related Sections:
 - 1. DIVISION 01, Section "Sustainable Design Requirements" for LEED® related requirements for recycled content materials and local/regionally manufactured and sourced materials.

1.03 REFERENCES:

- A. American Architectural Manufacturers Association:
 - 1. AAMA 800-2005 - Voluntary Specifications and Test Methods for Sealants.
- B. American National Standards Institute:
 - 1. ANSI Z97.1-2004 - Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
- C. American Society of Civil Engineers/Structural Engineering Institute:
 - 1. ASCE/SEI 7-2005 - Minimum Design Loads for Buildings and Other Structures.
- D. ASTM International:
 - 1. ASTM C509-00 - Specification for Elastomeric Cellular Preformed Gasket and Sealing Material.
 - 2. ASTM C542-05 - Specification for Lock-Strip Gaskets.
 - 3. ASTM C716-00 - Specification for Installing Lock-Strip Gaskets and Infill Glazing Materials.
 - 4. ASTM C864-05 - Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
 - 5. ASTM C920-05 - Specification for Elastomeric Joint Sealants.
 - 6. ASTM C1021-01 - Practice for Laboratories Engaged in the Testing of Building Sealants.
 - 7. ASTM C1036-01 - Specification for Flat Glass.
 - 8. ASTM C1048-04 - Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass.
 - 9. ASTM C1087-00 - Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
 - 10. ASTM C1115-00 - Specification for Dense Elastomeric Silicone Rubber Gaskets and Accessories.
 - 11. ASTM C1172-03 - Specification for Laminated Architectural Flat Glass.
 - 12. ASTM C1281-03 - Specification for Preformed Tape Sealants for Glazing Applications.
 - 13. ASTM C1330-02 - Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
 - 14. ASTM E1300-04 - Practice for Determining Load Resistance of Glass in Buildings.

SECTION 088000 - GLAZING: continued

15. ASTM E1886-05 - Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
 16. ASTM E1996-06 - Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.
 17. ASTM E2190-02 - Specification for Insulating Glass Unit Performance and Evaluation.
 - E. Code of Federal Regulations:
 1. 16 CFR 1201-2006 - Safety Standard for Architectural Glazing Materials.
 2. 40 CFR 59, Subpart D-2005 - National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - F. Glass Association of North America:
 1. Engineering Standards Manual, 2001.
 2. Glazing Manual, 2004.
 3. Laminated Glazing Reference Manual, 2006.
 - G. Insulating Glass Manufacturers Alliance:
 1. IGMA TB-3001-2001 - Guidelines for Sloped Glazing.
 2. SIGMA TM-3000-1990 (Revised 2004) - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use.
 - H. International Code Council:
 1. International Building Code, 2003.
 - I. Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; Building Technologies Department; Windows & Daylighting Group:
 1. WINDOW 5.2 - A PC Program for Analyzing Window Thermal Performance (Available at <http://windows.lbl.gov/software>).
 - J. National Fenestration Rating Council:
 1. NFRC 100-2004 - Procedure for Determining Fenestration Product Thermal Properties (Currently Limited to U-Factors).
 2. NFRC 200-2004 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficients at Normal Incidence.
 3. NFRC 300-2004 - Procedures for Determining Solar Optical Properties of Simple Fenestration Products.
 - K. NFPA 252-2003 - Fire Tests of Door Assemblies.
 - L. NFPA 257-2000 - Fire Test for Window and Glass Block Assemblies.
- 1.04 DEFINITIONS:
- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
 - B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C1036.
 - C. Interspace: Space between lites of an insulating-glass unit.
- 1.05 PERFORMANCE REQUIREMENTS:
- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

SECTION 088000 - GLAZING: continued

1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
 - a. Wind Design Data: As indicated on Drawings.
 - b. Basic Wind Speed: 150 mph.
 - c. Importance Factor: 1.1.
 - d. Exposure Category: D.
 2. Design Snow Loads: As indicated on Drawings.
 3. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
 4. Glass Type Factors for Wired, and Sandblasted Glass:
 - a. Short-Duration Glass Type Factor for Wired Glass: 0.5.
 - b. Long-Duration Glass Type Factor for Wired Glass: 0.3.
 - c. Short-Duration Glass Type Factor for Patterned Glass: 1.0.
 - d. Long-Duration Glass Type Factor for Patterned Glass: 0.6.
 - e. Short-Duration Glass Type Factor for Sandblasted Glass: 0.5.
 5. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
 6. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
1. Temperature Change: 120°F, ambient; 180°F, material surfaces.

1.06 SUBMITTALS:

- A. Product Data: For each glass product and glazing material indicated.
- B. LEED Submittals:
 1. Product Data for Credit IEQ 4.1: For glazing sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
- C. Glass Samples: For each type of the following products; 12 inches square.
 1. Tinted glass.
 2. Wired glass.
 3. Insulating glass.
- D. Glazing Accessory Samples: For gaskets, sealants and spacers, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
- E. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- F. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.07 INFORMATIONAL SUBMITTALS:

- A. Qualification Data: For manufacturers of insulating-glass units with sputter-coated, low-e coatings.
- B. Product Certificates: For glass and glazing products, from manufacturer.

SECTION 088000 - GLAZING: continued

- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for tinted glass, insulating glass, glazing sealants and glazing gaskets.
 - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Preconstruction adhesion and compatibility test report.
- E. Warranties: Sample of special warranties.

1.08 QUALITY ASSURANCE:

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.
- E. Source Limitations for Glass: Obtain ultraclear float glass, tinted float glass, coated float glass, laminated glass, and insulating glass from single source from single manufacturer for each glass type.
- F. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
- G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
 - 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
 - 3. IGMMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- H. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- I. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450°F, and the fire-resistance rating in minutes.
- J. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

1.09 DELIVERY, STORAGE, AND HANDLING:

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

SECTION 088000 - GLAZING: continued

1.10 PROJECT CONDITIONS:

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40°F.

1.11 WARRANTY:

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 GLASS PRODUCTS, GENERAL:

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
 - 1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
 - 2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.
- C. Windborne-Debris-Impact Resistance: Provide exterior glazing that passes enhanced-protection testing requirements in ASTM E1996 for Wind Zone 4 when tested according to ASTM E1886. Test specimens shall be no smaller in width and length than glazing indicated

SECTION 088000 - GLAZING: continued

for use on the Project and shall be installed in same manner as glazing indicated for use on the Project.

1. Large-Missile Test: For glazing located within 30 feet of grade.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For laminated-glass lites, properties are based on products of construction indicated.
 2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. by h by degree F.
 4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.02 GLASS PRODUCTS:

- A. Float Glass: ASTM C1036, Type I, Quality-Q3, Class I (clear), unless otherwise indicated.
- B. Ultraclear Float Glass: ASTM C1036, Type I, Quality-Q3, Class I, complying with other requirements specified and with visible light transmission not less than 91% and solar heat gain coefficient not less than 0.87.
 1. Products: Subject to compliance with requirements, provide the following or approved equal:
 - a. AFG Industries, Inc.; Krystal Klear.
 - b. Guardian Industries Corp.; Ultrawhite.
 - c. Pilkington North America; Optiwhite.
 - d. PPG Industries, Inc.; Starphire.
- C. Heat-Treated Float Glass: ASTM C1048; Type I; Quality-Q3; Class I (clear), unless otherwise indicated; of kind and condition indicated.
 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
 2. For uncoated glass, comply with requirements for Condition A.
 3. For coated vision glass, comply with requirements for Condition C (other coated glass).
- D. Uncoated Tinted Float Glass: Class 2, complying with other requirements specified.
 1. Products: Subject to compliance with requirements, provide the following:
 2. Tint Color: Green.
 3. Visible Light Transmittance: 60% minimum.
- E. Polished Wired Glass: ASTM C1036, Type II, Class 1 (clear), Form 1, Quality-Q6, complying with ANSI Z97.1, Class C.
 1. Products: Subject to compliance with requirements, provide the following:
 2. Mesh: M2 (square).

2.03 INSULATING GLASS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E2190, and complying with other requirements specified.
 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary.
 2. Spacer: Manufacturer's standard spacer material and construction.

SECTION 088000 - GLAZING: continued

3. Desiccant: Molecular sieve or silica gel, or blend of both.
 - C. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Insulating-Glass Types" Article and in "Insulating-Laminated-Glass Types" Article.
- 2.04 SPANDREL GLASS:
- A. Ceramic-Coated Spandrel Glass; ASTM C1048, Condition B, Type I, Quality-Q3, and complying with other requirements specified.
 1. Glass: Clear float.
 2. Tint Color: Green.
 3. Ceramic Coating Color for Interior Face or Face 3 of Insulating Unit: Black.
- 2.05 LAMINATED GLASS:
- A. Laminated Glass: ASTM C1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written recommendations.
 2. Interlayer Thickness: 0.076 mm, minimum.
 3. Interlayer Color: Clear, unless otherwise indicated.
- 2.06 GLAZING GASKETS:
- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
 1. Neoprene complying with ASTM C864.
 2. EPDM complying with ASTM C864.
 3. Silicone complying with ASTM C1115.
 4. Thermoplastic polyolefin rubber complying with ASTM C1115.
 - B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene, EPDM or thermoplastic polyolefin rubber gaskets complying with ASTM C509, Type II, black; of profile and hardness required to maintain watertight seal.
 1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.
 - C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C542, black.
- 2.07 GLAZING SEALANTS:
- A. General:
 1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 3. Sealants used inside the weatherproofing system, shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

SECTION 088000 - GLAZING: continued

4. Colors of Exposed Glazing Sealants: As selected by Contracting Officer from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Dow Corning Corporation; 790.
 - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
 - c. May National Associates, Inc.; Bondaflex Sil 290.
 - d. Pecora Corporation; 890.
 - e. Sika Corporation, Construction Products Division; SikaSil-C990.
 - f. Tremco, Incorporated; Spectrem 1.
 2. Applications:
- C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT.
 1. Products: Subject to compliance with requirements, provide the following or approved equal:
 - a. BASF Building Systems; Omniseal 50.
 - b. Dow Corning Corporation; 756 SMS.
 - c. GE Advanced Materials - Silicones; SilGlaze II SCS2800.
 - d. May National Associates, Inc.; Bondaflex Sil 295.
 - e. Pecora Corporation; 864.
 - f. Polymeric Systems, Inc.; PSI-641.
 - g. Sika Corporation, Construction Products Division; SikaSil-C995.
 - h. Tremco, Incorporated; Spectrem 2.
 2. Applications:
- D. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.
 1. Products: Subject to compliance with requirements, provide the following or approved equal:
 - a. Dow Corning Corporation; 799.
 - b. GE Advanced Materials - Silicones; UltraGlaze SSG4000.
 - c. May National Associates, Inc.; Bondaflex Sil 200 GPN.
 - d. Polymeric Systems, Inc.; PSI-631.
 - e. Schnee-Morehead, Inc., an ITW company; SM5731 Poly-Glaze Plus.
 - f. Tremco, Incorporated; Proglaze SSG.
 2. Applications:
- E. Glazing Sealant: Acid-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, use NT.
 1. Products: Subject to compliance with requirements, provide the following or approved equal:
 - a. BASF Building Systems; OmniPlus.
 - b. Bostik, Inc.; Chem-Calk 1200.
 - c. Dow Corning Corporation; 999-A.
 - d. GE Advanced Materials - Silicones; Contractors SCS1000.
 - e. May National Associates, Inc.; Sil 100 GC.
 - f. Pecora Corporation; 860.
 - g. Polymeric Systems, Inc.; PSI-601.
 - h. Schnee-Morehead, Inc., an ITW company; SM5732 Polyglaze.

SECTION 088000 - GLAZING: continued

- i. Tremco, Incorporated; Proglaze.
 - 2. Applications:
 - F. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated.
- 2.08 GLAZING TAPES:
 - A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100% solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:
 - 1. AAMA 804.3 tape, where indicated.
 - 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
 - B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 - 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 - 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.
- 2.09 MISCELLANEOUS GLAZING MATERIALS:
 - A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
 - B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
 - C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, ± 5 .
 - D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
 - E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
 - F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
 - G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.
- 2.10 FABRICATION OF GLAZING UNITS:
 - A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 - B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
 - C. Grind smooth and polish exposed glass edges and corners.

SECTION 088000 - GLAZING: continued

2.11 GLASS TYPES:

- A. Exterior Windows (Glass Type 4):
 - 1. 1-5/16-inch insulated glass:
 - a. 5/16-inch laminated exterior light, green.
 - b. 3/4-inch air space, argon filled.
 - c. 1/4-inch laminated interior light, clear.
- B. Spandrel Glass (Glass Type 5):
 - 1. 1-5/16-inch insulated glass:
 - a. 5/16-inch laminated exterior light, green.
 - b. 3/4-inch air space, argon filled.
 - c. 1/4-inch laminated interior light, clear, with ceramic frit.
- C. Exterior Doors (See Door Schedule for Locations):
 - 1. 3/16-inch laminated safety glass, clear (Type 1).
 - 2. 1/4-inch laminated safety glass, clear (Type 2).
 - 3. 1-inch insulated glass, smoke grey tint (Type 3).
- D. Exterior Entrance Enclosures (Glass Type 6):
 - 1. 1-5/16-inch insulated glass:
 - a. 5/16-inch laminated exterior light, clear.
 - b. 3/4-inch air space, argon filled.
 - c. 1/4-inch laminated interior light, clear.
- E. Interior Doors:
 - 1. 1/4-inch laminated safety glass, smoke gray tint (Type 2A).

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION:

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.03 GLAZING, GENERAL:

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

SECTION 088000 - GLAZING: continued

- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches.
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.04 TAPE GLAZING:

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.05 SEALANT GLAZING (WET):

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding

SECTION 088000 - GLAZING: continued

into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.06 CLEANING AND PROTECTION:

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

SECTION 089000 - LOUVERS AND VENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this Section.
- B. DIVISION 01, Section "Sustainable Design Requirements" for LEED® related requirements for recycled content materials and local/regionally manufactured and sourced materials.
- C. DIVISION 07, Section "Joint Sealants" apply to this Section.

1.02 SUMMARY:

- A. Section Includes:
 - 1. Fixed, extruded-aluminum louvers.

1.03 REFERENCES:

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500-L-1999 - Test Methods for Louvers, Dampers.
 - 2. AMCA 501-2003 - Application Manual for Air Louvers.
- B. American Architectural Manufacturers Association:
 - 1. AAMA 611-1998 - Voluntary Specification for Anodized Architectural Aluminum.
 - 2. AAMA 2603-2002 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
 - 3. AAMA 2604-2002 - Voluntary Specification, Performance Requirements and Test Procedures for High Performing Organic Coatings on Aluminum Extrusions and Panels.
 - 4. AAMA 2605-2002 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- C. American Welding Society:
 - 1. AWS D1.2/D1.2M-2003 - Structural Welding Code - Aluminum.
 - 2. AWS D1.3-1998 - Structural Welding Code - Sheet Steel.
- D. ASTM International:
 - 1. ASTM A240/A240M-04a - Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 2. ASTM A653/A653M-04a - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 3. ASTM A780-01 - Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - 4. ASTM B26/B26M-03 - Specification for Aluminum-Alloy Sand Castings.
 - 5. ASTM B209-04 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 6. ASTM B209M-04 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric].
 - 7. ASTM B221-04a - Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
 - 8. ASTM D1187-97 (Reapproved 2002) - Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
 - 9. ASTM E413-04 - Classification for Rating Sound Insulation.
 - 10. ASTM E488-96 (Reapproved 2003) - Test Methods for Strength of Anchors in Concrete and Masonry Elements.
 - 11. ASTM E1332-90 (Reapproved 2003) - Classification for Determination of Outdoor-Indoor Transmission Class.

SECTION 089000 - LOUVERS AND VENTS: continued

- E. National Association of Architectural Metal Manufacturers:
 - 1. Metal Finishes Manual for Architectural and Metal Products, 1988.
- F. Sheet Metal and Air Conditioning Contractors' National Association:
 - 1. Architectural Sheet Metal Manual, 2003.
- G. Structural Engineering Institute/American Society of Civil Engineers:
 - 1. SEI/ASCE 7-2002 - Minimum Design Loads for Buildings and Other Structures.

1.04 DEFINITIONS:

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.
- C. Storm-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.05 PERFORMANCE REQUIREMENTS:

- A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural and seismic performance requirements and design criteria indicated.
- B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
 - 1. Wind Loads: Determine loads based on a uniform pressure of 35 lbf/sq. ft., acting inward or outward.
 - 2. Wind Loads: Determine loads based on pressures indicated below:
 - a. Corner Zone: Within 10 feet of building corners, uniform pressure of 40 psf, acting inward and 40 psf, acting outward.
 - b. Other Than Corner Zone: Uniform pressure of 40 psf, acting inward and 40 psf, acting outward.
- C. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. Design earthquake spectral response acceleration, short period (Sds) for Project is 0.141.
 - 2. Component Importance Factor is 1.5.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.
 - 1. Temperature Change (Range): 120°F, ambient; 180°F, material surfaces.
- E. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

1.06 SUBMITTALS:

- A. Product Data: For each type of product indicated.
 - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

SECTION 089000 - LOUVERS AND VENTS: continued

- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
 - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
 - 2. Show mullion profiles and locations.
- C. Samples: For units with factory-applied color finishes.
- D. LEED Submittals:
 - 1. Product Data for Credit MRc4: For products containing recycled content, submit documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content for each product or portion of a product having recycled content. Include statement indicating cost for each product containing recycled content material.
 - 2. Product Data for Credit MRc5: For products and materials complying with requirements for regional materials, submit documentation indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

1.07 INFORMATIONAL SUBMITTALS:

- A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

1.08 QUALITY ASSURANCE:

- A. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."
- C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.
- D. UL and NEMA Compliance: Provide motors and related components for motor-operated louvers that are listed and labeled by UL and comply with applicable NEMA standards.

1.09 PROJECT CONDITIONS:

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B209 (ASTM B209M), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Aluminum Castings: ASTM B26/B26M, Alloy 319.
- D. Galvanized-Steel Sheet: ASTM A653/A653M, G60 (Z180) zinc coating, mill phosphatized.
- E. Fasteners: Use types and sizes to suit unit installation conditions.
 - 1. Use Phillips flat-head screws for exposed fasteners, unless otherwise indicated.
 - 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.

SECTION 089000 - LOUVERS AND VENTS: continued

3. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
 4. For fastening stainless steel, use 300 series stainless-steel fasteners.
 5. For color-finished louvers, use fasteners with heads that match color of louvers.
- F. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E488, conducted by a qualified independent testing agency.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.

2.02 FABRICATION, GENERAL:

- A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.
1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern.
- C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
1. Frame Type: Channel, unless otherwise indicated.
- E. Include supports, anchorages, and accessories required for complete assembly.
- F. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches o.c., whichever is less.
1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
 2. Exterior Corners: Prefabricated corner units with mitered and welded blades, mullions at corners.
- G. Provide subsills made of same material as louvers for recessed louvers.
- H. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.03 FIXED, EXTRUDED-ALUMINUM LOUVERS:

- A. Horizontal Storm-Resistant Louver:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. Air Balance, Inc.; a Mestek company.
 - b. Air Flow Company, Inc.
 - c. Airolite Company, LLC (The).
 - d. All-Lite Architectural Products.
 - e. American Warming and Ventilating, Inc.; a Mestek company.
 - f. Arrow United Industries; a division of Mestek, Inc.
 - g. Construction Specialties, Inc.

SECTION 089000 - LOUVERS AND VENTS: continued

- h. Greenheck Fan Corporation.
- i. Industrial Louvers, Inc.
- j. NCA Manufacturing, Inc.
- k. Nystrom Building Products.
- l. Reliable Products, Inc.
- m. Ruskin Company; Tomkins PLC.
- n. United Enertech Corp.
- 2. Louver Depth: 5 inches.
- 3. Frame and Blade Nominal Thickness: Not less than 0.080 inch for blades and 0.080 inch for frames.
- 4. Louver Performance Ratings:
 - a. Free Area: Not less than 7.0 sq. ft. for 48-inch wide by 48-inch high louver.
 - b. Air Performance: Not more than 0.10-inch wg static pressure drop at 600-fpm free-area exhaust velocity.
 - c. Wind-Driven Rain Performance: Not less than 99% effectiveness when subjected to a rainfall rate of 3 inches per hour and a wind speed of 29 mph at a core-area intake velocity of 500 fpm.
- 5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.04 LOUVER SCREENS:

- A. General: Provide screen at each exterior louver.
 - 1. Screen Location for Fixed Louvers: Interior face.
 - 2. Screening Type: Bird screening.
- B. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
 - 1. Metal: Same kind and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
 - 2. Finish: Same finish as louver frames to which louver screens are attached.
 - 3. Type: Rewirable frames with a driven spline or insert.
- D. Louver Screening for Aluminum Louvers:
 - 1. Bird Screening: Aluminum, 1/2-inch square mesh, 0.063-inch wire.

2.05 FINISHES, GENERAL:

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.06 ALUMINUM FINISHES:

- A. Finish louvers after assembly.
- B. High-Performance Organic Finish: 3-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70% PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: As selected by Contracting Officer from manufacturer's full range.

SECTION 089000 - LOUVERS AND VENTS: continued

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION:

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.03 INSTALLATION:

- A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- F. Protect unpainted galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with DIVISION 07, Section "Joint Sealants" for sealants applied during louver installation.

3.04 ADJUSTING AND CLEANING:

- A. Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.
- B. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- C. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- D. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Contracting Officer, remove damaged units and replace with new units.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089000

DIVISION 09 - FINISHES

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS:
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this Section.
- 1.02 SUMMARY:
- A. Section Includes:
 - 1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
 - B. Related Requirements:
 - 1. DIVISION 01 Section "Sustainable Design Requirements" for LEED related requirements for recycled content materials and local/regionally manufactured and sourced materials.
 - 2. DIVISION 05 Section "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs.
- 1.03 REFERENCES:
- A. ASTM International:
 - 1. ASTM A641/641M-03 - Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - 2. ASTM A653/653M-07 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 3. ASTM C645-08a - Specification for Nonstructural Steel Framing Members.
 - 4. ASTM C754-07 - Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
 - 5. ASTM C840-07 - Specification for Application and Finishing of Gypsum Board.
 - 6. ASTM D226-06 - Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
 - 7. ASTM E90-04 - Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - 8. ASTM E119-08a - Test Methods for Fire Tests of Building Construction and Materials.
 - 9. ASTM E413-04 - Classification for Rating Sound Insulation.
 - 10. ASTM E488-96 (Reapproved 2003) - Test Methods for Strength of Anchors in Concrete and Masonry Elements.
 - 11. ASTM E1190-95 (Reapproved 2007) - Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members.
- 1.04 SUBMITTALS:
- A. Product Data: For each type of product.
 - B. LEED® Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
 - 2. Product Data for Credit MRc5: For products and materials complying with requirements for regional materials, submit documentation indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each

SECTION 092216 - NON-STRUCTURAL METAL FRAMING: continued

raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

1.05 INFORMATION SUBMITTALS:

- A. Evaluation Reports: For dimpled steel studs and runners and firestop tracks, from ICC-ES.

PART 2 - PRODUCTS

2.01 DESCRIPTION:

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25%.

2.02 FRAMING SYSTEMS:

- A. Framing Members, General: Comply with ASTM C754 for conditions indicated.
1. Steel Sheet Components: Comply with ASTM C645 requirements for metal unless otherwise indicated.
 2. Protective Coating: ASTM A653/A653M, G40 (Z120), hot-dip galvanized, unless otherwise indicated.
- B. Studs and Runners: ASTM C645. Use either steel studs and runners or dimpled steel studs and runners.
1. Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.033 inch.
 - b. Depth: As shown on Drawings.
 2. Dimpled Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.025 inch.
 - b. Depth: As shown on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
1. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - (1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
 - (2) MBA Building Supplies; FlatSteel Deflection Track.
 - (3) Steel Network Inc. (The); VertiClip SLD Series.
 - (4) Superior Metal Trim; Superior Flex Track System (SFT).
 - (5) Telling Industries; Vertical Slip Track.
- D. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Fire Trak Corp.; Fire Trak System attached to studs with Fire Trak Posi Klip.
 - b. Grace Construction Products; FlameSafe FlowTrak System.
 - c. Metal-Lite, Inc.; The System.

SECTION 092216 - NON-STRUCTURAL METAL FRAMING: continued

- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - 1. Minimum Base-Metal Thickness: 0.033 inch.
- F. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-metal thickness, with minimum 1/2-inch wide flanges.
 - 1. Depth: 1-1/2 inches.
 - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch thick, galvanized steel.
- G. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch wide flanges.
 - 1. Depth: 3/4 inch.
 - 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch.
 - 3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch diameter wire, or double strand of 0.048-inch diameter wire.

2.03 SUSPENSION SYSTEMS:

- A. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
 - b. Chicago Metallic Corporation; Drywall Grid System.
 - c. USG Corporation; Drywall Suspension System.
 - d. Or approved equal.

2.04 AUXILIARY MATERIALS:

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
 - 1. Asphalt-Saturated Organic Felt: ASTM D226, Type I (No. 15 asphalt felt), nonperforated.
 - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION:

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

SECTION 092216 - NON-STRUCTURAL METAL FRAMING: continued

3.03 INSTALLATION, GENERAL:

- A. Installation Standard: ASTM C754, except comply with framing sizes and spacing indicated.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.04 INSTALLING FRAMED ASSEMBLIES:

- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- B. Install studs so flanges within framing system point in same direction.
 - 1. Space studs as follows:
 - a. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
 - b. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.
- C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- D. Direct Furring:
 - 1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.05 INSTALLING SUSPENSION SYSTEMS:

- A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

SECTION 092216 - NON-STRUCTURAL METAL FRAMING: continued

- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads.
 - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 5. Do not attach hangers to steel roof deck.
 - 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Interior gypsum board.
 - 2. Tile backing panels.
 - 3. Exterior gypsum board sheathing.
- B. Related Requirements:
 - 1. DIVISION 01, Section "Sustainable Design Requirements" for LEED® related requirements for recycled content materials and local/regionally manufactured and sourced materials.
 - 2. DIVISION 09, Section "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.
 - 3. DIVISION 09, Section "Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.03 REFERENCES:

- A. American National Standards Institute:
 - 1. ANSI A108/A118/A136 (2005) - Installation of Ceramic Tile.
- B. ASTM International:
 - 1. ASTM B221-06 - Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 2. ASTM C423-08 - Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - 3. ASTM C475/C475M-02 (Reapproved 2007) - Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 - 4. ASTM C665-06 - Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - 5. ASTM C840-08 - Specification for Application and Finishing of Gypsum Board.
 - 6. ASTM C954-07 - Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. to 0.112 in. in Thickness.
 - 7. ASTM C1002-07 - Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
 - 8. ASTM C1047-05 - Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
 - 9. ASTM C1177/C1177M-06 - Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
 - 10. ASTM C1178/C1178M-06 - Specification for Glass Mat Water-Resistant Gypsum Backing Panel.
 - 11. ASTM C1325-08 - Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units.
 - 12. ASTM C1396/C1396M-06a - Specification for Gypsum Board.
 - 13. ASTM C1658/C1658M-06 - Specification for Glass Mat Gypsum Panels.

SECTION 092900 - GYPSUM BOARD: continued

14. ASTM D3273-00 (Reapproved 2005) - Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
 15. ASTM D3274-09 - Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation.
 16. ASTM E84-08a - Test Method for Surface Burning Characteristics of Building Materials.
 17. ASTM E90-04 - Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 18. ASTM E119-08a - Test Methods for Fire Tests of Building Construction and Materials.
 19. ASTM E413-04 - Classification for Rating Sound Insulation.
- C. Code of Federal Regulations:
1. 40 CFR, Part 59, Subpart D (2007) - National Volatile Organic Compound Emission Standards for Architectural Coatings.
- 1.04 SUBMITTALS:
- A. Product Data: For each type of product.
- B. LEED Submittals:
1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 2. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
 3. Product Data for Credit IEQ 4.1: For adhesives used to laminate gypsum board panels to substrates, documentation including printed statement of VOC content.
- C. Samples: For the following products:
1. Trim Accessories: Full-size Sample in 12-inch long length for each trim accessory indicated.
- 1.05 DELIVERY, STORAGE AND HANDLING:
- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.
- 1.06 FIELD CONDITIONS:
- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

SECTION 092900 - GYPSUM BOARD: continued

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS:

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. Low-Emitting Materials: The VOC content for gypsum board panel adhesives installed inside the weatherproofing barrier of the building shall not exceed 50 g/L.

2.02 GYPSUM BOARD, GENERAL:

- A. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25%.
- B. Regional Materials: Gypsum panel products shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- C. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.03 INTERIOR GYPSUM BOARD:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - 1. American Gypsum.
 - 2. CertainTeed Corp.
 - 3. Georgia-Pacific Gypsum LLC.
 - 4. Lafarge North America Inc.
 - 5. National Gypsum Company.
 - 6. PABCO Gypsum.
 - 7. Temple-Inland.
 - 8. USG Corporation.
- B. Gypsum Wallboard: ASTM C1396/C1396M.
 - 1. Thickness: 5/8 inch.
 - 2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
- C. Gypsum Board, Type X: ASTM C1396/C1396M.
 - 1. Thickness: 5/8 inch.
 - 2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
- D. Gypsum Ceiling Board: ASTM C1396/C1396M.
 - 1. Thickness: 1/2 inch.
 - 2. Long Edges: Tapered.
- E. Moisture- and Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.
 - 1. Core: 5/8 inch, Type X.
 - 2. Long Edges: Tapered.
 - 3. Mold Resistance: ASTM D3273, score of 10.

2.04 SPECIALTY GYPSUM BOARD:

- A. Glass-Mat Interior Gypsum Board: ASTM C1658/C1658M. With fiberglass mat laminated to both sides. Specifically designed for interior use.
 - 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Georgia-Pacific Gypsum LLC; DensArmour Plus.

SECTION 092900 - GYPSUM BOARD: continued

2. Core: 5/8 inch, abuse resistant.
 3. Long Edges: Tapered.
 4. Mold Resistance: ASTM D3273, score of 10.
- 2.05 EXTERIOR GYPSUM BOARD SHEATHING:
- A. Glass-Mat Gypsum Sheathing Board: ASTM C1177/C1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following or approved equal:
 - a. CertainTeed Corp.; GlasRoc Sheathing.
 - b. Georgia-Pacific Gypsum LLC; Dens-Glass Gold.
 - c. National Gypsum Company; Gold Bond, e(2)XP.
 - d. USG Corporation; Securock Glass Mat Sheathing.
- 2.06 TILE BACKING PANELS:
- A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or 1325, with manufacturer's standard edges.
 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. C-Cure; C-Cure Board 990.
 - b. CertainTeed Corp.; FiberCement BackerBoard.
 - c. Custom Building Products; Wonderboard.
 - d. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
 - e. James Hardie Building Products, Inc.; Hardiebacker.
 - f. National Gypsum Company, Permabase Cement Board.
 - g. USG Corporation; DUROCK Cement Board.
 2. Thickness: 5/8 inch.
 3. Mold Resistance: ASTM D3273, score of 10.
 4. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equals:
 - a. American Gypsum.
 - b. CertainTeed Corp.
 - c. Georgia-Pacific Gypsum LLC.
 - d. Lafarge North America Inc.
 - e. PABCO Gypsum.
 - f. Temple-Inland.
 - g. USG Corporation.
 5. Core: 5/8 inch.
- 2.07 TRIM ACCESSORIES:
- A. Interior Trim: ASTM C1047.
 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
 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.

SECTION 092900 - GYPSUM BOARD: continued

- e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
- f. Expansion (control) joint.

2.08 JOINT TREATMENT MATERIALS:

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Glass-Mat Gypsum Sheathing Board: 10 by 10 glass mesh.
 - 3. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
 - 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.
- D. Joint Compound for Tile Backing Panels:
 - 1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
 - 2. Cementitious Backer Units: As recommended by backer unit manufacturer.
- E. VOC Content: VOC content for joint compounds shall not exceed 250 g/L.

2.09 AUXILIARY MATERIALS:

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: ASTM C1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Sound Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
 - 2. Recycled Content of Blankets: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25%.
 - 3. Products: Subject to compliance with requirements, provide one of the following or approved equals:
 - a. Accumetric LLC; BOSS 824 Acoustical Sound Sealant.
 - b. Grabber Construction Products; Acoustical Sealant GSC.
 - c. Pecora Corporation; AC-20 FTR.
 - d. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
 - e. USG Corporation; SHEETROCK Acoustical Sealant.
- D. Thermal Insulation: As specified in DIVISION 07, Section "Thermal Insulation."

SECTION 092900 - GYPSUM BOARD: continued

- E. Vapor Retarder: As specified in DIVISION 07, Section "Thermal Insulation."

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLYING AND FINISHING PANELS, GENERAL:

- A. Comply with ASTM C840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panel's not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.03 APPLYING INTERIOR GYPSUM BOARD:

- A. Install interior gypsum board in the following locations:
 - 1. Wallboard Type: Vertical and horizontal surfaces.
 - 2. Type X: Where required for fire-resistance-rated assembly.
 - 3. Glass-Mat Interior Type: Vertical Surfaces.
 - 4. Exterior Gypsum Board Sheathing:
 - a. Vertical Surfaces.
- B. Single-Layer Application:
 - 1. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

SECTION 092900 - GYPSUM BOARD: continued

- a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 2. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- 3.04 APPLYING TILE BACKING PANELS:
- A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.
 - B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.
- 3.05 INSTALLING TRIM ACCESSORIES:
- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
 - B. Control Joints: Install control joints according to ASTM C840 and in specific locations approved by Contracting Officer for visual effect.
 - C. Interior Trim: Install in the following locations:
 1. Cornerbead: Use at outside corners.
 2. Bullnose Bead: Use at outside corners.
 3. U-Bead: Use at exposed panel edges.
 4. Curved-Edge Cornerbead: Use at curved openings.
- 3.06 FINISHING GYPSUM BOARD:
- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
 - B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
 - C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
 - D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
 1. Level 2: Panels that are substrate for tile.
 2. Level 4: At panel surfaces that will be exposed to view.
 - a. Primer and its application to surfaces are specified in other DIVISION 09 Sections.
 - E. Exterior Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
 - F. Cementitious Backer Units: Finish according to manufacturer's written instructions.
- 3.07 PROTECTION:
- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
 - B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
 - C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

SECTION 092900 - GYPSUM BOARD: continued

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093000 - PORCELAIN TILE

PART 1 - GENERAL

1.01 REFERENCES:

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to within the text by the basic designation only.
1. ASTM International (ASTM):
 - a. ASTM C1026 - Standard Test Method for Measuring the Resistance of Ceramic Tile to Freeze-Thaw Cycling, 1987; R 2002.
 - b. ASTM C1027 - Standard Test Method for Determining Visible Abrasion Resistance of Glazed Ceramic Tile, 1999; R 2004.
 - c. ASTM C1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method, 2007.
 - d. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar, 2004.
 - e. ASTM C150 - Standard Specification for Portland Cement, 2007.
 - f. ASTM C206 - Standard Specification for Finishing Hydrated Lime, 2003.
 - g. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes, 2006.
 - h. ASTM C241 - Standard Specification for Abrasion Resistance of Stone Subjected to Foot Traffic, 1990; R 2005.
 - i. ASTM C373 - Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products, 1988; R 2006.
 - j. ASTM C482 - Bond Strength of Ceramic Tile to Portland Cement, 2002.
 - k. ASTM C501 - Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser, 1984; R 2002.
 - l. ASTM C648 - Breaking Strength of Ceramic Tile, 2004.
 - m. ASTM E2129 - Standard Practice for Data Collection for Sustainability Assessment of Building Products, 2005.
 2. Bay Area Air Quality Management District (Bay Area AQMD):
 - a. Bay Area AQMD Rule 8-51 - Adhesive and Sealant Products, 1992; R 2001.
 3. Green Seal (GS):
 - a. GS-36 - Commercial Adhesives, 2000.
 4. National Fire Protection Association:
 - a. NFPA 99 - Health Care Facilities, 2005; Errata 2005.
 5. South Coast Air Quality Management District (SCAQMD):
 - a. SCAQMD Rule 1168 - Adhesive and Sealant Applications, 1989; R 2005.
 6. Tile Council of America (TCA):
 - a. TCA Hdbk - Handbook for Ceramic Tile Installation, 2007.
 7. U.S. Green Building Council (USGBC):
 - a. LEED[®] - Leadership in Energy and Environmental Design[™] Green Building Rating System for New Construction (LEED-NC), 2002; R 2005.

1.02 SUBMITTALS:

- A. Submit the following in accordance with SECTION 013300 - SUBMITTAL PROCEDURES:
1. Product Data:
 - a. Local/Regional Materials; LEED.
 - (1) Submit LEED Documentation indicating distance between manufacturing facility and the project site.
 - (2) Indicate distance of raw material origin from the project site.

SECTION 093000 - PORCELAIN TILE: continued

- (3) Indicate relative dollar value of local/regional materials to total dollar value of products included in project.
 - (4) Include in LEED Documentation Notebook.
 - b. Environmental Data.
 - c. Tile.
 - d. Setting-Bed.
 - e. Mortar, Grout, and Adhesive; LEED:
 - (1) Manufacturer's catalog data and preprinted installation and cleaning instructions.
 - (2) Indicate VOC content.
 - f. Tile; LEED.
 - g. Reinforcing Wire Fabric; LEED
 - (1) Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product.
 - (2) Indicate relative dollar value of recycled content products to total dollar value of products included in project.
 - 2. Samples:
 - a. Tile.
 - b. Accessories.
 - c. Marble Thresholds.
 - d. Grout:
 - (1) Samples of sufficient size to show color range, pattern, type and joints.
 - 3. Certificates:
 - a. Tile.
 - b. Mortar, Grout, and Adhesive:
 - (1) Certificates indicating conformance with specified requirements.
 - (2) Furnish a master grade certificate for tile.
 - 4. Closeout Submittals:
 - a. Local/Regional Materials; LEED:
 - (1) LEED documentation relative to local/regional materials credit in accordance with LEED Reference Guide.
 - (2) Include in LEED Documentation Notebook.
 - b. Tile; LEED.
 - c. Reinforcing Wire Fabric; LEED:
 - (1) LEED documentation relative to recycled content credit in accordance with LEED Reference Guide.
 - (2) Include in LEED Documentation Notebook.
 - d. Adhesives; LEED:
 - (1) LEED documentation relative to low-emitting materials credit in accordance with LEED Reference Guide.
 - (2) Include in LEED Documentation Notebook.
- 1.03 DELIVERY AND STORAGE:
 - A. Deliver materials to the project site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact.
 - B. Protect materials from weather, and stored under cover in accordance with manufacturer's printed instructions.

SECTION 093000 - PORCELAIN TILE: continued

1.04 ENVIRONMENTAL REQUIREMENTS:

- A. Close space in which tile is being set to traffic and other work.
 - 1. Keep closed until tile is firmly set.
 - 2. Do not walk or work on newly tiled floors without using kneeling boards or equivalent protection of the tiled surface.
 - 3. Keep traffic off horizontal Portland cement mortar installations for at least 72 hours.
 - 4. Keep all traffic off epoxy installed floors for at least 40 hours after grouting, and heavy traffic off for at least 7 days, unless otherwise specifically authorized by manufacturer.
- B. Do not perform ceramic tile work unless the substrate and ambient temperature is at least 50°F and rising.
 - 1. Maintain temperature above 50°F while the work is being performed and for at least 7 days after completion of the work.
 - 2. When temporary heaters are used, ventilate the area to the outside to avoid carbon dioxide damage to new tilework.

1.05 SUSTAINABLE DESIGN REQUIREMENTS:

- A. Local/Regional Materials:
 - 1. Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500-mile radius from the project site, if available from a minimum of three sources.
 - 2. See SECTION 013329 - LEED DOCUMENTATION for cumulative total local material requirements.
 - 3. Tile materials may be locally available.
- B. Environmental Data:
 - 1. Submit Table 1 of ASTM E2129 for the following products:
 - a. Ceramic tile.
 - b. Grout.
 - c. Adhesives.

1.06 WARRANTY:

- A. Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period.

PART 2 - PRODUCTS

2.01 TILE:

- A. Conform to TCA Hdbk for standard grade tile:
 - 1. Provide grade sealed containers.
 - 2. Mark seals with the marks on the signed master grade certificate.
 - 3. Provide an impact resistant tile with a minimum floor breaking strength for wall tile of 90 pounds and for floor tile of 250 pounds in accordance with ASTM C648.
 - 4. The manufacturer will provide a frost resistant rating for tile used in cold climate projects as determined by ASTM C1026.
 - 5. Provide a 0.50 maximum percent water absorption in accordance with ASTM C373.
 - 6. Provide a minimum coefficient of friction of 0.50 wet and dry in accordance with ASTM C1028.
 - 7. Identify floor tile as Class III-Medium Heavy Traffic, durability classification as rated by the manufacturer when tested in accordance with ASTM C1027 for abrasion resistance as related to foot traffic.

SECTION 093000 - PORCELAIN TILE: continued

8. See SECTION 013329 - LEED DOCUMENTATION for cumulative total recycled content.
 9. Tile may contain post-consumer or post-industrial recycled content.
 - B. Porcelain Tile:
 1. Furnish a polished and unpolished porcelain tile and trim with the color extending uniformly through the body of the tile.
 2. Criteria for tile to meet or exceed is as follows: Abrasive wear in accordance with ASTM C501 and bonding strength in accordance with ASTM C482.
 3. Comply with 36 CFR 1191 for coefficient of friction for interior tiled floors.
- 2.02 UNGLAZED (UNPOLISHED) PORCELAIN PAVER TILE:
- A. Unglazed (unpolished) porcelain paver tile shall be standard grade conforming to ANSI A173.1.
 - B. Containers shall be grade sealed.
 - C. Seals shall be marked to correspond with the marks on the signed master grade certificate.
 - D. Tile shall be impact resistant with a minimum breaking strength for wall tile of 250 pounds for floor tile in accordance with ASTM C648.
 - E. Water absorption shall be 0.50 maximum percent in accordance with ASTM C373.
 - F. Floor tile shall have a minimum coefficient of friction of 0.50 wet and dry in accordance with ASTM C1028.
 - G. Floor tile shall be Class III-Medium Heavy durability classification as rated by the manufacturer when tested in accordance with ASTM C1027 for abrasion resistance as related to foot traffic.
- 2.03 BASIS OF DESIGN:
- A. Basis of design for texture, color and pattern is as follows:
 1. Unpolished Porcelain Paver Tile:
 - a. Daltile Corporation.
 - b. Pattern/Style: Diamante.
 - c. Finish: Unpolished.
 - d. Size: 18 by 18 inches.
 - e. Cushioned edges.
 - f. Grout Joint Width: 1/4 inch.
 - g. Grout: Kerapoxy with Bioblock.
 2. Or equals with prior approval.

2.04 WATER:

- A. Provide potable water.

2.05 MORTAR, GROUT, AND ADHESIVE:

- A. Interior adhesives, sealants, primers and sealants used as filler must meet the requirements of LEED low emitting materials credit.
- B. Conform to SCAQMD Rule 1168 and Bay Area AQMD Rule 8-51, and to the following for mortar, grout, adhesive, and sealant:
 1. Dry-Set Portland Cement Mortar: TCA Hdbk.
 2. Grout: TCA Hdbk:
 - a. Petroleum-free and plastic free commercial Portland cement grout.
 - b. Maximum VOC content of 150 grams/liter.

SECTION 093000 - PORCELAIN TILE: continued

PART 3 - EXECUTION

3.01 PREPARATORY WORK AND WORKMANSHIP:

- A. Inspect surface to receive tile in conformance to the requirements of TCA Hdbk for surface conditions for the type setting bed specified and for workmanship.
- B. Provide variations of tiled surfaces that fall within maximum values shown below:

<u>Type</u>	<u>Walls</u>	<u>Floors</u>
Latex Portland Cement Mortar	1/8 inch in 8 feet	1/8 inch in 10 feet

3.02 GENERAL INSTALLATION REQUIREMENTS:

- A. Do not start tile work until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring membrane waterproofing have been installed and tested.
- B. Apply tile in the area shown on the drawings.
- C. Install tile with the respective surfaces in true even planes to the elevations and grades shown.
- D. Provide special shapes as required for sills, jambs, recesses, offsets, external corners, and other conditions to provide a complete and neatly finished installation.
- E. Solidly back tile bases and coves with mortar.

3.03 INSTALLATION OF FLOOR TILE:

- A. Floor tile shall be installed in accordance with TCA Handbook using the following methods:
 - 1. Porcelain Paver Tile on Concrete (Floor): F113-05.
- B. Dry-Set and Latex-Portland Cement:
 - 1. Use latex-Portland cement mortar to install tile directly over properly cured, plane, clean concrete slabs in accordance with TCA Hdbk.
 - 2. Use latex Portland cement when installing porcelain ceramic tile.
- C. Polymer Modified Grout:
 - 1. Polymer-modified tile grout; sanded grout.
 - 2. Prepare and install in accordance with TCA Hdbk.
 - 3. Rake and clean joints to the full depth of the tile and neutralize when recommended by the polymer modified grout manufacturer.
 - 4. Install polymer modified grout in conformance with TCA Hdbk.
 - 5. Follow manufacturer's printed installation instructions of installed polymer modified grout for proportioning, mixing, installing, and curing.
 - 6. Maintain the recommended temperature in the area and on the surface to be grouted.
 - 7. Protect finished grout.

3.04 EXPANSION JOINTS:

- A. Form and seal joints as specified in SECTION 079200 - JOINT SEALANTS.
- B. Floors:
 - 1. Provide expansion joints over construction joints, control joints, and expansion joints in concrete slabs.
 - 2. Provide expansion joints where tile abuts restraining surfaces such as perimeter walls, curbs and columns and at intervals of 24 to 36 feet each way in large interior floor areas and 12 to 16 feet each way in large exterior areas or areas exposed to direct sunlight or moisture.
 - 3. Extend expansion joints through setting-beds and fill.

SECTION 093000 - PORCELAIN TILE: continued

3.05 CLEANING AND PROTECTING:

- A. Upon completion, thoroughly clean tile surfaces in accordance with manufacturer's approved cleaning instructions.
- B. Do not use acid for cleaning glazed tile.
- C. Clean floor tile in accordance with printed instructions of the grout manufacturer.
- D. After the grout has set, provide a protective coat of a noncorrosive soap or other approved method of protection for tile wall surfaces.
- E. Cover tiled floor areas with building paper before foot traffic is permitted over the finished tile floors.
- F. Provide board walkways on tiled floors that are to be continuously used as passageways by workmen.
- G. Replace damaged or defective tiles.

3.06 WASTE MANAGEMENT:

- A. Separate waste, including metal and cardboard, in accordance with the Waste Management Plan and recycle or reuse.
- B. Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in designated containers and areas.
- C. Close and seal tightly partly used sealant and adhesive containers and store in protected, well-ventilated, fire-safe area at moderate temperature.
- D. Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in designated containers and areas and dispose of properly.
- E. Set aside and protect half-tile and larger offcuts and remainders for reuse by the Government.
- F. Crush broken tile, offcuts smaller than a half tile, and excess mortar and grout for use as mosaic, sub-base, or fill.
- G. Identify manufacturer's policy for collection or return of construction scrap, unused material, demolition scrap, and packaging material.
- H. Institute recycling to take advantage of manufacturer's programs.
- I. When such a service is not available, seek local recyclers to reclaim the materials.

END OF SECTION 093000

SECTION 095123 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Acoustical tiles for ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.03 REFERENCES:

- A. American Architectural Manufacturers Association:
 - 1. AAMA 611 (1998) - Voluntary Specification for Anodized Architectural Aluminum.
- B. American Society of Civil Engineers/Structural Engineering Institute:
 - 1. ASCE/SEI 7 (2005) - Minimum Design Loads for Buildings and Other Structures.
- C. ASTM International:
 - 1. ASTM A641/A641M-03 - Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - 2. ASTM A653/A653M-08 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 3. ASTM B221-08 - Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 4. ASTM B633-07 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
 - 5. ASTM C635/C635M-07 - Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
 - 6. ASTM C636/C636M-08 - Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
 - 7. ASTM D3273-00 (Reapproved 2005) - Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
 - 8. ASTM D3274-95 (Reapproved 2002) - Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Microbial (Fungal or Algal) Growth or Soil and Dirt Accumulation.
 - 9. ASTM E84-08a - Test Method for Surface Burning Characteristics of Building Materials.
 - 10. ASTM E90-04 - Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - 11. ASTM E119-08a - Test Methods for Fire Tests of Building Construction and Materials.
 - 12. ASTM E488-96 (Reapproved 2003) - Test Method for Strength of Anchors in Concrete and Masonry Elements.
 - 13. ASTM E795-05 - Practices for Mounting Test Specimens during Sound Absorption Tests.
 - 14. ASTM E1190-95 (Reapproved 2007) - Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members.
 - 15. ASTM E1264-08 - Classification for Acoustical Ceiling Products.
 - 16. ASTM E1512-01 (Reapproved 2007) - Test Methods for Testing Bond Performance of Bonded Anchors.
 - 17. ASTM F593-02 (Reapproved 2008) - Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

SECTION 095123 - ACOUSTICAL TILE CEILINGS: continued

18. ASTM F594-08 - Specification for Stainless Steel Nuts.
 19. ASTM G21-96 (Reapproved 2002) - Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
 - D. California Department of Health Services:
 1. Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, 2004.
 - E. Ceilings & Interior Systems Construction Association:
 1. Ceiling Systems Handbook, 1999.
 - F. Code of Federal Regulations:
 1. 40 CFR 59, Subpart D (2008) - National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - G. Underwriters Laboratories Inc.:
 1. Fire Resistance Directory, 2008.
- 1.04 SUBMITTALS:
- A. Product Data: For each type of product.
 - B. LEED[®] Submittals:
 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
 2. Product Data for Credit MR 5: For products and materials complying with requirements for regional materials, submit documentation indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
 - C. Samples: For each exposed product and for each color and texture specified, 6 inches in size.
 - D. Samples: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 1. Acoustical Tile: Set of full-size Samples of each type, color, pattern, and texture.
 2. Exposed Moldings and Trim: Set of 6-inch long Samples of each type and color.
- 1.05 INFORMATIONAL SUBMITTALS:
- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Ceiling suspension-system members.
 2. Method of attaching hangers to building structure.
 - a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
 3. Size and location of initial access modules for acoustical tile.
 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 5. Minimum Drawing Scale: 1/4 inch = 1 foot (1:48).
 - B. Qualification Data: For testing agency.
 - C. Product Test Reports: For each acoustical tile ceiling, for tests performed by a qualified testing agency.
 - D. Evaluation Reports: For each acoustical tile ceiling suspension system and anchor and fastener type, from ICC-ES.
 - E. Field quality-control reports.

SECTION 095123 - ACOUSTICAL TILE CEILINGS: continued

1.06 CLOSEOUT SUBMITTALS:

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.07 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. Acoustical Ceiling Units: Full-size tiles equal to 2% of quantity installed.
 - 2. Suspension-System Components: Quantity of each concealed grid and exposed component equal to 2% of quantity installed.

1.08 QUALITY ASSURANCE:

- A. Testing Agency Qualifications: Qualified according to the National Voluntary Laboratory Accreditation Program (NVLAP) for testing indicated.

1.09 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver acoustical tiles, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical tiles carefully to avoid chipping edges or damaging units in any way.

1.10 FIELD CONDITIONS:

- A. Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical tile ceiling installation.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS:

- A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E1264 for Class A materials.
 - 2. Smoke-Developed Index: 50 or less.
- C. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.02 ACOUSTICAL TILES, GENERAL:

- A. Low-Emitting Materials: Acoustical tile ceilings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the

SECTION 095123 - ACOUSTICAL TILE CEILINGS: continued

Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- B. Source Limitations:
 - 1. Acoustical Ceiling Tile: Obtain each type from single source from single manufacturer.
 - 2. Suspension System: Obtain each type from single source from single manufacturer.
- C. Source Limitations: Obtain each type of acoustical ceiling tile and supporting suspension system from single source from single manufacturer.
- D. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25%.
- E. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E795.
- F. Acoustical Tile Colors and Patterns: Match appearance characteristics indicated for each product type.
 - 1. Where appearance characteristics of acoustical tiles are indicated by referencing pattern designations in ASTM E1264 and not manufacturers' proprietary product designations, provide products selected by Contracting Officer from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.03 ACOUSTICAL TILES:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - 1. Armstrong World Industries, Inc.
 - 2. CertainTeed Corp.
 - 3. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Classification: Provide tiles complying with ASTM E1264 for type, form, and pattern as follows:
 - 1. Type and Form: Type III, mineral base with painted finish; Form 1, nodular.
 - 2. Pattern: C (perforated, small holes).
- C. Basis of Design for acoustic ceiling tiles:
 - 1. Offices: Armstrong Cirrus Open Plan 558, 24 by 24 by 7/8 inches, white (beveled tegular lay-in).
 - 2. Classrooms: Armstrong Cirrus Open Plan 563, 24 by 24 by 7/8 inches, white (square lay-in).
 - 3. Corridors: Armstrong Cirrus Open Plan 558, 24 by 24 by 7/8 inches, white (beveled tegular lay-in).
 - 4. Training Rooms: Armstrong Cirrus Open Plan 558, 24 by 24 by 7/8 inches, white (beveled tegular lay-in).
 - 5. Toilet Room: Armstrong Health Zone Ultima 1937, 24 by 24 by 3/4 inches, white (beveled tegular lay-in).
 - 6. Other Spaces: Armstrong Cirrus Open Plan 563, 24 by 24 by 7/8 inches, white (square lay-in).
 - 7. Demarc Rooms: Armstrong Cirrus Open Plan 563, 24 by 48 by 7/8 inches, white (square lay-in).
- D. LR: Not less than 0.65.
- E. NRC: Not less than 0.50.

SECTION 095123 - ACOUSTICAL TILE CEILINGS: continued

- F. CAC: Not less than 20.
- G. AC: Not less than 170.
- H. Edge/Joint Detail: Beveled, kerfed and rabbeted, or tongue and grooved, or butt.
- I. Thickness: 7/8 inch.
- J. Modular Size: 24 by 24 inches.
- K. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical tiles treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D3273 and evaluated according to ASTM D3274 or ASTM G21.

2.04 METAL SUSPENSION SYSTEMS, GENERAL:

- A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25%.
- B. Metal Suspension-System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C635/C635M.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch diameter wire.
- E. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- F. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04 inch thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch diameter bolts.
- G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate lateral forces.
- H. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical tiles in-place.

2.05 METAL EDGE MOLDINGS AND TRIM:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - 1. Armstrong World Industries, Inc.
 - 2. CertainTeed Corp.
 - 3. Chicago Metallic Corporation.
 - 4. Fry Reglet Corporation.
 - 5. Gordon, Inc.
 - 6. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations complying with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

SECTION 095123 - ACOUSTICAL TILE CEILINGS: continued

1. Provide manufacturer's standard edge moldings that fit acoustical tile edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine acoustical tiles before installation. Reject acoustical tiles that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION:

- A. Testing Substrates: Before installing adhesively applied tiles on wet-placed substrates such as cast-in-place concrete or plaster, test and verify that moisture level is below tile manufacturer's recommended limits.
- B. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders, and comply with layout shown on reflected ceiling plans.

3.03 INSTALLATION OF SUSPENDED ACOUSTICAL TILE CEILINGS:

- A. General: Install acoustical panel ceilings to comply with ASTM C636/C636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.

SECTION 095123 - ACOUSTICAL TILE CEILINGS: continued

6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 8. Do not attach hangers to steel deck tabs.
 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. Arrange acoustical tiles as follows:
1. Install tiles in a basket-weave pattern.
- F. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension-system flanges into kerfed edges so tile-to-tile joints are closed by double lap of material.
1. Fit adjoining tile to form flush, tight joints. Scribe and cut tile for accurate fit at borders and around penetrations through tile.
 2. Hold tile field in compression by inserting leaf-type, spring-steel spacers between tile and moldings, spaced 12 inches o.c.
 3. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.
- 3.04 FIELD QUALITY CONTROL:
- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
1. Compliance of seismic design.
- B. Perform the following tests and inspections of completed installations of acoustical tile ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20% completion but no tiles have been installed. Do not proceed with installations of acoustical tile ceiling hangers for the next area until test results for previously completed installations of acoustical tile ceiling hangers show compliance with requirements.
1. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf of tension.
 2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- C. Acoustical tile ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.

SECTION 095123 - ACOUSTICAL TILE CEILINGS: continued

D. Prepare test and inspection reports.

3.05 CLEANING:

A. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095123

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Resilient base.
- B. Related Sections:
 - 1. DIVISION 09, Section "Resilient Tile Flooring" for resilient floor tile.

1.03 REFERENCES:

- A. ASTM International:
 - 1. ASTM E648-03 - Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
 - 2. ASTM F710-05 - Practice for Preparing Concrete Floors to Receive Resilient Flooring.
 - 3. ASTM F1861-02 - Specification for Resilient Wall Base.
 - 4. ASTM F1869-04 - Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
 - 5. ASTM F2170-02 - Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- B. Code of Federal Regulations:
 - 1. 40 CFR 59, Subpart D-2003 - National Volatile Organic Compound Emission Standards for Architectural Coatings.

1.04 SUBMITTALS:

- A. Product Data: For each type of product indicated.
- B. LEED® Submittals:
 - 1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit IEQ 4: For adhesives, documentation indicating that products 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."
- C. Samples for Selection: For each type of product indicated.
- D. Samples: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

1.05 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. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.06 QUALITY ASSURANCE:

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

SECTION 096513 - RESILIENT BASE AND ACCESSORIES: continued

- B. Mockups: Provide resilient products with mockups specified in other sections.

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50°F or more than 90°F.

1.08 PROJECT CONDITIONS:

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70°F or more than 95°F, in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55°F or more than 95°F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.01 RESILIENT BASE:

- A. Resilient Base:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. Allstate Rubber Corp.; Stoler Industries.
 - b. Armstrong World Industries, Inc.
 - c. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - d. Endura Rubber Flooring; Division of Burke Industries, Inc.
 - e. Estrie Products International; American Biltrite (Canada) Ltd.
 - f. Flexco, Inc.
 - g. Johnsonite.
 - h. Mondo Rubber International, Inc.
 - i. Musson, R. C. Rubber Co.
 - j. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
 - k. PRF USA, Inc.
 - l. Roppe Corporation, USA.
 - m. VPI, LLC; Floor Products Division.
- B. Resilient Base Standard: ASTM F1861.
 - 1. Material Requirement: Type TS (rubber, vulcanized thermoset).
 - 2. Manufacturing Method: Group I (solid, homogeneous).
 - 3. Style: Cove (base with toe).
- C. Minimum Thickness: 0.125 inch.
- D. Height: 4 inches.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Preformed.
- G. Inside Corners: Job formed.
- H. Finish: Matte.
- I. Colors and Patterns: As selected by Contracting Officer from full range of industry colors.

SECTION 096513 - RESILIENT BASE AND ACCESSORIES: continued

2.02 RESILIENT MOLDING ACCESSORY:

- A. Resilient Molding Accessory:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - b. Flexco, Inc.
 - c. Johnsonite.
 - d. R.C.A. Rubber Company (The).
 - e. Roppe Corporation, USA.
 - f. VPI, LLC; Floor Products Division.
- B. Description: Joiner for tile and carpet.
- C. Material: Rubber.
- D. Profile and Dimensions:
 - 1. 2-shaped 1-inch cap, 1/4-inch carpet to 1/8-inch tile reducer.
- E. Colors and Patterns: As selected by Contracting Officer from full range of industry colors.

2.03 INSTALLATION MATERIALS:

- A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
 - 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION:

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Treads and Accessories: Prepare according to ASTM F710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
 - 4. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

SECTION 096513 - RESILIENT BASE AND ACCESSORIES: continued

- a. Perform anhydrous calcium chloride test, ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 pounds of water/1,000 sq. feet in 24 hours.
- b. Perform relative humidity test using in situ probes, ASTM F2170. Proceed with installation only after substrates have maximum 75% relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are same temperature as the space where they are to be installed.
 - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.03 RESILIENT BASE INSTALLATION:

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible.

3.04 RESILIENT ACCESSORY INSTALLATION:

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet that would otherwise be exposed.

3.05 CLEANING AND PROTECTION:

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.

SECTION 096513 - RESILIENT BASE AND ACCESSORIES: continued

- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS:
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this Section.
- 1.02 SUMMARY:
- A. This Section Includes:
 - 1. Vinyl composition floor tile.
 - B. Related Sections:
 - 1. DIVISION 01 Section "Sustainable Design Requirements" for LEED® related requirements for recycled content materials and local/regionally manufactured and sourced materials.
 - 2. DIVISION 09 Section "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.
- 1.03 REFERENCES:
- A. ASTM International:
 - 1. ASTM C109/C109M-02 - Test Method for Compressive Strength of Hydraulic Cement Mortars.
 - 2. ASTM D695-02a - Test Method for Compressive Properties of Rigid Plastics.
 - 3. ASTM D2240-04 - Test Method for Rubber Property Durometer Hardness.
 - 4. ASTM E648-03 - Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
 - 5. ASTM F510-93 (Reapproved 2004) - Test Method for Resistance to Abrasion of Resilient Floor Coverings Using an Abrader with a Grit Feed Meter.
 - 6. ASTM F710-05 - Practice for Preparing Concrete Floors to Receive Resilient Flooring.
 - 7. ASTM F970-00 - Test Method for Static Load Limit.
 - 8. ASTM F1066-04 - Specification for Vinyl Composition Floor Tile.
 - 9. ASTM F1869-04 - Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
 - 10. ASTM F2170-02 - Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in Situ Probes.
 - B. Code of Federal Regulations:
 - 1. 40 CFR 59, Subpart D-2003 - National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - C. NFPA:
 - 1. NFPA 253-2000 - Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.
- 1.04 SUBMITTALS:
- A. Product Data: For each type of product indicated.
 - B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
 - 2. Product Data for Credit IEQ 4.3: For adhesives and chemical-bonding compounds, documentation including printed statement of VOC content.

SECTION 096519 - RESILIENT TILE FLOORING: continued

3. Product Data for Credit IEQ 4.3: For resilient tile flooring and wall base products, documentation from an independent testing agency indicating compliance with the FloorScore Standard.
 4. Product Data for Credit MRc4: For products containing recycled content, submit documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content for each product or portion of a product having recycled content. Include statement indicating cost for each product containing recycled content material.
 5. Product Data for Credit MRc5: For products and materials complying with requirements for regional materials, submit documentation indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
- C. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
1. Show details of special patterns.
- D. Samples: Full-size units of each color and pattern of floor tile required.
- E. Product Schedule: For floor tile.
- 1.05 INFORMATIONAL SUBMITTALS:
- A. Qualification Data: For qualified Installer.
- 1.06 CLOSEOUT SUBMITTALS:
- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.
- 1.07 MATERIALS MAINTENANCE 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. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.
- 1.08 QUALITY ASSURANCE:
- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation indicated.
1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.
- B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- 1.09 DELIVERY, STORAGE, AND HANDLING:
- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50°F or more than 90°F. Store floor tiles on flat surfaces.
- 1.10 PROJECT CONDITIONS:
- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70°F or more than 95°F, in spaces to receive floor tile during the following time periods:
1. 48 hours before installation.
 2. During installation.

SECTION 096519 - RESILIENT TILE FLOORING: continued

3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55°F or more than 95°F.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS:

- A. FloorScore Compliance: Resilient tile flooring shall comply with requirements of FloorScore Standard.

2.02 VINYL COMPOSITION FLOOR TILE:

- A. Tile Standard: ASTM F1066, Class 2, through-pattern tile.
- B. Wearing Surface: Smooth.
- C. Thickness: 0.125 inch.
- D. Size: 12 by 12 inches.
- E. Basis of Design for vinyl composition floor tile:
 1. Congoleum Corporation Choices, Color Group 1, four different color selections.
 2. Or equal with prior approval.
- F. Or equal with prior approval.

2.03 INSTALLATION MATERIALS:

- A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.
 1. Adhesives shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. VCT and Asphalt Tile Adhesives: Not more than 50 g/L.
- C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION:

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F710.

SECTION 096519 - RESILIENT TILE FLOORING: continued

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 - a. Perform anhydrous calcium chloride test, ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 pounds of water/1,000 sq. ft. in 24 hours.
 - b. Perform relative humidity test using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until they are same temperature as space where they are to be installed.
 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.03 FLOOR TILE INSTALLATION:

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 1. Lay tiles square with room axis.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 1. Lay tiles with grain direction alternating in adjacent tiles (basket-weave pattern).
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.04 CLEANING AND PROTECTION:

- A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.

SECTION 096519 - RESILIENT TILE FLOORING: continued

- B. Perform the following operations immediately after completing floor tile installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish.
 - 1. Apply two coats.
- E. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. This Section includes modular, fusion-bonded carpet tile.
- B. Related Requirements:
 - 1. DIVISION 01, Section "Sustainable Design Requirements" for LEED® related requirements for recycled content materials and local/regionally manufactured and sourced materials.
 - 2. DIVISION 09, Section "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.03 REFERENCES:

- A. American Association of Textile Chemists and Colorists:
 - 1. AATCC 16-2004 - Colorfastness to Light.
 - 2. AATCC 24-2004 - Resistance of Textiles to Insects.
 - 3. AATCC 134-2006 - Electrostatic Propensity of Carpets.
 - 4. AATCC 165-1999 - Colorfastness to Crocking - Carpets - AATCC Crockmeter Method.
 - 5. AATCC 174-2007 - Antimicrobial Activity Assessment of Carpets.
- B. American National Standards Institute/NSF International:
 - 1. ANSI/NSF 140-2005 - Sustainable Carpet Assessment Standard.
- C. ASTM International:
 - 1. ASTM C423-08 - Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - 2. ASTM D1335-05 - Test Method for Tuft Bind of Pile Yarn Floor Coverings.
 - 3. ASTM D2646-05 - Test Methods for Backing Fabric Characteristics of Pile Yarn Floor Coverings.
 - 4. ASTM D3936-05 - Test Method for Resistance to Delamination of the Secondary Backing of Pile Yarn Floor Covering.
 - 5. ASTM D6859-05 - Test Method for Pile Thickness of Finished Level Pile Yarn Floor Coverings.
 - 6. ASTM D7330-07 - Test Method for Assessment of Surface Appearance Change in Pile Floor Coverings Using Standard Reference Scales.
 - 7. ASTM F710-08 - Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- D. California Department of Health Services:
 - 1. Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, 2004.
- E. The Carpet and Rug Institute:
 - 1. CRI 104-2002 - Standard for Installation Specification of Commercial Carpet.
 - 2. Green Label Plus (testing program), Undated.
- F. Code of Federal Regulations:
 - 1. 40 CFR 59, Subpart D-2002 - National Volatile Organic Compound Emission Standards for Architectural Coatings.
- G. International Organization for Standardization:
 - 1. ISO 2551 (Aachen Test)-1981 - Machine-Made Textile Floor Coverings - Determination of Dimensional Changes in Varying Moisture Conditions.

SECTION 096813 - TILE CARPETING: continued

- H. NFPA:
 - 1. NFPA 253-2006 - Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

- 1.04 SUBMITTALS:
 - A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include installation recommendations for each type of substrate.
 - B. LEED Submittals:
 - 1. Product Data for Credit EQ 4.3:
 - a. For carpet tile, documentation indicating compliance with testing and product requirements of CRI's "Green Label Plus" program.
 - b. For installation adhesive, documentation including printed statement of VOC content.
 - 2. Product Data for Credit MRc4: For products containing recycled content, submit documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content for each product or portion of a product having recycled content. Include statement indicating cost for each product containing recycled content material.
 - 3. Product Data for Credit MRc5: For products and materials complying with requirements for regional materials, submit documentation indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
 - C. Shop Drawings: Show the following:
 - 1. Carpet tile type, color, and dye lot.
 - 2. Type of subfloor.
 - 3. Type of installation.
 - 4. Pattern of installation.
 - 5. Pattern type, location, and direction.
 - 6. Pile direction.
 - 7. Transition details to other flooring materials.
 - D. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Full-size Sample.
 - 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch long Samples.
 - E. Sustainability: Provide the Statement of the Achievement Level the carpet has attained for Gold, 52 to 70 points, based on specific Sustainable Attribute Performance for all product stages according to ANSI/NSF 140.

- 1.05 INFORMATIONAL SUBMITTALS:
 - A. Qualification Data: For Installer.
 - B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
 - C. Sample Warranty: For special warranty.

SECTION 096813 - TILE CARPETING: continued

1.06 CLOSEOUT SUBMITTALS:

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.07 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. Carpet Tile: Full-size units equal to 2% of amount installed for each type indicated, but not less than 10 square yards.

1.08 QUALITY ASSURANCE:

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.
- B. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockups at locations and in sizes shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.09 DELIVERY, STORAGE, AND HANDLING:

- A. Comply with CRI 104.

1.10 FIELD CONDITIONS:

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

1.11 WARRANTY:

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, more than 10% edge raveling, snags, runs, dimensional stability, excess static discharge, loss of tuft bind strength, loss of face fiber, and delamination.
 - 3. Warranty Period: 10 years from date of Substantial Completion.

SECTION 096813 - TILE CARPETING: continued

PART 2 - PRODUCTS

2.01 CARPET TILE:

- A. Carpet shall comply with the following:
 - 1. Pattern Loop.
 - 2. Type: Modular tile, 24 by 24 inches square with 0.15% growth/shrink rate in accordance with ISO 2551.
 - 3. Pile Fiber: Commercial 100% branded (Federally-registered trademark) nylon continuous filament.
 - 4. Pile Height: Minimum 0.119 inch in accordance with ASTM D418.
 - 5. Gauge or Pitch: Minimum 1/12 inch in accordance with ASTM D5793.
 - 6. Stitches or Rows/Wires: Minimum 9.3 per square inch.
 - 7. Finished Pile Yarn Weight: Minimum 30.0 ounces per square yard. This does not include weight of backings. Weight shall be determined in accordance with ASTM D5848.
 - 8. Dye Method: Solution dyed.
 - 9. Backing Materials: Primary backing materials shall be synthetic. Secondary backing shall be 100% recyclable with recycled content thermoplastic polyolefin with fiberglass reinforcing.
 - 10. Installation Method: Quarter-turn.
 - 11. Color: Colors shall be as selected by Contracting Officer from manufacturers standard color palette.
 - 12. Recycle Efforts: Use of nylon fiber with 25% minimum recycled content.
- B. Basis of Design: Glitz Tile 59360 as manufactured by Shaw Contract Group.
 - 1. Minimum four different colors.
 - 2. Or equals with prior approval.

2.02 INSTALLATION ACCESSORIES:

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
 - 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness

SECTION 096813 - TILE CARPETING: continued

characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.

2. Subfloor finishes comply with requirements specified in DIVISION 03, Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION:

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch, unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- D. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
- E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.03 INSTALLATION:

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.
- C. Maintain dye lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.
- H. Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

3.04 CLEANING AND PROTECTION:

- A. Perform the following operations immediately after installing carpet tile:
 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 2. Remove yarns that protrude from carpet tile surface.
 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."

SECTION 096813 - TILE CARPETING: continued

- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
 - 1. Steel.
 - 2. Galvanized metal.
- B. Related Requirements:
 - 1. DIVISION 05 Sections for shop priming of metal substrates with primers specified in this Section.
 - 2. DIVISION 09, Section "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

1.03 REFERENCES:

- A. ASTM International:
 - 1. ASTM D523-08 - Test Method for Specular Gloss.
- B. California Department of Health Services:
 - 1. Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, 2004.
- C. Code of Federal Regulations:
 - 1. 40 CFR 59, Subpart D-2002 - National Volatile Organic Compound Emission Standards for Architectural Coatings.
- D. Master Painters Institute:
 - 1. MPI Approved Products List, January 2004.
 - 2. MPI Architectural Painting Specification Manual, 2004.
- E. SSPC - The Society for Protective Coatings:
 - 1. SSPC-PA 1 2000 (Revised 2004) - Paint Application Specification No. 1 - Shop, Field, and Maintenance Painting of Steel.
 - 2. SSPC-SP 2 1982 (Revised 2004) - Surface Preparation Specification No. 2 - Hand Tool Cleaning.
 - 3. SSPC-SP 3 1982 (Revised 2004) - Surface Preparation Specification No. 3 - Power Tool Cleaning.
 - 4. SSPC-SP 7/NACE No. 4 2000 (Revised 2004) - Joint Surface Preparation Standard SSPC-SP 7/NACE No. 4 - Brush-off Blast Cleaning.
 - 5. SSPC-SP 11 1987 (Revised 2004) - Power Tool Cleaning to Bare Metal.

1.04 DEFINITIONS:

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- B. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- D. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- E. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

SECTION 099113 - EXTERIOR PAINTING: continued

F. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.05 SUBMITTALS:

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples: For each type of paint system and each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- C. 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 Approved Products List" for each product category specified, with the proposed product highlighted.
 - 3. LEED[®] Submittals: For any exterior paint or coating also used inside the weatherproofing barrier and applied on-site, comply with the VOC requirements of LEED Credit IEQc4.2.

1.06 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: 2%, but not less than 1 gallon of each material and color applied.

1.07 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°F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.08 FIELD CONDITIONS:

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

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equals:
 - 1. Behr Process Corporation.
 - 2. Benjamin Moore & Co.
 - 3. Benjamin Moore & Co. (Canada).
 - 4. Bennette Paint Manufacturing Company, Inc.
 - 5. Betonel Ltd.
 - 6. BLP Mobile Paint Manufacturing.
 - 7. California Paints.
 - 8. Cloverdale Paint.

SECTION 099113 - EXTERIOR PAINTING: continued

9. Color Wheel Paints & Coatings.
10. Columbia Paint & Coatings.
11. Conco Paints.
12. Coronado Paint.
13. Davis Paint Company.
14. Del Technical Coatings.
15. Diamond Vogel Paints.
16. Dunn-Edwards Corporation.
17. Durant Performance Coatings.
18. Duron, Inc.
19. Envirocoatings Canada, Inc.
20. Euclid Chemical Company.
21. Farrell-Calhoun.
22. Frazee Paint.
23. General Paint.
24. Hallman Lindsay Paints.
25. Hirshfield's, Inc.
26. ICI Paints.
27. ICI Paints (Canada).
28. Insl-x.
29. Kelly-Moore Paints.
30. Kwal Paint.
31. Life Paint Corp.
32. M.A.B. Paints.
33. Microblend Technologies, Inc.
34. Miller Paint.
35. Mills Paint.
36. PARA Paints.
37. Parex LaHabra, Inc.
38. Parker Paint Mfg. Co., Inc.
39. PPG Architectural Finishes, Inc.
40. Pratt & Lambert.
41. Rodda Paint Co.
42. Scott Paint.
43. Sherwin-Williams Company (The).
44. Sico, Inc.
45. Vista Paint.
46. Zinsser.

2.02 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.

SECTION 099113 - EXTERIOR PAINTING: continued

- C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.
 - D. Colors: As listed in SECTION 090690 - COLOR SCHEDULE.
- 2.03 PRIMERS/SEALERS:
- A. Primer, Alkali Resistant, Water Based: MPI #3.
 - B. Primer, Bonding, Water Based: MPI #17.
 - C. Primer, Bonding, Solvent Based: MPI #69.
- 2.04 METAL PRIMERS:
- A. Primer, Alkyd, Anti-Corrosive for Metal: MPI #79.
 - B. Primer, Alkyd, Quick Dry, for Metal: MPI #76.
 - C. Primer, Galvanized, Water Based: MPI #134.
- 2.05 WATER-BASED PAINTS:
- A. Latex, Exterior Flat (Gloss Level 1): MPI #10.
 - B. Latex, Exterior Semi-Gloss (Gloss Level 5): MPI #11.
 - C. Latex, Exterior, Gloss (Gloss Level 6): MPI #119.
 - D. Light Industrial Coating, Exterior, Water Based (Gloss Level 3): MPI #161.
 - E. Light Industrial Coating, Exterior, Water Based, Semi-Gloss (Gloss Level 5): MPI #163.
 - F. Light Industrial Coating, Exterior, Water Based, Gloss (Gloss Level 6): MPI #164.
- 2.06 SOURCE QUALITY CONTROL:
- A. Testing of Paint Materials: Contracting Officer reserves the right to invoke the following procedure:
 - 1. Contracting Officer will 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. Contracting Officer may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying 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.

PART 3 - EXECUTION

- 3.01 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. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
 - C. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

SECTION 099113 - EXTERIOR PAINTING: continued

3.02 PREPARATION:

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems 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.
- 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 by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.03 APPLICATION:

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 - 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 - 4. Paint entire exposed surface of window frames and sashes.
 - 5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. 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.

3.04 FIELD QUALITY CONTROL:

- A. Dry Film Thickness Testing: Contracting Officer 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

SECTION 099113 - EXTERIOR PAINTING: continued

additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.05 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 Contracting Officer, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.06 EXTERIOR PAINTING SCHEDULE:

- A. Steel Substrates:
 - 1. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Primer, alkyd, anti-corrosive for metal, MPI #79.
 - b. Prime Coat: Shop primer specified in DIVISION 05 Section where substrate is specified.
 - c. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
 - d. Topcoat: Light industrial coating, exterior, water based (Gloss Level 3), MPI #161.
 - 2. Quick-Drying Enamel System:
 - a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.
 - b. Intermediate Coat: Alkyd, quick dry, matching topcoat.
 - c. Topcoat: Alkyd, quick dry, semi-gloss (Gloss Level 5), MPI #81.
- B. Galvanized-Metal Substrates:
 - 1. Latex System:
 - a. Prime Coat: Primer, galvanized, water based, MPI #134.
 - b. Prime Coat: Primer, galvanized metal, as recommended in writing by topcoat manufacturer for exterior use on galvanized-metal substrates with topcoat indicated.
 - c. Intermediate Coat: Latex, exterior, matching topcoat.
 - d. Topcoat: Latex, exterior flat (Gloss Level 1), MPI #10.

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS:
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this Section.
- 1.02 SUMMARY:
- A. Section includes surface preparation and the application of paint systems on interior substrates:
 - 1. Concrete masonry units (CMU).
 - 2. Steel.
 - 3. Galvanized metal.
 - 4. Gypsum board.
 - B. Related Requirements:
 - 1. DIVISION 01, Section "Sustainable Design Requirements" for LEED[®] related requirements for low-emitting paints and coatings, recycled content materials and local/regionally manufactured and sourced materials.
 - 2. DIVISION 05 Sections for shop priming of metal substrates with primers specified in this Section.
 - 3. DIVISION 08 Sections for factory priming doors with primers specified in this Section.
 - 4. DIVISION 09, Section "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.
- 1.03 REFERENCES:
- A. ASTM International:
 - 1. ASTM D523-08 - Test Method for Specular Gloss.
 - B. California Department of Health Services:
 - 1. Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, 2004.
 - C. Code of Federal Regulations:
 - 1. 40 CFR 59, Subpart D-2002 - National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - D. Master Painters Institute:
 - 1. MPI Approved Products List, January 2004.
 - 2. MPI Architectural Painting Specification Manual, 2004.
 - E. SSPC - The Society for Protective Coatings:
 - 1. SSPC-PA 1 2000 (Revised 2004) - Paint Application Specification No. 1 - Shop, Field, and Maintenance Painting of Steel.
 - 2. SSPC-SP 2 1982 (Revised 2004) - Surface Preparation Specification No. 2 - Hand Tool Cleaning.
 - 3. SSPC-SP 3 1982 (Revised 2004) - Surface Preparation Specification No. 3 - Power Tool Cleaning.
 - 4. SSPC-SP 7/NACE No. 4 2000 (Revised 2004) - Joint Surface Preparation Standard
SSPC-SP 7/NACE No. 4 - Brush-off Blast Cleaning.
 - 5. SSPC-SP 11 1987 (Revised 2004) - Power Tool Cleaning to Bare Metal.
- 1.04 DEFINITIONS:
- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.

SECTION 099123 - INTERIOR PAINTING: continued

- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
- G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.05 SUBMITTALS:

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. LEED Submittals:
 - 1. Product Data for Credit EQ 4.2: For paints and coatings applied on-site and inside the weatherproofing barrier of the building, including printed statement of VOC content and use on the project.
- C. Samples: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches 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.
- 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 Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
 - 3. VOC content.

1.06 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: 2%, but not less than 1 gallon of each material and color applied.

1.07 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. Contracting Officer will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 square feet.
 - b. Other Items: Contracting Officer will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Contracting Officer at no added cost to Contracting Officer.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Contracting Officer specifically approves such deviations in writing.

SECTION 099123 - INTERIOR PAINTING: continued

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- 1.08 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°F.
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.
- 1.09 FIELD CONDITIONS:
- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95°F.
 - B. Do not apply paints when relative humidity exceeds 85%; at temperatures less than 5°F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

- 2.01 MANUFACTURERS:
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equals:
 1. Behr Process Corporation.
 2. Benjamin Moore & Co.
 3. Benjamin Moore & Co. (Canada).
 4. Bennette Paint Manufacturing Company, Inc.
 5. Betonel Ltd.
 6. BLP Mobile Paint Manufacturing.
 7. California Paints.
 8. Cloverdale Paint.
 9. Color Wheel Paints & Coatings.
 10. Columbia Paint & Coatings.
 11. Conco Paints.
 12. Coronado Paint.
 13. Davis Paint Company.
 14. Diamond Vogel Paints.
 15. Dunn-Edwards Corporation.
 16. Durant Performance Coatings.
 17. Duron, Inc.
 18. Envirocoatings Canada, Inc.
 19. Euclid Chemical Company.
 20. Farrell-Calhoun.
 21. Frazee Paint.
 22. General Paint.
 23. Hallman Lindsay Paints.
 24. Hirshfield's, Inc.
 25. ICI Paints.
 26. ICI Paints (Canada).
 27. Insl-x.
 28. Kelly-Moore Paints.
 29. Kwal Paint.

SECTION 099123 - INTERIOR PAINTING: continued

30. M.A.B. Paints.
 31. McCormick Paints.
 32. Microblend Technologies, Inc.
 33. Miller Paint.
 34. Mills Paint.
 35. PARA Paints.
 36. Parex LaHabra, Inc.
 37. Parker Paint Mfg. Co., Inc.
 38. PPG Architectural Finishes, Inc.
 39. Pratt & Lambert.
 40. Rodda Paint Co.
 41. Scott Paint.
 42. Sherwin-Williams Company (The).
 43. Sico, Inc.
 44. Southern Diversified Products, LLC.
 45. Smith Paint Products.
 46. Vista Paint.
 47. Zinsser.
- B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles for the paint category indicated.

2.02 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).
1. Flat Paints and Coatings: 50 g/L.
 2. Nonflat Paints and Coatings: 150 g/L.
 3. Primers, Sealers, and Undercoaters: 200 g/L.
 4. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 5. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 6. Pretreatment Wash Primers: 420 g/L.
- D. Colors: See SECTION 090690.

2.03 BLOCK FILLERS:

- A. Block Filler, Latex, Interior/Exterior: MPI #4.

2.04 PRIMERS/SEALERS:

- A. Primer Sealer, Latex, Interior: MPI #50.
- B. Primer, Alkali Resistant, Water Based: MPI #3.
- C. Primer Sealer, Alkyd, Interior: MPI #45.

SECTION 099123 - INTERIOR PAINTING: continued

D. Primer, Bonding, Water Based: MPI #17.

2.05 METAL PRIMERS:

- A. Primer, Rust-Inhibitive, Water Based: MPI #107.
- B. Primer, Alkyd, Anti-Corrosive, for Metal: MPI #79.
- C. Primer, Alkyd, Quick Dry, for Metal: MPI #76.
- D. Primer, Galvanized, Water Based: MPI #134.

2.06 WATER-BASED PAINTS:

- A. Latex, Interior, Flat, (Gloss Level 1): MPI #53.
- B. Latex, Interior, (Gloss Level 2): MPI #44.
- C. Latex, Interior, (Gloss Level 3): MPI #52.
- D. Latex, Interior, (Gloss Level 4): MPI #43.
- E. Latex, Interior, Semi-Gloss, (Gloss Level 5): MPI #54.
- F. Latex, Interior, Gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees): MPI #114.
- G. Latex, Interior, Institutional Low Odor/VOC, Flat (Gloss Level 1): MPI #143.
- H. Latex, Interior, Institutional Low Odor/VOC, (Gloss Level 2): MPI #144.
- I. Latex, Interior, Institutional Low Odor/VOC, (Gloss Level 3): MPI #145.
- J. Latex, Interior, Institutional Low Odor/VOC, Semi-Gloss (Gloss Level 5): MPI #147.
- K. Latex, Interior, High Performance Architectural, (Gloss Level 2): MPI #138.
- L. Latex, Interior, High Performance Architectural, (Gloss Level 3): MPI #139.
- M. Latex, Interior, High Performance Architectural, (Gloss Level 4): MPI #140.
- N. Latex, Interior, High Performance Architectural, Semi-Gloss (Gloss Level 5): MPI #141.
- O. Light Industrial Coating, Interior, Water Based (Gloss Level 3): MPI #151.
- P. Light Industrial Coating, Interior, Water Based, Semi-Gloss (Gloss Level 5): MPI #153.

2.07 SOURCE QUALITY CONTROL:

- A. Testing of Paint Materials: Contracting Officer reserves the right to invoke the following procedure:
 - 1. Contracting Officer will 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. Contracting Officer may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying 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.

PART 3 - EXECUTION

3.01 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.

SECTION 099123 - INTERIOR PAINTING: continued

- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12%.
 - 2. Masonry (Clay and CMU): 12%.
 - 3. Gypsum Board: 12%.
- 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.

3.02 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. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer, but not less than the following:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
 - 3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
 - 4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
- G. 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.
- H. 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.

3.03 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.

SECTION 099123 - INTERIOR PAINTING: continued

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 equipment rooms:
 - a. Equipment.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 2. 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.
 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.04 FIELD QUALITY CONTROL:

- A. Dry Film Thickness Testing: Contracting Officer 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.

SECTION 099123 - INTERIOR PAINTING: continued

3.05 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 Contracting Officer, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.06 INTERIOR PAINTING SCHEDULE:

- A. CMU Substrates:
 - 1. Latex System:
 - a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat, (Gloss Level 1), MPI #53.
 - 2. Water-Based Light Industrial Coating System:
 - a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based (Gloss Level 3), MPI #151.
 - 3. Alkyd System:
 - a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
 - b. Sealer Coat: Primer sealer, latex, interior, MPI #50.
 - c. Intermediate Coat: Alkyd, interior, matching topcoat.
 - d. Topcoat: Alkyd, interior, flat (Gloss Level 1), MPI #49.
- B. Steel Substrates:
 - 1. Latex over Alkyd Primer System:
 - a. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat, (Gloss Level 1), MPI #53.
 - 2. Water-Based Dry-Fall System:
 - a. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79.
 - 3. Institutional Low-Odor/VOC Latex System:
 - a. Prime Coat: Primer, rust-inhibitive, water based MPI #107.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1), MPI #143.
 - 4. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Primer, rust-inhibitive, water based MPI #107.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based (Gloss Level 3), MPI #151.
 - 5. Alkyd System:
 - a. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79.
 - b. Intermediate Coat: Alkyd, interior, matching topcoat.
 - c. Topcoat: Alkyd, interior, flat (Gloss Level 1), MPI #49.
 - 6. Quick-Drying Enamel System:
 - a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.
 - b. Intermediate Coat: Alkyd, quick dry, matching topcoat.

SECTION 099123 - INTERIOR PAINTING: continued

- c. Topcoat: Alkyd, quick dry, semi-gloss (Gloss Level 5), MPI #81.
- C. Galvanized-Metal Substrates:
 - 1. Latex over Waterborne Primer System:
 - a. Prime Coat: Primer, galvanized, water based, MPI #134.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat, (Gloss Level 1), MPI #53.
 - 2. Institutional Low-Odor/VOC Latex System:
 - a. Prime Coat: Primer, galvanized, water based, MPI #134.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1), MPI #143.
- D. Gypsum Board Substrates:
 - 1. Latex System:
 - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat, (Gloss Level 1), MPI #53.
 - 2. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based (Gloss Level 3), MPI #151.

END OF SECTION 099123

DIVISION 10 - SPECIALTIES

SECTION 101100 - MARKERBOARDS AND TACKBOARDS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes markerboards and accessories.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American Architectural Manufacturers Association (AAMA):
 - a. 603.8 - Voluntary Performance requirements and Test Procedures for Pigmented Organic Coatings on Extruded Aluminum.
 - 2. American Society for Testing and Materials (ASTM):
 - a. E84 - Test Method for Surface Burning Characteristics of Building Materials.
 - 3. Federal Specifications (FS):
 - a. CCC-W-408A - Wall Covering, Vinyl-Coated.
 - 4. National Association Architectural Metal Manufacturers (NAAMM):
 - a. NAAMM - Metal Finishes Manual.
 - 5. Porcelain Enamel Institute (PEI):
 - a. PEI S-100 - Architectural Porcelain Enamel on Steel for Exterior Use.

1.03 SUBMITTALS:

- A. Submit as specified in DIVISION 01.
- B. Includes, but not limited to, the following:
 - 1. Product data, specifications, and catalog cuts.
 - 2. Elevation for each type or style.
 - 3. Details of components and assembly.
 - 4. Color charts or Samples.
 - 5. One 6-inch square sample of each markerboard and tackboard material.

1.04 QUALITY ASSURANCE:

- A. Surface Burning Characteristics: Provide tackboard surfaces with flame-spread rating of not more than 25 and smoke developed of not more than 25 when tested in accordance with ASTM E84.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Store inside building in a clean, dry storage area as packaged by the manufacturer.
- B. Support to retain proper shape and protect from damage.

1.06 WARRANTY:

- A. Warranty period shall be for life of building.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Alliancewall, American Chalkboard Co., Inc.
- B. Best-Rite Manufacturing.
- C. Carolina Chalkboard, Div. of Information Display Technology, Inc.

SECTION 101100 – MARKERBOARDS AND TACKBOARDS: continued

- D. Claridge Products and Equipment, Inc.
- E. Ghent Manufacturing, Inc.
- F. Greensteel, Div. of Information Display Technology, Inc.
- G. Nelson-Adams Co., Inc.
- H. Or approved equals.

2.02 MARKERBOARD UNITS:

- A. Cover Coat for Markerboards: Provide the manufacturer's standard, light-colored, special writing surface with gloss finish intended for use with liquid, felt-tipped markers.
Color: White.
- B. Core: 3/8-inch particleboard.
- C. Backing: 0.015-inch-thick aluminum sheet.
- D. Edges: Panel edges at butt joints shall have porcelain-enamel coating. Panels shall be cut or sheared before firing.
- E. Trim and Accessories: Specified in Article "TRIM AND ACCESSORIES" this PART.

2.03 TACKBOARD UNITS:

- A. Natural Cork:
 - 1. Facing: Single-layer, seamless compressed cork sheet, 1/4-inch- thick, face sanded for natural finish. Factory-laminated under heat and pressure to burlap backing.
 - 2. Board Backing: 1/4-inch treated (hardboard) (fiberboard).
 - 3. Edges shall be unwrapped.
- B. Trim and Accessories: Specified in Article "TRIM AND ACCESSORIES" this PART.

2.04 TRIM AND ACCESSORIES:

- A. Aluminum Alloy 6063-T5, minimum 0.062-inch thickness with (clear) (color), satin-anodized finish and corners mitered to neat, hairline closure.
- B. Factory-Assembled Units:
 - 1. Manufacturer's standard wide trim, approximately 1-1/2 inches wide with clip-angle hangers or integral hangers, top and bottom.
- C. Accessories:
 - 1. Chalktrough:
 - a. Solid extrusions, manufacturer's standard ribbed section with at least 1-inch radius at front ends.
 - b. Length shall be same as entire unit.
 - c. Provide for markerboards.

2.05 SIZE AND LOCATION:

- A. Markerboard Units:
 - 1. Room 103, Conference Room: One - 6'-0" wide by 4'-0" high unit.
 - 2. Room 115, 25U Classroom: Four - 6'-0" wide by 4'-0" high units.
 - 3. Room 131, Training Room 1: Two - 6'-0" wide by 4'-0" high units.
 - 4. Room 132, Training Room 2: Two - 6'-0" wide by 4'-0" high units.
 - 5. Room 133, Training Room 3: Two - 6'-0" wide by 4'-0" high units.
 - 6. Room 134, Training Room 4: Two - 6'-0" wide by 4'-0" high units.
 - 7. Mount bottom of unit at 3'-0" above floor.
- B. Tackboard Units:
 - 1. Room 127, Breakroom: One - 4'-0" wide by 3'-0" high unit.
 - 2. Room 102A, Vestibule: One - 4'-0" wide by 3'-0" high unit.

SECTION 101100 – MARKERBOARDS AND TACKBOARDS: continued

3. Room 115, 25U Classroom: Two - 4'-0" wide by 4'-0" high units.
4. Room 131, Training Room 1: One - 4'-0" wide by 4'-0" high unit.
5. Room 132, Training Room 2: One - 4'-0" wide by 4'-0" high unit.
6. Room 133, Training Room 3: One - 4'-0" wide by 4'-0" high unit.
7. Room 134, Training Room 4: One - 4'-0" wide by 4'-0" high unit.
8. Mount bottom of unit at 3'-0" above floor.

2.06 FABRICATION:

- A. Provide factory-built units completely assembled in one piece without joints, whenever possible.
- B. Where dimensions exceed panel size, provide two or more pieces of equal length as acceptable to Contracting Officer.
- C. When overall dimensions require delivery in separate units, prefit at factory, disassemble for delivery, and make final joints at site.
- D. Use splines at joints to maintain surface alignment.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Install units plumb and level, and conforming to manufacturer's printed instructions.
- B. Install all anchors and units securely to substrate. Provide all grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories for complete installation.

3.02 CLEANING:

- A. Clean all surfaces after installation.
- B. Replace or repair damaged surfaces.
- C. Protect units from damage.

END OF SECTION 101100

SECTION 101400 - SIGNAGE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this Section.
- B. DIVISION 01, Section "Sustainable Design Requirements" for LEED® related requirements for recycled content materials and local/regionally manufactured and sourced materials.

1.02 SUMMARY:

- A. This Section includes the following:
 - 1. Dimensional characters.
 - 2. Panel signs.
 - 3. Interior signs.
 - 4. Exterior building numbers and letters.

1.03 REFERENCES:

- A. American Architectural Manufacturers Association:
 - 1. AAMA 611-1998 - Voluntary Specifications for Anodized Architectural Aluminum.
 - 2. AAMA 2603-2002 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
- B. ASTM International:
 - 1. ASTM A240 -04a - Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 2. ASTM A529 -04 - Specification for High Strength Carbon-Manganese Steel of Structural Quality.
 - 3. ASTM A572 -04 - Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
 - 4. ASTM A591 -98 - Specification for Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Weight Applications.
 - 5. ASTM A653 -04a - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 6. ASTM A666-03 - Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - 7. ASTM A1008 -04b - Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low-Alloy with Improved Formability.
 - 8. ASTM B26 -03 - Specification for Aluminum Alloy Sand Casting.
 - 9. ASTM B36 -01 - Specification for Brass Plate, Sheet, Strip, and Rolled Bar.
 - 10. ASTM B152 -00 - Specification for Copper Sheet, Strip, Plate, and Rolled Bar.
 - 11. ASTM B209-04 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 12. ASTM B221-02 - Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
 - 13. ASTM B584-00 - Specification for Copper Alloy Sand Castings for General Applications.
 - 14. ASTM D256-04 - Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
 - 15. ASTM D638-03 - Test Method for Tensile Properties of Plastics.
 - 16. ASTM D648-04 - Test Method for Deflection Temperature of Plastics Under Flexural Load in Edgewise Position.

SECTION 101400 - SIGNAGE: continued

17. ASTM D790-03 - Test Method for Flexural Properties for Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
18. ASTM D1044-99 - Test Method for Resistance of Transparent Plastics to Surface Abrasion.
19. ASTM D4802-02 - Specification for Poly (Methyl Methacrylate) Acrylic Plastic Sheet.
- C. International Code Council/American National Standards Institute:
 1. ICC/ANSI A117.1-98 - Accessible and Usable Buildings and Facilities.
- D. National Association of Architectural Metal Manufacturers:
 1. Metal Finishes Manual for Architectural and Metal Products, 1988.
- E. SSPC - The Society for Protective Coatings:
 1. SSPC-SP 5/NACE No. 1 2000 - Joint Surface Preparation Standard SSPC-SP 5/NACE No. 1 - White Metal Blast Cleaning.
 2. SSPC-SP 8 1982 (Revised 2000) - Surface Preparation Specification No. 8: Pickling.
- F. Underwriters Laboratories Inc.:
 1. UL 924-01 - Emergency Lighting and Power Equipment.
- G. U.S. Architectural & Transportation Barriers Compliance Board:
 1. Americans with Disabilities Act (ADA) Accessibility Guidelines for Build.

1.04 DEFINITIONS:

- A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines."

1.05 SUBMITTALS:

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for signs.
 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 2. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.
 3. Wiring Diagrams: Power, signal, and control wiring.
- C. Samples: For each of the following products and for the full range of color, texture, and sign material indicated, of sizes indicated:
 1. Dimensional Characters: Full-size Samples of each type of dimensional character (letter, number, and graphic element).
 2. Aluminum: For each form, finish, and color, on 6-inch long sections of extrusions and squares of sheet at least 4 by 4 inches.
 3. Acrylic Sheet: 8 by 10 inches for each color required.
 4. Polycarbonate Sheet: 8 by 10 inches for each color required.
 5. Panel Signs: Not less than 12 inches square including border.
- D. Sign Schedule: Use same designations indicated on Drawings.
- E. LEED Submittals:
 1. Product Data for Credit MRc4: For products containing recycled content, submit documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content for each product or portion of a product having recycled content. Include statement indicating cost for each product containing recycled content material.
 2. For products and materials complying with requirements for regional materials, submit documentation indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement

SECTION 101400 - SIGNAGE: continued

indicating cost for each regional material and the fraction by weight that is considered regional.

3. Product Data for Credit IEQc4.1: For adhesives installed on-site and inside the weatherproofing barrier of the building, submit documentation including manufacturer's printed statement (MSDS Sheet) of VOC content of each product.
- 1.06 INFORMATIONAL SUBMITTALS:
- A. Qualification Data: For fabricator.
 - B. Warranty: Special warranty specified in this Section.
- 1.07 CLOSEOUT SUBMITTALS:
- A. Maintenance Data: For signs to include in maintenance manuals.
- 1.08 QUALITY ASSURANCE:
- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
 - B. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
 - C. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer.
 - D. Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
 - E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- 1.09 PROJECT CONDITIONS:
- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit installation of signs in exterior locations to be performed according to manufacturers' written instructions and warranty requirements.
 - B. Field Measurements: Verify recess openings by field measurements before fabrication and indicate measurements on Shop Drawings.
- 1.10 COORDINATION:
- A. Coordinate placement of anchorage devices with templates for installing signs.
- 1.11 WARRANTY:
- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Deterioration of metal and polymer finishes beyond normal weathering.
 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Aluminum Castings: ASTM B26, of alloy and temper recommended by sign manufacturer for casting process used and for use and finish indicated.

SECTION 101400 - SIGNAGE: continued

- B. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 5005-H32.
- C. Aluminum Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 6063-T5.
- D. Steel:
 - 1. Galvanized Steel Sheet: ASTM A653, G90 (Z275) coating, either commercial or forming steel.
 - 2. Stainless-Steel Sheet: ASTM A240 or ASTM A666, Type 304, stretcher-leveled standard of flatness.
 - 3. For steel exposed to view on completion, provide materials having flat, smooth surfaces without blemishes. Do not use materials whose surfaces exhibit pitting, seam marks, roller marks, rolled trade names, or roughness.
- E. Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).
- F. Polycarbonate Sheet: Of thickness indicated, manufactured by extrusion process, coated on both surfaces with abrasion-resistant coating:
 - 1. Impact Resistance: 16 ft.-lbf/in. per ASTM D256, Method A.
 - 2. Tensile Strength: 9,000 lbf/sq. in. per ASTM D638.
 - 3. Flexural Modulus of Elasticity: 340,000 lbf/sq. in. per ASTM D790.
 - 4. Heat Deflection: 265°F at 264 lbf/sq. in. per ASTM D648.
 - 5. Abrasion Resistance: 1.5% maximum haze increase for 100 revolutions of a Taber abraser with a load of 500 g per ASTM D1044.
- G. Applied Vinyl: Die-cut characters from vinyl film of nominal thickness of 3 mils with pressure-sensitive adhesive backing, suitable for exterior applications.

2.02 DIMENSIONAL CHARACTERS:

- 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. ACE Sign Systems, Inc.
 - 2. Advance Corporation; Braille-Tac Division.
 - 3. A. R. K. Ramos.
 - 4. ASI-Modulex, Inc.
 - 5. Bunting Graphics, Inc.
 - 6. Charleston Industries, Inc.
 - 7. Gemini Incorporated.
 - 8. Grimco, Inc.
 - 9. Innerface Sign Systems, Inc.
 - 10. Metal Arts; Div. of L&H Mfg. Co.
 - 11. Mills Manufacturing Company.
 - 12. Mohawk Sign Systems.
 - 13. Nelson-Harkins Industries.
 - 14. Signature Signs, Incorporated.
 - 15. Southwell Company (The).
 - 16. Or approved equals.
- C. Cast Characters: Produce characters with smooth flat faces, sharp corners, and precisely formed lines and profiles, free of pits, scale, sand holes, and other defects. Cast lugs into back

SECTION 101400 - SIGNAGE: continued

of characters and tap to receive threaded mounting studs. Alloy and temper recommended by sign manufacturer for casting process used and for use and finish indicated. Comply with the following requirements.

1. Character Material: Epoxy coated aluminum.
2. Thickness: 1/2-inch minimum.
3. Color(s): Green (hexadecimal code 485320).
4. Mounting: Concealed studs.

2.03 INTERIOR SIGNS:

- A. Subject to compliance with requirements, provide products by one of the following:
 1. ACE Sign Systems, Inc.
 2. Advance Corporation; Braille-Tac Division.
 3. Allen Industries Architectural Signage.
 4. Allenite Signs; Allen Marking Products, Inc.
 5. APCO Graphics, Inc.
 6. ASI-Modulex, Inc.
 7. Best Sign Systems Inc.
 8. Bunting Graphics, Inc.
 9. Fossil Industries, Inc.
 10. Gemini Incorporated.
 11. Grimco, Inc.
 12. Innerface Sign Systems, Inc.
 13. InPro Corporation.
 14. Matthews International Corporation; Bronze Division.
 15. Mills Manufacturing Company.
 16. Mohawk Sign Systems.
 17. Nelson-Harkins Industries.
 18. Seton Identification Products.
 19. Signature Signs, Incorporated.
 20. Supersine Company (The).
 21. Or approved equals.
- B. Interior Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of $\pm 1/16$ inch measured diagonally from corner to corner, complying with the following requirements:
 1. Aluminum Sheet: 0.050 inch thick.
 2. Laminated, Aluminum-Faced Sheet: 0.020-inch thick aluminum sheet laminated to each side of 0.197-inch thick, corrugated backing with painted edges.
 3. Laminated, Polycarbonate-Faced Sheet: 0.060-inch thick, polycarbonate face sheet laminated to each side of 0.197-inch thick phenolic backing.
 4. Acrylic Sheet: 0.060 inch thick.
 5. PVC Sheet: 0.060-inch thick, extruded, high-impact PVC plastic in color to match face color.
 6. High-Pressure Decorative Laminate: 0.048 inch thick.
 7. Phenolic-Backed Photopolymer Sheet: Provide light-sensitive, water-wash photopolymer face layer bonded to a phenolic base layer to produce a composite sheet with overall, face layer, and base-layer thicknesses, respectively, of 0.120, 0.040, and 0.080 inch.
 8. Laminated Sheet: High-pressure engraved stock with contrasting color face laminated to acrylic core.

SECTION 101400 - SIGNAGE: continued

9. Laminated, Etched Photopolymer: Raised graphics with Braille 1/32 inch above surface with contrasting colors as selected by Contracting Officer from manufacturer's full range and laminated to acrylic back.
 10. Laminated, Sandblasted Polymer: Raised graphics with Braille 1/32 inch above surface with contrasting colors as selected by Contracting Officer from manufacturer's full range and laminated to acrylic back.
 11. Edge Condition: Beveled.
 12. Corner Condition: Square.
 13. Mounting: Framed.
 - a. Wall mounted with concealed anchors.
 - b. Manufacturer's standard anchors for substrates encountered.
 14. Color: As selected by Contracting Officer from manufacturer's full range.
 15. Tactile Characters: Characters and Grade 2 Braille raised 1/32 inch above surface with contrasting colors.
- C. Brackets: Fabricate brackets and fittings for bracket-mounted signs from extruded aluminum to suit panel sign construction and mounting conditions indicated. Factory paint brackets in color matching Contracting Officer's sample.
- D. Changeable Message Inserts: Fabricate signs to allow insertion of changeable messages in the form of slide-in inserts.
1. Furnish insert material and software for creating text and symbols for PC-Windows computers for Contracting Officer production of paper inserts.
 2. Furnish insert material cut-to-size for changeable message insert.
- E. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks; Braille dots with domed or rounded shape.
1. Panel Material: Opaque acrylic sheet.
 2. Raised-Copy Thickness: Not less than 1/32 inch.

2.04 EXTERIOR BUILDING NUMBERS AND LETTERS:

- A. Sheet stainless steel, ASTM A167, Type 302, thickness as required by letter size but not less than 18-gage for stainless steel, heliarc-welded construction. Precisely cut characters with square cut, smooth edges.
- B. Style: Century gothic.
- C. Fabricate for 2-inch projected mounting. Provide with fasteners as required for mounting surface and wind load requirements.
- D. Size: 12 inches high.
- E. Manufacturers:
 1. Andco Industries Corp.
 2. A.R.K. Ramos.
 3. Gemini, Inc.
 4. The Southwell Co.
 5. Or approved equals.

2.05 ACCESSORIES:

- A. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

SECTION 101400 - SIGNAGE: continued

2.06 FABRICATION:

- A. General: Provide manufacturer's standard signs of configurations indicated.
 - 1. Welded Connections: Comply with AWS standards for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded surfaces of welding flux and dress exposed and contact surfaces.
 - 2. Mill joints to tight, hairline fit. Form joints exposed to weather to exclude water penetration.
 - 3. Preassemble signs in the shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in location not exposed to view after final assembly.
 - 4. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

2.07 FINISHES, GENERAL:

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.08 ALUMINUM FINISHES:

- A. Clear Anodic Finish: Manufacturer's standard Class 1 clear anodic coating, 0.018 mm or thicker, over a satin (directionally textured) mechanical finish, complying with AAMA 611.

2.09 STAINLESS-STEEL FINISHES:

- A. Remove tool and die marks and stretch lines or blend into finish. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- B. Directional Satin Finish: No. 4 finish.
- C. Mirrorlike Reflective, Nondirectional Polish: No. 8 finish.
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.10 ACRYLIC SHEET FINISHES:

- A. Colored Coatings for Acrylic Sheet: For copy and background colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and that are UV and water resistant for five years for application intended.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

SECTION 101400 - SIGNAGE: continued

- B. Verify that items, including anchor inserts, are sized and located to accommodate signs.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.
 - 1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.
- B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
 - 1. Hook-and-Loop Tapes: Mount signs to smooth, nonporous surfaces.
- C. Dimensional Characters: Mount characters using standard fastening methods to comply with manufacturer's written instructions for character form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.
 - 1. Flush Mounting: Mount characters with backs in contact with wall surface.
 - 2. Projected Mounting: Mount characters at projection distance from wall surface indicated.
- D. Cast and Fabricated Metal Letters:
 - 1. Mount letters and numbers using standard fastening methods recommended by manufacturer for letter form, type of mounting, wall construction, and condition of exposure.
 - 2. For projected mounting, mount letters at projection distance from wall surface specified.
 - 3. Mount in locations indicated on drawings.

3.03 CLEANING AND PROTECTION:

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Contracting Officer.

END OF SECTION 101400

SECTION 102113 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Solid-polymer toilet compartments configured as toilet enclosures and urinal screens.
- B. Related Sections:
 - 1. DIVISION 01, Section "Sustainable Design Requirements" for LEED[®] related requirements for recycled content materials and local/regionally manufactured and sourced materials.
 - 2. DIVISION 05, Section "Metal Fabrications" for supports that attach floor-and-ceiling-anchored compartments to overhead structural system.
 - 3. DIVISION 10, Section "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

1.03 REFERENCES:

- A. ASTM International:
 - 1. ASTM A653/A653M-05a - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM A666-03 - Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - 3. ASTM A743/A743M-06 - Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
 - 4. ASTM A879/A879M-04 - Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.
 - 5. ASTM B26/B26M-05 - Specification for Aluminum-Alloy Sand Castings.
 - 6. ASTM B86-05 - Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings.
 - 7. ASTM B221-05a - Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 8. ASTM B455-05 - Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes.
 - 9. ASTM B584-06 - Specification for Copper Alloy Sand Castings for General Applications.
 - 10. ASTM E84-05 - Test Method for Surface Burning Characteristics of Building Materials.
- B. General Services Administration:
 - 1. CID-A-A-60003-1997 - Partitions, Toilet, Complete.
- C. International Code Council/American National Standards Institute:
 - 1. ICC/ANSI A117.1-2003 - Accessible and Usable Buildings and Facilities.
- D. U.S. Architectural & Transportation Barriers Compliance Board:
 - 1. Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities. Adopted in 2004.

1.04 SUBMITTALS:

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

SECTION 102113 - TOILET COMPARTMENTS: continued

- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.4: For particleboard, documentation indicating that product contains no added urea formaldehyde.
 - 2. Product Data for Credit MRc4: For products containing recycled content, submit documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content for each product or portion of a product having recycled content. Include statement indicating cost for each product containing recycled content material.
 - C. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of cutouts for compartment-mounted toilet accessories.
 - 2. Show locations of reinforcements for compartment-mounted grab bars.
 - 3. Show locations of centerlines of toilet fixtures.
 - 4. Show ceiling grid and overhead support or bracing locations.
 - D. Samples: For the following products, in manufacturer's standard sizes unless otherwise indicated:
 - 1. Each type of material, color, and finish required for units, prepared on 6-inch square Samples of same thickness and material indicated for Work.
 - 2. Each type of hardware and accessory.
- 1.05 INFORMATIONAL SUBMITTALS:
- A. Product Certificates: For each type of toilet compartment, from manufacturer.
- 1.06 CLOSEOUT SUBMITTALS:
- A. Maintenance Data: For toilet compartments to include in maintenance manuals.
- 1.07 QUALITY ASSURANCE:
- A. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete."
 - B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84, or another standard acceptable to authorities having jurisdiction, 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: 450 or less.
 - C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.
- 1.08 PROJECT CONDITIONS:
- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

- 2.01 MATERIALS:
- A. Stainless-Steel Sheet: ASTM A666, Type 304, stretcher-leveled standard of flatness.
 - B. Stainless-Steel Castings: ASTM A743/A743M.
 - C. Adhesives: Miscellaneous adhesives used on the project shall not exceed the VOC limits as listed in LEED Credit IEQ 4.1 for the application.

SECTION 102113 - TOILET COMPARTMENTS: continued

2.02 SOLID-POLYMER UNITS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Accurate Partitions Corporation.
 - 2. Ampco, Inc.
 - 3. Bradley Corporation; Mills Partitions.
 - 4. Comtec Industries/Capitol Partitions.
 - 5. General Partitions Mfg. Corp.
 - 6. Global Steel Products Corp.
 - 7. Hadrian Manufacturing, Inc.
 - 8. Knickerbocker Partition Corporation.
 - 9. Metpar Corp.
 - 10. Partition Systems, Incorporated of South Carolina.
 - 11. Rockville Partitions, Incorporated.
 - 12. Santana Products, Inc.
 - 13. Sanymetal; a Crane Plumbing company.
 - 14. Weis-Robart Partitions, Inc.
 - 15. Or approved equals.
- B. Toilet-Enclosure Style: Floor mounted, overhead braced.
- C. Urinal-Screen Style: Wall hung.
- D. Door, Panel, Screen, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, no-sightline system, and with homogenous color and pattern throughout thickness of material.
 - 1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
 - 2. Heat-Sink Strip: Manufacturer's standard continuous, stainless-steel strip fastened to exposed bottom edges of solid-polymer components to prevent burning.
 - 3. Color and Pattern: One color and pattern in each room.
- E. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; stainless steel.
 - 1. Polymer Color and Pattern: Matching pilaster.
- F. Brackets (Fittings):
 - 1. Stirrup Type: Ear or U-brackets, stainless steel.
- G. Bracing for Floor Mounted, Overhead Braced Units: As recommended by manufacturer and fabricated from solid polymer.

2.03 ACCESSORIES:

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
 - 1. Material: Stainless steel.
 - 2. Hinges: Manufacturer's standard paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
 - 3. Latch and Keeper: Manufacturer's standard recessed latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
 - 4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
 - 5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.

SECTION 102113 - TOILET COMPARTMENTS: continued

- 6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
 - B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
 - C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.
- 2.04 FABRICATION:
- A. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.
 - B. Door Size and Swings: Unless otherwise indicated, provide 24-inch wide, in-swinging doors for standard toilet compartments and 36-inch wide, out-swinging doors with a minimum 32-inch wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch.
 - b. Panels and Walls: 1 inch.
 - 2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.
 - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Floor-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.02 ADJUSTING:

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

SECTION 102226 - FOLDING PANEL PARTITIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Manually operated, folding panel partitions.
- B. Related Sections:
 - 1. SECTION 055000 - METAL FABRICATIONS for supports that attach supporting tracks to overhead structural system.

1.03 DEFINITIONS:

- A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."
- B. Glass and Glazing Definitions: See SECTION 088000 - GLAZING.
- C. NIC: Noise Isolation Class.
- D. NRC: Noise Reduction Coefficient.
- E. STC: Sound Transmission Class.

1.04 PERFORMANCE REQUIREMENTS:

- A. Delegated Design: Design folding panel partitions, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Seismic Performance: Operable panel partitions shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the panels will remain in place without separation of any parts from the system when subjected to the seismic forces specified."
- C. Acoustical Performance: Provide folding panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:
 - 1. Sound-Transmission Requirements: Folding panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E90, determined by ASTM E413, and rated for not less than the STC indicated.
 - 2. Noise-Reduction Requirements: Folding panel partition assembly, identical to partition tested for STC, tested for sound-absorption performance according to ASTM C423, and rated for not less than the NRC indicated.
 - 3. Acoustical Performance Requirements: Installed folding panel partition assembly, identical to partition tested for STC, tested for NIC according to ASTM E336, determined by ASTM E413, and rated for 10 dB less than STC value indicated.

1.05 SUBMITTALS:

- A. Product Data: For each type of product indicated.
- B. LEED® Submittals:
 - 1. Certificates for Credit MR 7: Chain-of-custody certificates certifying that folding panel partitions comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.

SECTION 102226 - OPERABLE PARTITIONS: continued

- Include statement indicating cost for each certified wood product including blocking, hardwood lumber, veneer and plywood.
2. Product Data for Credit IEQ 4.4: For composite wood products, documentation indicating that products contain no urea formaldehyde.
 3. Product Data for Credit MRc4: For products containing recycled content, submit documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content for each product or portion of a product having recycled content. Include statement indicating cost for each product containing recycled content material.
 4. Product Data for Credit MRc5: For products and materials complying with requirements for regional materials, submit documentation indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
 5. Product Data for Credit IEQc4.1: For adhesives and sealants installed inside the weatherproofing barrier of the building and installed on site, submit documentation including manufacturer's printed statement (MSDS Sheet) of VOC content of each product.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
1. For installed products indicated to comply with design loads, include structural analysis data for attachments, signed and sealed by the qualified professional engineer responsible for their preparation.
 2. Indicate storage and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
 3. Wiring Diagrams: For power, signal, and control wiring.
- D. Samples: For each type of exposed material, finish, covering, or facing indicated, prepared on Samples of size indicated below:
1. Textile: Full width by not less than 36-inch long section of fabric from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat.
 2. Panel Facing Material: Manufacturer's standard-size unit, not less than 3 inches square.
 3. Panel Edge Material: Not less than 3 inches long.
 4. Hardware: Manufacturer's standard exposed door-operating device.

1.06 INFORMATIONAL SUBMITTALS:

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Suspended ceiling components.
 2. Structural members to which suspension systems will be attached.
 3. Size and location of initial access modules for acoustical tile.
 4. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.
 - b. HVAC ductwork, outlets, and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Smoke detectors.
 - f. Access panels.
- B. Setting Drawings: For embedded items and cutouts required in other work, including support-beam, mounting-hole template.

SECTION 102226 - OPERABLE PARTITIONS: continued

- C. Qualification Data: For qualified Installer.
- D. Seismic Qualification Certificates: For folding panel partitions, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Product Certificates: For each type of folding panel partition, from manufacturer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each folding panel partition.
- G. Field quality-control reports.
- H. Warranty: Sample of special warranty.

1.07 CLOSEOUT SUBMITTALS:

- A. Operation and Maintenance Data: For folding panel partitions to include in maintenance manuals. In addition to items specified in SECTION 017823 - OPERATION AND MAINTENANCE DATA, include the following:
 - 1. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
 - 2. Seals, hardware, track, carriers, and other operating components.
 - 3. Electric operator.

1.08 MAINTENANCE MATERIAL SUBMITTALS:

- A. Furnish extra materials from the same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Panel Finish-Facing Material: Furnish full width in quantity to cover both sides of two panels when installed.

1.09 QUALITY ASSURANCE:

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- C. Testing Agency Qualifications: Qualified according to SECTION 014000 - QUALITY REQUIREMENTS for testing indicated.
- D. Fire-Test-Response Characteristics: Provide panels with finishes meeting one of the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. Surface-Burning Characteristics: As determined by testing per ASTM E84.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 2. Fire Growth Contribution: Meeting acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265.

SECTION 102226 - OPERABLE PARTITIONS: continued

1.10 DELIVERY, STORAGE, AND HANDLING:

- A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

1.11 PROJECT CONDITIONS:

- A. Field Measurements: Verify actual dimensions of folding panel partition openings by field measurements before fabrication.

1.12 WARRANTY:

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of folding panel partitions that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Faulty operation of folding panel partitions.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal wear.
 - 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Forest Certification: Fabricate products with solid hardwood, plywood, wood veneers, and wood-based panel products produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- B. Steel Frame: Steel sheet, manufacturer's standard nominal minimum thickness for uncoated steel.
- C. Steel Face/Liner Sheets: Tension-levleed steel sheet, manufacturer's standard nominal minimum thickness for uncoated steel.
- D. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; ASTM B221 for extrusions; manufacturer's standard strengths and thicknesses for type of use.
 - 1. Frame Reinforcement: Manufacturer's standard steel or aluminum.
- E. Gypsum Board: ASTM C36/C36M.
- F. Cement Board: ASTM C1288.
- G. Plywood: DOC PS 1 made with binder containing no added urea formaldehyde.
- H. Particleboard: ANSI A208.1, made with binder containing no added urea formaldehyde.
- I. Medium-Density Fiberboard: ANSI A208.2, made with binder containing no added urea formaldehyde.
- J. Adhesives: VOC content of adhesives used on-site shall not exceed the VOC limits of LEED Credit IEQ 4.1 for the specific application.

2.02 FOLDING ACOUSTICAL PANELS:

- A. Operable Acoustical Panels: Folding acoustical panel partition system, including panels, seals, finish facing, suspension system, operators, and accessories.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advanced Equipment Corporation.

SECTION 102226 - OPERABLE PARTITIONS: continued

- b. Curtition, Inc.
 - c. FolDoor; Holcomb & Hoke Mfg. Co., Inc.
 - d. Hufcor.
 - e. KWIK-WALL Company.
 - f. Moderco, Inc.
 - g. Modernfold, Inc.; a DORMA Group Company.
 - h. Panelfold, Inc.
 - i. Or approved equal.
- B. Panel Operation: Manually operated, paired panels.
 - C. Panel Construction: Provide top reinforcement as required to support panel from suspension components and provide reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
 - D. Dimensions: Fabricate folding acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
 - 1. Panel Width: 48 inches.
 - E. STC: Not less than 38.
 - F. NRC: Not less than 0.50.
 - G. Panel Weight: 10 lb./sq. ft. maximum.
 - H. Panel Thickness: 4 inches.
 - I. Panel Closure: Manufacturer's standard.
 - 1. Initial Closure: Flexible, resilient PVC, bulb-shaped acoustical seal.
 - 2. Final Closure: Constant-force, lever-operated mechanical closure expanding from panel edge to create a constant-pressure acoustical seal.
 - J. Hardware: Manufacturer's standard as required to operate folding panel partition and accessories; with decorative, protective finish.
 - 1. Hinges: Concealed (invisible).
 - 2. Exit Device: Manufacturer's standard.

2.03 SEALS:

- A. General: Provide types of seals indicated that produce folding panel partitions complying with acoustical performance requirements and the following:
 - 1. Manufacturer's standard seals.
 - 2. Seals made from materials and in profiles that minimize sound leakage.
 - 3. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between folding panel partition perimeter and adjacent surfaces, when folding panel partition is extended and closed.
- B. Vertical Seals: Deep-nesting, interlocking steel astragals mounted on each edge of panel, with continuous PVC acoustical seal.
- C. Horizontal Top Seals:
 - 1. Continuous-contact, extruded-PVC seal exerting uniform constant pressure on track.
 - 2. PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on track when extended.
 - 3. Continuous-contact, extruded-PVC seal exerting uniform constant pressure on track or PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on track when extended.

SECTION 102226 - OPERABLE PARTITIONS: continued

- D. Horizontal Bottom Seals: PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.
 - 1. Mechanically Operated for Acoustical Panels: Extension and retraction of bottom seal by operating handle or built-in operating mechanism, with operating range not less than 1-1/2 inches between retracted seal and floor finish.

2.04 FINISH FACING:

- A. General: Provide finish facings for panels that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.
 - 1. Apply one-piece, seamless facings free of air bubbles, wrinkles, blisters, and other defects, with edges tightly butted, and with invisible seams complying with Shop Drawings for location, and with no gaps or overlaps. Horizontal butted edges or seams are not permitted. Tightly secure and conceal raw and selvage edges of facing for finished appearance.
 - 2. Where facings with directional or repeating patterns or directional weave are indicated, mark facing top and attach facing in same direction.
 - 3. Match facing pattern 72 inches above finished floor.
 - 4. Color/Pattern: As selected by Contracting Officer from manufacturer's full range.
- B. Fabric Wall Covering: 100% polyolefin woven fabric, from same dye lot, treated to resist stains.
- C. Cap-Trimmed Edges: Protective perimeter-edge trim with tight hairline joints concealing edges of panel and finish facing, finished as follows:
 - 1. Steel, Painted: Finished with manufacturer's standard neutral color.
 - 2. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper required to comply with performance requirements; and with manufacturer's standard mill finish.
- D. Trimless Edges: Fabricate exposed panel edges so finish facing wraps uninterrupted around panel, covering edge and resulting in an installed partition with facing visible on vertical panel edges, without trim, for minimal sightlines at panel-to-panel joints.

2.05 SUSPENSION SYSTEMS:

- A. Suspension Tracks: Steel or aluminum with adjustable steel hanger rods for overhead support, designed for type of operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
 - 1. Panel Guide: Aluminum; finished with factory-applied, decorative, protective finish.
 - 2. Head Closure Trim: As required for acoustical performance; with factory-applied, decorative, protective finish.
- B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.
 - 1. Multidirectional Carriers: Capable of negotiating 90-degree L, T, and X intersections without track switches.

SECTION 102226 - OPERABLE PARTITIONS: continued

- C. Track Intersections, Switches, and Accessories: As required for type of operation, storage, track configuration, and layout indicated for operable panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.
 - 1. X Intersections: Allowing panels to pass through or change travel direction full circle in 90-degree increments, and allowing 1 partition to cross track of another.
 - 2. Center carrier stop.
 - D. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish, unless otherwise indicated.
 - E. Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating, unless otherwise indicated.
- 2.06 ACCESSORIES:
- A. Pass Doors: Fabricated to comply with recommendations in ICC/ANSI A117.1. Swinging door built into and matching panel materials, construction, acoustical qualities, finish, and thickness, complete with frames and operating hardware. Hinges finished to match other exposed hardware.
 - 1. Single Pass Door: 36 by 84 inches , with the following:
 - a. Door Seals: Mechanically operated floor seal on panels containing pass doors.
 - b. Concealed door closer.
 - c. Latchset: Passage set.

PART 3 - EXECUTION

- 3.01 EXAMINATION:
- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.
 - B. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.02 INSTALLATION:
- A. General: Comply with ASTM E557 except as otherwise required by operable panel partition manufacturer's written installation instructions.
 - B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed.
 - C. Install panels from marked packages in numbered sequence indicated on Shop Drawings.
 - D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.
 - E. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.
- 3.03 ADJUSTING:
- A. Adjust operable panel partitions to operate smoothly, without warping or binding. Lubricate hardware and other moving parts.
 - B. Adjust pass doors to operate smoothly and easily, without binding or warping. Check and readjust operating hardware. Confirm that latches and locks engage accurately and securely without forcing or binding.

SECTION 102226 - OPERABLE PARTITIONS: continued

3.04 FIELD QUALITY CONTROL:

- A. Light-Leakage Test: Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids; adjust partitions for acceptable fit.

3.05 CLEANING:

- A. Clean soiled surfaces of operable panel partitions to remove dust, loose fibers, fingerprints, adhesives, and other foreign materials according to manufacturer's written instructions.

3.06 DEMONSTRATION:

- A. Engage a factory-authorized service representative to train Contracting Officer's maintenance personnel to adjust, operate, and maintain operable panel partitions.

END OF SECTION 102226

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this Section.
- B. DIVISION 01, Section "Sustainable Design Requirements" for LEED® related requirements for recycled content materials and local/regionally manufactured and sourced materials.

1.02 SUMMARY:

- A. Section Includes:
 - 1. Public-use washroom accessories.
 - 2. Warm-air dryers.
 - 3. Custodial accessories.

1.03 REFERENCES:

- A. ASTM International:
 - 1. ASTM A153/A153M-05 - Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 2. ASTM A653/A653M-06a - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 3. ASTM A666-03 - Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - 4. ASTM A1008/A1008M-07 - Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 - 5. ASTM B16/B16M-05 - Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.
 - 6. ASTM B19-05 - Specification for Cartridge Brass Sheet, Strip, Plate, Bar, and Disks.
 - 7. ASTM B30-06a - Specification for Copper Alloys in Ingot Form.
 - 8. ASTM B456-03 - Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
 - 9. ASTM C1503-01 - Specification for Silvered Flat Glass Mirror.
 - 10. ASTM F446-85 (Reapproved 2004) - Consumer Safety Specification for Grab Bars and Accessories Installed in the Bathing Area.
- B. NFPA 70-2008 - National Electrical Code.

1.04 SUBMITTALS:

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Features that will be included for Project.
 - 5. Manufacturer's warranty.
- B. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.
 - 1. Approved full-size Samples will be returned and may be used in the Work.

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES: continued

- C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify products using designations indicated.
 - D. LEED Submittals:
 - 1. Product Data for Credit MRC4: For products containing recycled content, submit documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content for each product or portion of a product having recycled content. Include statement indicating cost for each product containing recycled content material.
- 1.05 INFORMATIONAL SUBMITTALS:
- A. Warranty: Sample of special warranty.
- 1.06 CLOSEOUT SUBMITTALS:
- A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.
- 1.07 QUALITY ASSURANCE:
- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.
 - B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 1.08 COORDINATION:
- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
 - B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.
- 1.09 WARRANTY:
- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

- 2.01 MATERIALS:
- A. Stainless Steel: ASTM A666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
 - B. Brass: ASTM B19, flat products; ASTM B16/B16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B30, castings.
 - C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.
 - D. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 (Z180) hot-dip zinc coating.
 - E. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.
 - F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES: continued

- G. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.02 PUBLIC-USE WASHROOM ACCESSORIES:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. A & J Washroom Accessories, Inc.
 - 2. American Specialties, Inc.
 - 3. Bobrick Washroom Equipment, Inc.
 - 4. Bradley Corporation.
 - 5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
 - 6. Tubular Specialties Manufacturing, Inc.
 - 7. Or approved equals.
- B. Toilet Tissue (Roll) Dispenser (TA-1):
 - 1. Description: Double-roll dispenser with shelf.
 - 2. Mounting: Surface mounted.
 - 3. Operation: Noncontrol delivery with standard spindle.
 - 4. Capacity: Designed for 4-1/2- or 5-inch diameter tissue rolls.
 - 5. Material and Finish: Stainless steel, No. 4 finish (satin).
- C. Paper Towel (Folded) Dispenser (TA-2):
 - 1. Mounting: Surface mounted.
 - 2. Minimum Capacity: 400 C-fold or 525 multifold towels.
 - 3. Material and Finish: Stainless steel, No. 4 finish (satin).
 - 4. Lockset: Tumbler type.
 - 5. Refill Indicators: Pierced slots at sides or front.
- D. Liquid-Soap Dispenser (TA-3):
 - 1. Description: Designed for dispensing soap in liquid or lotion form.
 - 2. Mounting: Vertically -oriented, surface mounted.
 - 3. Capacity: 20 ounces.
 - 4. Materials:
 - 5. Lockset: Tumbler type.
 - 6. Refill Indicator: Window type.
- E. Seat-Cover Dispenser (TA-4):
 - 1. Mounting: Surface mounted.
 - 2. Minimum Capacity: 250 seat covers.
 - 3. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).
 - 4. Lockset: Tumbler type.
- F. Grab Bars (TA-5):
 - 1. Mounting: Flanges with concealed fasteners.
 - 2. Material: Stainless steel, 0.05 inch thick.
 - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
 - 3. Outside Diameter: 1-1/4 inches.
 - 4. Configuration and Length: As indicated on Drawings.
- G. Waste Receptacle (TA-6):
 - 1. Open top, freestanding.
 - 2. Minimum capacity.
 - 3. Material: Stainless steel, No. 4 finish (satin).
 - 4. Liner: Reusable vinyl liner.

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES: continued

- H. Sanitary-Napkin Disposal Unit (TA-7):
 - 1. Mounting: Surface mounted.
 - 2. Door: Self-closing, disposal-opening cover and hinged face panel with tumble lockset.
 - 3. Receptacle: Removable vinyl.
 - 4. Material and finish: Stainless steel, No. 4 finish (satin).
- I. Not Used (TA-8).
- J. Vendor (TA-9):
 - 1. Type: Sanitary napkin.
 - 2. Mounting: Surface mounted.
 - 3. Capacity: 50.
 - 4. Operation: Single coin (25 cents).
 - 5. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).
 - 6. Lockset: Tumbler type with separate lock and key for coin box.
- K. Mirror Unit:
 - 1. Frame: Stainless-steel angle, 0.05 inch thick.
 - a. Corners: Manufacturer's standard.
 - 2. Integral Shelf: 5 inches deep.
 - 3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
 - b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
 - 4. Size: As indicated on Drawings.

2.03 CUSTODIAL ACCESSORIES:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. A & J Washroom Accessories, Inc.
 - 2. American Specialties, Inc.
 - 3. Bobrick Washroom Equipment, Inc.
 - 4. Bradley Corporation.
 - 5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
 - 6. Tubular Specialties Manufacturing, Inc.
 - 7. Or approved equals.
- B. Mop and Broom Holder (TA-10) :
 - 1. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
 - 2. Length: 36 inches.
 - 3. Hooks: Three.
 - 4. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
 - 5. Material and Finish: Stainless steel, No. 4 finish (satin).
 - a. Shelf: Not less than nominal 0.05-inch thick stainless steel.
 - b. Rod: Approximately 1/4-inch diameter stainless steel.

2.04 FABRICATION:

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES: continued

- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Contracting Officer's representative.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F446.

3.02 ADJUSTING AND CLEANING:

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

SECTION 104413 - FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. This Section Includes:
 - 1. Fire protection cabinets for the following:
 - a. Portable fire extinguishers.
- B. Related Sections:
 - 1. DIVISION 01, Section "Sustainable Design Requirements" for LEED[®] related requirements for recycled content materials and local/regionally manufactured and sourced materials.

1.03 REFERENCES:

- A. American Architectural Manufacturers Association:
 - 1. AAMA 611 (1998) - Voluntary Specification for Anodized Architectural Aluminum.
 - 2. AAMA 2603 (2002) - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
- B. ASTM International:
 - 1. ASTM A666-03 - Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - 2. ASTM A1008/A1008M-04 - Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - 3. ASTM B36/B36M-01 - Specification for Brass Plate, Sheet, Strip, and Rolled Bar.
 - 4. ASTM B209-04 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 5. ASTM B221-02 - Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 6. ASTM C1036-01 - Specification for Flat Glass.
 - 7. ASTM C1048-04 - Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass.
 - 8. ASTM D4802-02 - Specification for Poly (Methyl Methacrylate) Acrylic Plastic Sheet.
 - 9. ASTM E814-02 - Test Method for Fire Tests of Through-Penetration Fire Stops.
- C. National Association of Architectural Metal Manufacturers:
 - 1. Metal Finishes Manual for Architectural and Metal Products, 1988.
- D. NFPA:
 - 1. NFPA 10 (2002) - Portable Fire Extinguishers.
 - 2. NFPA 70 (2002) - National Electrical Code.
- E. SSPC - The Society for Protective Coatings:
 - 1. SSPC-SP 8 (1982) (Revised 2000) - Surface Preparation Specification No. 8 - Pickling.
 - 2. SSPC-SP 5/NACE No. 1 (2000) (Revised 2004) - Joint Surface Preparation Standard SSPC-SP 5/NACE No. 1 - White Metal Blast Cleaning.

SECTION 104413 - FIRE EXTINGUISHER CABINETS: continued

1.04 SUBMITTALS:

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
 - 1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Size: 6 by 6 inches square.
- D. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.
- E. Product Data for Credit MRc4: For products containing recycled content, submit documentation indicating percentages, by weight, of post-consumer and pre-consumer recycled content for each product or portion of a product having recycled content. Include statement indicating cost for each product containing recycled content material.

1.05 CLOSEOUT SUBMITTALS:

- A. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

1.06 COORDINATION:

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate size of fire protection cabinets to ensure that type and capacity of fire hoses, hose valves, and hose racks indicated are accommodated.
- C. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 - PRODUCTS

2.01 FIRE PROTECTION CABINET:

- A. Cabinet Type: Suitable for 4A:60B:C, 10-lb. fire extinguisher.
 - 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Fire End & Croker Corporation.
 - b. J. L. Industries, Inc., a division of Activar Construction Products Group.
 - c. Kidde Residential and Commercial Division, Subsidiary of Kidde plc.
 - d. Larsen's Manufacturing Company.
 - e. Modern Metal Products, Division of Technico Inc.
 - f. Moon-American.
 - g. Potter Roemer LLC.
 - h. Watrous Division, American Specialties, Inc.
- B. Cabinet Construction: Nonrated.
 - 1. Construct cabinets fabricated from 0.0428-inch thick, cold-rolled steel sheet. Provide factory-drilled mounting holes.
- C. Cabinet Material: Steel sheet.

SECTION 104413 - FIRE EXTINGUISHER CABINETS: continued

- D. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
 - 1. Square-Edge Trim: 1-1/4- to 1-1/2-inch backbend depth.
- E. Cabinet Trim Material: Steel sheet.
- F. Door Material: Steel sheet.
- G. Door Style: Fully glazed, frameless, backless.
- H. Door Glazing: Clear float glass.
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide recessed door pull and friction latch.
 - 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- J. Accessories:
 - 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 - 2. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
 - 3. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
 - 4. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated on the drawings.
 - a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
 - (1) Location: Applied to cabinet door.
 - (2) Application Process: Silk-screened.
 - (3) Lettering Color: Red.
 - (4) Orientation: Vertical.
- K. Finishes:
 - 1. Manufacturer's standard baked-enamel paint for the following:
 - a. Exterior of cabinet door and trim except for those surfaces indicated to receive another finish.
 - b. Interior of cabinet and door.
 - 2. Steel: Baked enamel or powder coat.

2.02 FABRICATION:

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 - 1. Weld joints and grind smooth.
 - 2. Provide factory-drilled mounting holes.
 - 3. Prepare doors and frames to receive locks.
 - 4. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
 - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.

SECTION 104413 - FIRE EXTINGUISHER CABINETS: continued

2. Fabricate door frames of one-piece construction with edges flanged.
 3. Miter and weld perimeter door frames.
 - C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.
- 2.03 GENERAL FINISH REQUIREMENTS:
- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
 - C. Finish fire protection cabinets after assembly.
 - D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- 2.04 STEEL FINISHES:
- A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning". After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
 - B. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
 1. Color and Gloss: As selected by Contracting Officer from manufacturer's full range.

PART 3 - EXECUTION

- 3.01 EXAMINATION:
- A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.
 - B. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.02 PREPARATION:
- A. Prepare recesses for semirecessed fire protection cabinets as required by type and size of cabinet and trim style.
- 3.03 INSTALLATION:
- A. General: Install fire protection cabinets in locations and at mounting heights indicated.
 1. Fire Protection Cabinets: 54 inches above finished floor to top of cabinet.
 - B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
 1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire protection cabinets.
 2. Provide inside latch and lock for break-glass panels.
 3. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.
- 3.04 ADJUSTING AND CLEANING:
- A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturers written installation instructions.

SECTION 104413 - FIRE EXTINGUISHER CABINETS: continued

- B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.
- E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

DIVISION 11 - EQUIPMENT

SECTION 115213 - AUDIO-VISUAL EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Electrically operated projection screens and controls.
 - 2. Overhead projector mounting arms and brackets.
- B. Related Sections:
 - 1. DIVISION 05 Section "Metal Fabrications" for metal support framing for projection screens.
 - 2. DIVISION 26 Sections for electrical service and connections including device boxes for switches and conduit.

1.03 REFERENCES:

- A. American Architectural Manufacturers Association:
 - 1. AAMA 611-1998 - Voluntary Specification for Anodized Architectural Aluminum.
- B. ASTM International:
 - 1. ASTM B221-04a - Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 2. ASTM C1036-01 - Specification for Flat Glass.
 - 3. ASTM D1003-00 - Test Method for Haze and Luminous Transmittance of Transparent Plastics.
 - 4. ASTM D4802-02 - Specification for Poly (Methyl Methacrylate) Acrylic Plastic Sheet.
 - 5. ASTM E84-05 - Test Method for Surface Burning Characteristics of Building Materials.
 - 6. ASTM G21-96 (Reapproved 2002) - Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- C. NFPA:
 - 1. NFPA 70-2005 - National Electrical Code.
 - 2. NFPA 701-2004 - Standard Methods of Fire Tests for Flame-Resistant Textiles and Films.
- D. Society of Motion Picture and Television Engineers:
 - 1. SMPTE RP 94-2000 - Gain Determination of Front Projection Screens.

1.04 DEFINITIONS:

- A. Gain of Front-Projection Screens: Ratio of light reflected from screen material to that reflected perpendicularly from a magnesium carbonate surface as determined per SMPTE RP 94.
- B. Half-Gain Angle: The angle, measured from the axis of the screen surface to the most central position on a perpendicular plane through the horizontal centerline of the screen where the gain is half of the peak gain.

1.05 SUBMITTALS:

- A. Product Data: For each type of product indicated.

SECTION 115213 - AUDIO-VISUAL EQUIPMENT: continued

- B. Shop Drawings: For projection screens. Show layouts and types of projection screens. Include the following:
 - 1. For electrically operated projection screens and controls:
 - a. Location of screen centerline relative to ends of screen case.
 - b. Location of wiring connections for electrically operated units.
 - c. Location of seams in viewing surfaces.
 - d. Drop lengths.
 - e. Anchorage details, including connection to supporting structure for suspended units.
 - f. Details of juncture of exposed surfaces with adjacent finishes.
 - g. Accessories.
 - h. Wiring diagrams.
 - 2. For projector mounting brackets:
 - a. Manufacturer and model.
 - b. Drop length of projector mount.
 - c. Accessories.

1.06 CLOSEOUT SUBMITTALS:

- A. Maintenance Data: For projection screens to include in maintenance manuals.

1.07 QUALITY ASSURANCE:

- A. Source Limitations for Projection Screens: Obtain projection screens from single manufacturer. Obtain accessories, including necessary mounting hardware, from screen manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.08 DELIVERY, STORAGE, AND HANDLING:

- A. Environmental Limitations: Do not deliver or install projection screens until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.09 COORDINATION:

- A. Coordinate layout and installation of projection screens with adjacent construction, including ceiling suspension systems, light fixtures, HVAC equipment, and partitions.

PART 2 - PRODUCTS

2.01 ELECTRICALLY OPERATED PROJECTION SCREENS:

- A. General: Manufacturer's standard units consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation.
 - 1. Controls: Remote, three-position control switch installed in recessed device box with flush cover plate matching other electrical device cover plates in room where switch is installed.
 - a. Provide two control switches for each screen.
 - b. Provide power supply for low-voltage systems.
 - 2. Motor in Roller: Instant-reversing motor of size and capacity recommended by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions,

SECTION 115213 - AUDIO-VISUAL EQUIPMENT: continued

- and positive-stop action to prevent coasting. Mount motor inside roller with vibration isolators to reduce noise transmission.
3. Screen Mounting: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a 3/8-inch diameter metal rod with ends of rod protected by plastic caps.
 - a. Roller for motor in roller supported by vibration- and noise-absorbing supports.
 4. Tab Tensioning: Provide units that have a durable low-stretch cord, such as braided polyester, on each side of screen connected to edge of screen by tabs to pull screen flat horizontally.
- B. Suspended, Electrically Operated Screens with Automatic Ceiling Closure: Motor-in-roller units designed and fabricated for suspended mounting; with bottom of case composed of two panels, fully enclosing screen, motor, and wiring; one panel hinged and designed to open and close automatically when screen is lowered and fully raised, the other removable or openable for access to interior of case.
1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Motor in Roller:
 - (1) Da-Lite Screen Company; Boardroom Electrol.
 - (2) Draper Inc.; Envoy.
 - (3) Stewart Filmscreen Corporation; Model ABT-4.
 - b. End-Mounted Motor:
 - (1) Da-Lite Screen Company; Executive Electrol.
 - (2) Draper Inc.; Ambassador.
 2. Provide metal or metal-lined wiring compartment on units with motor in roller.
 3. Screen Case: Made from metal.
 4. Provide screen case with trim flange to receive ceiling finish.
 5. Finish on Exposed Surfaces: Vinyl covering or baked enamel.

2.02 FRONT-PROJECTION SCREEN MATERIAL:

- A. Glass-Beaded Viewing Surface: Peak gain not less than 2.0, and half-gain angle of at least 15 degrees from the axis of the screen surface.
1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Da-Lite Screen Company; Glass Beaded.
 - b. Draper Inc.; Glass Beaded.
- B. Material: Vinyl sheet.
- C. Mildew-Resistance Rating: 0 or 1 when tested according to ASTM G21.
- D. Flame Resistance: Passes NFPA 701.
- E. Flame-Spread Index: Not greater than 75 when tested according to ASTM E84.
- F. Seamless Construction: Provide screens, in sizes indicated, without seams.
- G. Edge Treatment: Black masking borders.
- H. Size of Viewing Surface: 72 by 96 inches.

2.03 OVERHEAD PROJECTOR MOUNTING ARMS AND BRACKETS:

- A. Mounting Arms: Provide prefinished steel mounting arms with the following minimum adjustment capabilities:
1. Capacity: 50 pounds.
 2. Pitch: ± 15 degrees.
 3. Roll: ± 20 degrees.

SECTION 115213 - AUDIO-VISUAL EQUIPMENT: continued

4. Swivel: 360 degrees.
 5. Mounting: Mounting plate bolted to structure above ceiling.
 6. Color: White.
 7. Basis of Design: Promounts, Projector Mount, Model UPR-PR0200.
- B. Mounting Brackets: Provide prefinished steel mounting brackets as follows:
1. Capacity: 50 pounds minimum.
 2. Color: White.
 3. Basis of Design: Promounts Universal Projector Mount, Model UPR-200.
 4. Or approved equal.
- C. Provide one projector mounting arm and bracket for each conference, classroom and training room.

PART 3 - EXECUTION

3.01 FRONT-PROJECTION SCREEN INSTALLATION:

- A. Install front-projection screens at locations indicated to comply with screen manufacturer's written instructions.
- B. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor to supporting substrate in a manner that produces a smoothly operating screen with vertical edges plumb and viewing surface flat when screen is lowered.
1. Install low-voltage controls according to NFPA 70 and complying with manufacturer's written instructions.
 - a. Wiring Method: Install wiring in raceway except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.
 2. Test electrically operated units to verify that screen controls, limit switches, closures, and other operating components are in optimum functioning condition.
 3. Test manually operated units to verify that screen-operating components are in optimum functioning condition.

END OF SECTION 115213

DIVISION 12 - FURNISHINGS

SECTION 122113 - HORIZONTAL LOUVER BLINDS

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS:
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this Section.
- 1.02 SUMMARY:
- A. Section Includes:
 - 1. Horizontal louver blinds with aluminum slats.
 - B. Related Requirements:
 - 1. DIVISION 06 Section "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting horizontal louver blinds and accessories.
- 1.03 REFERENCES:
- A. Window Covering Manufacturers Association:
 - 1. WCMA A 100.1 (2007) - Safety of Corded Window Covering Products (ANSI).
- 1.04 SUBMITTALS:
- A. Product Data: For each type of product.
 - B. Shop Drawings: Show fabrication and installation details for horizontal louver blinds.
 - C. Samples: For each type and color of horizontal louver blind indicated.
 - 1. Slat: Not less than 12 inches long.
 - 2. Tapes: Full width, not less than 6 inches long.
 - 3. Horizontal Louver Blind: Full-size unit, not less than 16 inches wide by 24 inches long.
 - 4. Valance: Full-size unit, not less than 12 inches wide.
- 1.05 INFORMATIONAL SUBMITTALS:
- A. Product Certificates: For each type of horizontal louver blind.
- 1.06 CLOSEOUT SUBMITTALS:
- A. Maintenance Data: For horizontal louver blinds to include in maintenance manuals.
- 1.07 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. Horizontal Louver Blinds: Full-size units equal to 5% of quantity installed for each size, color, texture, pattern, and gloss indicated, but no fewer than two units.
- 1.08 DELIVERY, STORAGE, AND HANDLING:
- A. Deliver horizontal louver blinds in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.
- 1.09 FIELD CONDITIONS:
- A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet and finish work in spaces, including painting, is complete and dry and ambient temperature and

SECTION 122113 - HORIZONTAL LOUVER BLINDS: continued

humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

- B. Field Measurements: Where horizontal louver blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Contracting Officer of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Source Limitations: Obtain horizontal louver blinds from single source from single manufacturer.

2.02 HORIZONTAL LOUVER BLINDS, ALUMINUM SLATS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - 1. Hunter Douglas Contract.
 - 2. Levolor Contract; a Newell Rubbermaid company.
 - 3. Springs Window Fashions.
- B. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radius corners.
 - 1. Width: 1 inch.
 - 2. Thickness: Not less than 0.008 inch.
 - 3. Spacing: Manufacturer's standard.
 - 4. Finish: Ionized antistatic, dust-repellent, baked polyester finish.
 - 5. Features:
 - a. Lift-Cord Rout Holes: Minimum size required for lift cord and located near back (outside) edge of slat to maximize slat overlap and minimize light gaps between slats.
 - b. Perforated Slats: Openness factor of 6 to 7%.
- C. Headrail: Formed steel or extruded aluminum; long edges returned or rolled. Headrails fully enclose operating mechanisms on three sides.
 - 1. Capacity: One blind per headrail unless otherwise indicated.
 - 2. Ends: Manufacturer's standard.
 - 3. Manual Lift Mechanism:
 - a. Lift-Cord Lock: Variable; stops lift cord at user-selected position within blind full operating range.
 - b. Operator: Extension of lift cord(s) through lift-cord lock mechanism to form cord pull.
 - 4. Manual Tilt Mechanism: Enclosed worm-gear mechanism and linkage rod that adjusts ladders.
 - a. Tilt: Full.
 - b. Operator: Corrosion-resistant steel rod.
 - c. Over-Rotation Protection: Manufacturer's detachable operator or slip clutch to prevent over rotation of gear.
 - 5. Manual Lift-Operator and Tilt-Operator Lengths: Manufacturer's standard.

SECTION 122113 - HORIZONTAL LOUVER BLINDS: continued

6. Manual Lift-Operator and Tilt-Operator Locations: Right side and left side of headrail, respectively.
7. Integrated Headrail/Valance: Curved face.
- D. Bottom Rail: Formed-steel or extruded-aluminum tube that secures and protects ends of ladders and lift cords and has plastic- or metal-capped ends.
 1. Type: Manufacturer's standard Bottom contoured to minimize light gaps.
- E. Lift Cords: Manufacturer's standard braided cord.
- F. Ladders: Evenly spaced across headrail at spacing that prevents long-term slat sag.
 1. Type: Braided cord.
- G. Valance: Two slats.
- H. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.
 1. Type: Overhead.
 2. Intermediate Support: Provide intermediate support brackets to produce support spacing recommended by blind manufacturer for weight and size of blind.
- I. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard.
- J. Colors, Textures, Patterns, and Gloss:
 1. Slats: As selected by Contracting Officer from manufacturer's full range.
 2. Components: Provide rails, cords, ladders, and materials exposed to view matching or coordinating with slat color.

2.03 HORIZONTAL LOUVER BLIND FABRICATION:

- A. Product Safety Standard: Fabricate horizontal louver blinds to comply with WCMA A 100.1 including requirements for corded, flexible, looped devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74°F:
 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which blind is installed less 1/4 inch per side or 1/2 inch total, $\pm 1/8$ inch. Length equal to head-to-sill dimension of opening in which blind is installed less 1/4 inch, $\pm 1/8$ inch.
- C. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.
 1. Lift-and-Tilt Mechanisms: With permanently lubricated moving parts.
- D. Mounting and Intermediate Brackets: Designed for removal and reinstallation of blind without damaging blind and adjacent surfaces, for supporting blind components, and for bracket positions and blind placement indicated.
- E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to brackets and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.
- F. Color-Coated Finish:
 1. Metal: For components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance.

SECTION 122113 - HORIZONTAL LOUVER BLINDS: continued

1. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.02 INSTALLATION:
- A. Install horizontal louver blinds level and plumb, aligned and centered on openings, and aligned with adjacent units according to manufacturer's written instructions.
 1. Locate so exterior slat edges are not closer than 1 inch from interior faces of glass and not closer than 1/2 inch from interior faces of glazing frames through full operating ranges of blinds.
 2. Install mounting and intermediate brackets to prevent deflection of headrails.
 3. Install with clearances that prevent interference with adjacent blinds, adjacent construction, and operating hardware of glazed openings, other window treatments, and similar building components and furnishings.
- 3.03 ADJUSTING:
- A. Adjust horizontal louver blinds to operate free of binding or malfunction through full operating ranges.
- 3.04 CLEANING AND PROTECTION:
- A. Clean horizontal louver blind surfaces after installation according to manufacturer's written instructions.
 - B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer, and that ensures that horizontal louver blinds are without damage or deterioration at time of Substantial Completion.
 - C. Replace damaged horizontal louver blinds that cannot be repaired in a manner approved by Contracting Officer before time of Substantial Completion.
- 3.05 DEMONSTRATION:
- A. Engage a factory-authorized service representative to train Contracting Officer's maintenance personnel to adjust, operate, and maintain systems.

END OF SECTION 122113

SECTION 124813 - ENTRANCE FLOOR MATS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. This Section includes the following:
 - 1. Entrance mats in recessed frames.
- B. Related Sections include the following:
 - 1. DIVISION 03 Section "Cast-in-Place Concrete" for slab depression grouting and filling for recessed mats and frames.

1.03 REFERENCES:

- A. American Architectural Manufacturers Association:
 - 1. AAMA 611 (1998) - Voluntary Specifications for Anodized Architectural Aluminum.
- B. ASTM International:
 - 1. ASTM B221-08 - Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 2. ASTM B455-05 - Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes.
- C. International Code Council:
 - 1. ICC A117.1 (2003) - Accessible and Usable Buildings and Facilities (ANSI).
- D. National Association of Architectural Metal Manufacturers:
 - 1. Metal Finishes Manual for Architectural and Metal Products, 2006.
- E. U.S. Architectural & Transportation Barriers Compliance Board:
 - 1. Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities. Adopted in 2004.

1.04 SUBMITTALS:

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show the following:
 - 1. Perimeter floor moldings.
- C. Samples: For each type of product indicated.
 - 1. Floor Mat: 12-inch square, assembled sections of floor mat.
 - 2. Tread Rail: 12-inch long Sample of each type and color.
 - 3. Frame Members: 12-inch long Sample of each type and color.

1.05 CLOSEOUT SUBMITTALS:

- A. Maintenance Data: For floor mats and frames to include in maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS:

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Entrance Tiles: Full-size units equal to 2% of amount installed for each size, color, and pattern indicated, but no fewer than 10 units.

SECTION 124813 - ENTRANCE FLOOR MATS AND FRAMES: continued

1.07 QUALITY ASSURANCE:

- A. Source Limitations: Obtain floor mats and frames through one source from a single manufacturer.
- B. Accessibility Requirements: Provide installed floor mats that comply with Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1.08 PROJECT CONDITIONS:

- A. Field Measurements: Indicate measurements on Shop Drawings.

1.09 COORDINATION:

- A. Coordinate size and location of recesses in concrete with installation of finish floors to receive floor mats and frames.

PART 2 - PRODUCTS

2.01 ENTRANCE MATS:

- 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. Basis of Design Product: Subject to compliance with requirements, provide:
 - 1. American Floor Products Company, Inc.
 - 2. ARDEN Architectural Specialties, Inc.
 - 3. Balco, Inc.
 - 4. Cactus Mat Mfg. Co.
 - 5. Consolidated Plastics Company, Inc.
 - 6. C/S Group.
 - 7. Durable Corporation.
 - 8. Flexco.
 - 9. Matco International.
 - 10. Mats, Inc.
 - 11. Musson, R. C. Rubber Co.
 - 12. Pawling Corporation; Architectural Products Division.
 - 13. Sbemco International Inc.
 - 14. Tennessee Mat Company, Inc.
 - 15. Tepromark International, Inc.
 - 16. U.S. Mat & Rubber Corporation.
 - 17. Or approved equal.
- C. Carpet-Type Mats: Nylon carpet bonded to 1/8- to 1/4-inch thick, flexible vinyl backing to form mats 3/8 or 7/16 inch thick with nonraveling edges.
 - 1. Colors, Textures, and Patterns: As selected by Contracting Officer from manufacturer's full range.
 - 2. Mat Size: 6 feet-0 inches wide by 10 feet-0 inches long, or as shown on Drawings.
- D. Recessed Frames:
 - 1. Extruded Aluminum: ASTM B221 (ASTM B221M), Alloy 6061-T6 or Alloy 6063-T5, T6, or T52.
 - 2. Color: Mill-finish.

SECTION 124813 - ENTRANCE FLOOR MATS AND FRAMES: continued

2.02 CONCRETE FILL AND GROUT MATERIALS:

- A. Provide concrete grout and fill equivalent in strength to cast-in-place concrete slabs for recessed mats and frames. Use aggregate no larger than one-third fill thickness.

2.03 FABRICATION:

- A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.
- B. Recessed Frames: As indicated, for permanent recessed installation, complete with corner pins or reinforcement and anchorage devices.
 - 1. Fabricate edge-frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.
- C. Coat surfaces of aluminum frames that will contact cementitious material with manufacturer's standard protective coating.

2.04 ALUMINUM FINISHES:

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine substrates and floor conditions for compliance with requirements for location, sizes, minimum recess depth, and other conditions affecting installation of floor mats and frames.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. Install recessed mat frames to comply with manufacturer's written instructions. Set mat tops at height recommended by manufacturer for most effective cleaning action; coordinate top of mat surfaces with bottom of doors that swing across mats to provide clearance between door and mat.
 - 1. Install necessary shims, spacers, and anchorages for proper location and secure attachment of frames.
 - 2. Install grout and fill around frames and, if required to set mat tops at proper elevations, in recesses under mats. Finish grout and fill smooth and level.
- B. Install surface-type units to comply with manufacturer's written instructions at locations indicated; coordinate with entrance locations and traffic patterns.
 - 1. Anchor fixed surface-type frame members to floor with devices spaced as recommended by manufacturer.

SECTION 124813 - ENTRANCE FLOOR MATS AND FRAMES: continued

3.03 PROTECTION:

- A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION 124813

SECTION 133423 - FABRICATED STRUCTURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section includes prefabricated steel equipment enclosure.
- B. Related Sections:
 - 1. DIVISION 03, Section "Cast-in-Place Concrete" for installing anchor bolts.

1.03 REFERENCES:

- A. American Architectural Manufacturers Association:
 - 1. AAMA 611-1998 - Voluntary Specification for Anodized Architectural Aluminum.
 - 2. AAMA 2603-2002 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
- B. American National Standards Institute:
 - 1. ANSI A208.1-1999 - Particleboard.
- C. American Society of Civil Engineers/Structural Engineering Institute:
 - 1. ASCE/SEI 7-2005 - Minimum Design Loads for Buildings and Other Structures.
- D. American Welding Society:
 - 1. AWS D1.1-2004 - Structural Welding Code - Steel.
 - 2. AWS D1.2-2003 - Structural Welding Code - Aluminum.
 - 3. AWS D1.3-1998 - Structural Welding Code - Sheet Steel.
- E. ASTM International:
 - 1. ASTM A36-05 - Specification for Carbon Structural Steel.
 - 2. ASTM A123-02 - Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 3. ASTM A153-05 - Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 4. ASTM A500-03a - Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - 5. ASTM A513-00 - Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.
 - 6. ASTM A572-04 - Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
 - 7. ASTM A653-05 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 8. ASTM A666-03 - Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - 9. ASTM A786-05 - Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
 - 10. ASTM B209-04 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 11. ASTM B221-05 - Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 12. ASTM B632-02 - Specification for Aluminum-Alloy Rolled Tread Plate.
 - 13. ASTM C1036-01 - Specification for Flat Glass.
 - 14. ASTM C1048-04 - Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass.

SECTION 133423 - FABRICATED STRUCTURES: continued

15. ASTM E774-97 - Specification for the Classification of the Durability of Sealed Insulating Glass Units.
 16. ASTM F2329-05 - Specification for Zinc Coating, Hot-Dip, Requirements for Applications to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts and Special Threaded Fasteners.
 - F. Code of Federal Regulations:
 1. 16 CFR 1201-2005 - Safety Standard for Architectural Glazing Materials.
 - G. Department of Commerce:
 1. DOC PS 1-1995 - Construction and Industrial Plywood.
 - H. National Association of Architectural Metal Manufacturers:
 1. Metal Finishes Manual for Architectural and Metal Products, 1988.
 - I. NFPA:
 1. NFPA 70-2005 - National Electrical Code.
- 1.04 PERFORMANCE REQUIREMENTS:
- A. Structural Performance: Control booths shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to:
 1. Dead Loads: Per IBC.
 2. Live Loads: Per IBC.
 3. Roof Loads: 20 psf.
 4. Snow Loads: 13 psf (flat-roof).
 5. Seismic Design Category: B.
 6. Wind Loads: 115 mph with 3-second gust.
 7. Deflection Limits: Design framing system to withstand design loads without deflections greater than the following:
 - a. Per IBC.
 - B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 1. Temperature Change (Range): 120°F, ambient; 180°F, material surfaces.
- 1.05 SUBMITTALS:
- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control booths.
 - B. Shop Drawings: For control booths. Include plans, elevations, sections, details, and attachments to other work.
 - C. Samples for Verification: For exposed finishes, in manufacturer's standard sizes.
- 1.06 INFORMATIONAL SUBMITTALS:
- A. Welding certificates.
 - B. Warranty: Sample of special warranty.
- 1.07 CLOSEOUT SUBMITTALS:
- A. Maintenance Data: For control booths to include in maintenance manuals.
- 1.08 QUALITY ASSURANCE:
- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1, "Structural Welding Code - Steel."

SECTION 133423 - FABRICATED STRUCTURES: continued

2. AWS D1.2, "Structural Welding Code - Aluminum."
3. AWS D1.3, "Structural Welding Code - Sheet Steel."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Safety Glazing Products: Category II materials complying with testing requirements in 16 CFR 1201.
 1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of SGCC or another certification agency acceptable to authorities having jurisdiction.
- D. Preinstallation Conference: Conduct conference at Project site.

1.09 COORDINATION:

- A. Coordinate installation of anchorages for enclosures. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.10 WARRANTY:

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair finish or replace wall panels that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
 1. Sheet: ASTM B209.
 2. Extruded Shapes: ASTM B221.
 3. Rolled Tread Plate: ASTM B632, Alloy 6061-T4 or Alloy 6061-T6.
- B. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653, commercial quality, G90 (Z275) coating designation; mill phosphatized.
- C. Galvanized, Rolled Steel Tread Plate: ASTM A786, rolled from steel plate complying with ASTM A572, Grade 55 (380); hot-dip galvanized according to ASTM A123.
- D. Steel Structural Tubing: ASTM A500, Grade B.
- E. Steel Plates, Shapes, and Bars: ASTM A36.
- F. Steel Mechanical Tubing: ASTM A513, welded steel mechanical tubing.
- G. Zinc-Coated (Galvanized) Steel: Hot-dip galvanized according to ASTM A123.
- H. Stainless-Steel Sheet: ASTM A666, Type 304.
- I. Plywood: DOC PS 1, Exterior grade.
- J. Anchorages: Anchor bolts; hot-dip galvanized according to ASTM A153.

2.02 PREFABRICATED CONTROL BOOTHS, GENERAL:

- A. General: Provide a complete, integrated set of mutually dependent components that form a completely assembled, prefabricated enclosure, ready for installation on Project site.
 1. Building Style: Standard square corners.
 2. Doors: Swinging door.
- B. Electrical Power Service: 125-A, 120/240Vac, single-phase, three-wire load center, with no fewer than four open circuits. Run copper wiring in 1/2-inch EMT conduit.

SECTION 133423 - FABRICATED STRUCTURES: continued

1. Provide one 120V ground-fault circuit interrupter (GFCI) power receptacle(s).
- C. Lighting Fixtures: Two ceiling-mounted fluorescent lighting fixture(s), 48 inches long, with acrylic lens and two 40-W lamps in each fixture. Provide single-pole switch mounted adjacent to door to control lighting fixture.
- D. Heating Unit: Wall-mounted, thermostatically controlled, 110V, 1,500-W electric heater with fan-forced operation and with capacity of not less than 5,000 Btu/h. Enclose in enameled-steel cabinet.
- E. Cooling Unit: Wall-mounted, thermostatically controlled air conditioner with cooling capacity of not less than 13,500 Btu/h. Enclose in enameled-steel cabinet.
- F. Accessories: Provide the following for each control booth:
 1. Ventilation fan.

2.03 PREFABRICATED STEEL CONTROL BOOTHS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 1. Austin Mohawk and Company, Inc.
 2. B.I.G. Enterprises, Inc.
 3. Canada Kiosk; an NRB company.
 4. Delta Scientific Corporation.
 5. Keystone Structures, Inc.
 6. Little Buildings, Inc.
 7. Mardan Fabricators.
 8. Parking Booth Company, Inc.
 9. Par-Kut International, Inc.
 10. Porta-King Building Systems.
- B. Structural Framework: Fabricated from 2-by-4-by-0.075-inch steel structural or mechanical tubing. Connect framework by welding.
- C. Base/Floor Assembly: 4-inch high assembly consisting of perimeter frame welded to structural framework of booth. Fabricate frame from 2-by-4-inch galvanized-steel structural tubing; 0.108-inch nominal-thickness, C-shaped, galvanized-steel sheet channels; or galvanized structural-steel angles. Include anchor clips fabricated from 1/4-inch thick galvanized-steel plate, predrilled and welded to exterior of integral floor frame.
 1. Subfloor and Finished Floor: Assembly consisting of 0.079-inch nominal-thickness, galvanized-steel sheet underside with rigid insulation core; covered by 0.125-inch thick, aluminum rolled tread plate; with overall assembly thickness of 2 inches.
- D. Wall Panel Assembly: Assembly consisting of exterior face panel fabricated from 0.50-inch nominal-thickness, exterior plywood; and interior face panel fabricated from 0.75-inch nominal-thickness, exterior plywood; with 2-inch thick, rigid fiberglass or polystyrene board insulation in cavity between exterior and interior face panels.
 1. Thermal Resistance Value (R-Value): R-7.
 2. Exterior Finish: Vinyl Siding, 4-inch double-dutch lap.
 3. Interior Finish: Painted plywood.
- E. Roof/Ceiling Assembly: Consisting of exterior roof panels, interior ceiling panels, and insulation between exterior and interior panels; sloped to drain at booth perimeter.
 1. Exterior Roof Panel: .50-inch plywood, 30-lb. asphalt felt, and composition asphalt shingles.
 2. Interior Ceiling Panel: Fabricated from 0.079-inch nominal-thickness, galvanized-steel sheet; with fiberglass insulation in cavity between ceiling and roof.
 - a. Thermal Resistance Value (R-Value): R-17.

SECTION 133423 - FABRICATED STRUCTURES: continued

3. Insulated Exterior/Interior Panel: Fabricated from 0.028-inch nominal-thickness, galvanized-steel, 0.032-inch thick, aluminum sheet faces and expanded-foam insulation core.
 - a. Thermal Resistance Value (R-Value): R-17.
4. Downspouts: Integral, extending 3 inches beyond booth walls.
5. Roof gutters.
- F. Swinging Door: 1-3/4 inches thick; tubular-frame design fabricated from galvanized steel; with top half of door glazed. Equip door with deadlock, three butt hinges, closer, and full weather stripping.
 1. Deadlock: Mortised, with lever handle and removable cylinder capable of being master keyed.
- G. Finish: Finish exposed metal surfaces, including structural framework, walls, canopy, and ceiling with rust-inhibitive primer and one finish coat of industrial air-dry acrylic enamel.
 1. Color: As selected by Contracting Officer from manufacturer's full range.

2.04 FABRICATION:

- A. Fabricate enclosure completely in factory.
- B. Preglaze enclosure doors at factory.
- C. Prewire enclosure at factory, ready for connection to service at Project site.
- D. Fabricate enclosure with forklift pockets in base of enclosure.

2.05 GENERAL FINISH REQUIREMENTS:

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.06 FINISHES:

- A. Steel Factory Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 1. Color and Gloss: As selected by Contracting Officer from manufacturer's full range.
- B. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 1. Color and Gloss: As selected by Contracting Officer from manufacturer's full range.

PART 3 - EXECUTION

3.01 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. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. Install enclosure according to manufacturer's written instructions.

SECTION 133423 - FABRICATED STRUCTURES: continued

- B. Set enclosure plumb and aligned. Level baseplates true to plane with full bearing on concrete bases.
- C. Fasten enclosure securely to cast-in anchor bolts.
- D. Connect electrical power service to power distribution system according to requirements specified in DIVISION 26 Sections.

3.03 ADJUSTING:

- A. Adjust doors, operable windows, and hardware to operate smoothly, easily, properly, and without binding. Confirm that locks engage accurately and securely without forcing or binding.
- B. Lubricate hardware and other moving parts.
- C. After completing installation, inspect exposed finishes and repair damaged finishes.

END OF SECTION 133423

DIVISION 21 - FIRE SUPPRESSION

SECTION 211000 - FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following fire-suppression piping inside the building:
 - 1. Wet-pipe sprinkler systems.
- B. Related Work Specified Elsewhere:
 - 1. Piping outside the building: SECTION 331100 - PRESSURE PIPING.
 - 2. Cabinets and fire extinguishers: SECTION 104400 - FIRE PROTECTION SPECIALTIES.
 - 3. Alarm devices not specified in this Section: SECTION 283100 - FIRE ALARM SYSTEMS.
 - 4. Electric-drive fire pumps: SECTION 213113 - ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS.

1.02 REFERENCES:

- A. Applicable Standards (Latest Edition):
 - 1. American Society for Testing and Materials (ASTM):
 - a. A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - b. A106 - Seamless Carbon Steel Pipe for High-Temperature Service.
 - c. A135 - Electric-Resistance-Welded Steel Pipe.
 - d. A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 - e. A536 - Ductile Iron Castings.
 - f. A733 - Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples.
 - g. A795 - Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
 - h. A865 - Threaded Couplings, Steel, Black or Zinc-Coated (Galvanized) Welded or Seamless, for Use in Steel Pipe Joints.
 - 2. American Society of Civil Engineers (ASCE):
 - a. 7 - Minimum Design Loads for Buildings and Other Structures: Section 9, Earthquake Loads.
 - 3. American Water Works Association (AWWA):
 - a. C110 - Ductile-Iron and Gray-Iron Fittings, 3 Inches through 48 Inches, for Water and Other Liquids.
 - b. C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - c. C151 - Ductile-Iron Pipe, Centrifugally Cast, for Water.
 - d. C606 - Grooved and Shouldered Joints.
 - 4. ASME International (ASME):
 - a. B1.20.1 - Pipe Threads, General Purpose (Inch).
 - b. B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
 - c. B16.3 - Malleable Iron Threaded Fittings.
 - d. B16.4 - Gray Iron Threaded Fittings.
 - e. B16.5 - Pipe Flanges and Flanged Fittings.
 - f. B16.9 - Factory-Made Wrought Steel Buttwelding Fittings.
 - g. B16.11 - Forged Fittings, Socket Welding and Threaded.

SECTION 211000 - FIRE-SUPPRESSION PIPING: continued

- h. Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 5. FM Global:
 - a. Fire Protection Approval Guide.
 - 6. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSSSP):
 - a. 80 - Bronze Gate, Globe, Angle, and Check Valves.
 - b. 110 - Ball Valves Threaded, Socket-Welding, Solder-Joint, Grooved and Flared Ends.
 - 7. National Electrical Manufacturers Association (NEMA):
 - a. ICS 6 - Industrial Control and Systems: Enclosures.
 - 8. National Fire Protection Association (NFPA):
 - a. 13 - Installation of Sprinkler Systems, 2007 Edition.
 - b. 24 - Installation of Private Fire Service Mains and Their Appurtenances.
 - c. 230 - Fire Protection of Storage.
 - d. 291 - Recommended Practice for Fire Flow Testing and Marking of Hydrants.
 - e. 1963 - Standard for Fire Hose Connections.
 - 9. Underwriters Laboratories Inc. (UL):
 - a. 193 - Alarm Valves for Fire-Protection Service.
 - b. 199 - Automatic Sprinklers for Fire-Protection Service.
 - c. 213 - Rubber Gasketed Fittings for Fire Protection Service.
 - d. 262 - Gate Valves for Fire-Protection Service.
 - e. 312 - Check Valves for Fire-Protection Service.
 - f. 346 - Waterflow Indicators for Fire Protection Signaling Systems.
 - g. 393 - Indicating Pressure Gauges for Fire-Protection Service.
 - h. 405 - Fire Department Connections.
 - i. 464 - Audible Signal Appliances.
 - j. 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 - k. 486B - Wire Connectors for Use with Aluminum Conductors.
 - l. 753 - Alarm Accessories for Automatic Water-Supply Control Valves for Fire Protection Service.
 - m. 1091 - Butterfly Valves for Fire-Protection Service.
 - n. 1474 - Adjustable Drop Nipples for Sprinkler Systems.
 - o. Fire Protection Equipment Directory.
 - 10. Unified Facilities Criteria (UFC):
 - a. UFC 3-600-01 - Fire Protection Engineering for Facilities.
- 1.03 DEFINITIONS:
- A. PE: Polyethylene plastic.
 - B. Underground Service-Entrance Piping: Underground service piping below the building.
- 1.04 SYSTEM DESCRIPTIONS:
- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.
- 1.05 SYSTEM PERFORMANCE REQUIREMENTS:
- A. Design and obtain approval from authority having jurisdiction for fire protection system specified. Design system in accordance with criteria on Drawings.

SECTION 211000 - FIRE-SUPPRESSION PIPING: continued

1.06 SUBMITTALS:

- A. General: Submit each item in this Article in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Product Data: For the following:
 - 1. Piping materials, including dielectric fittings, flexible connections, and sprinkler specialty fittings.
 - 2. Pipe hangers and supports, including seismic restraints.
 - 3. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.
 - 4. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
 - 5. Fire department connections, including type; number, size, and arrangement of inlets; caps and chains; size and direction of outlet; escutcheon and marking; and finish.
 - 6. Alarm devices, including electrical data.
- C. Shop Drawings: Diagram power, signal, and control wiring.
- D. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations.
- E. Contractor is responsible for obtaining approval of fire protection plan from the Delaware State Fire Marshal prior to submitting to Contracting Officer for review. Contractor is also responsible for paying all required fees for plan review. Visit the Fire Marshal website at www.statefiremarshal.delaware.gov/services/technical_planreview.shtml for further instructions.
- F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- G. Welding certificates.
- H. Field quality-control test reports.
- I. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.07 QUALITY ASSURANCE:

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on criteria indicated on the Drawings.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified fire protection professional engineer who meets one of the following requirements.
 - (1) Bachelor of Science or Master of Science degree in fire protection engineering from an accredited university; plus a minimum of 5 years' work experience.
 - (2) Professional Engineer (PE) registration by examination, National Council of Examiners for Engineering and Surveys (NCEES) fire protection engineering written examination.
 - (3) Qualifications as a GS 804-series FPE.
 - (4) PE registration in a related discipline with a minimum of 5 years' work experience in fire protection engineering.

SECTION 211000 - FIRE-SUPPRESSION PIPING: continued

- B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - C. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following hierarchy:
 - 1. UFC 3-600-01.
 - 2. NFPA 13.
 - 3. NFPA 230.
- 1.08 COORDINATION:
- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- 1.09 EXTRA MATERIALS:
- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

PART 2 - PRODUCTS

- 2.01 MANUFACTURERS:
- A. Manufacturers: Subject to compliance with requirements, provide products by one of those listed below or an approved equal.
- 2.02 DUCTILE-IRON PIPE AND FITTINGS:
- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell end and plain end.
 - 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern.
 - 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron gland, rubber gasket, and steel bolts and nuts.
- 2.03 STEEL PIPE AND FITTINGS:
- A. Threaded-End, Schedule 40 Standard-Weight Steel Pipe: ASTM A53, ASTM A135, or ASTM A795, hot-dip galvanized where indicated and with factory- or field-formed threaded ends.
 - 1. Cast-Iron Threaded Flanges: ASME B16.1.
 - 2. Malleable-Iron Threaded Fittings: ASME B16.3.
 - 3. Gray-Iron Threaded Fittings: ASME B16.4.
 - 4. Steel Threaded Pipe Nipples: ASTM A733, made of ASTM A53 or ASTM A106, Schedule 40, seamless steel pipe hot-dip galvanized where indicated. Include ends matching joining method.
 - 5. Steel Threaded Couplings: ASTM A865 hot-dip galvanized-steel pipe where indicated.
 - B. Plain-End, Schedule 40 Standard-Weight Steel Pipe: ASTM A53, ASTM A135, or ASTM A795 hot-dip galvanized-steel pipe where indicated.
 - 1. Steel Welding Fittings: ASTM A234, and ASME B16.9 or ASME B16.11.
 - 2. Steel Flanges and Flanged Fittings: ASME B16.5.

SECTION 211000 - FIRE-SUPPRESSION PIPING: continued

- C. Grooved-End, Schedule 40 Standard-Weight Steel Pipe: ASTM A53, ASTM A135, or ASTM A795, hot-dip galvanized where indicated and with factory- or field-formed, square-cut-grooved ends.
 - 1. Grooved-Joint Piping Systems:
 - a. Manufacturers:
 - (1) Central Sprinkler Corp.
 - (2) Ductilic, Inc.
 - (3) National Fittings, Inc.
 - (4) Victaulic Co. of America.
 - b. Grooved-End Fittings: UL-listed, ASTM A536, ductile-iron casting with OD matching steel-pipe OD.
 - c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.

2.04 IN-BUILDING RISER:

- A. An in-building service entrance riser shall be installed as indicated on the drawings. Riser shall be composed of a single extended 90-degree fitting of fabricated 304 stainless steel tubing, maximum working pressure of 200 psig. The fitting shall have a flanged connection on the aboveground outlet and a CIPS coupler on the underground inlet. Ames Fire and Waterworks series IBR or an approved equal.

2.05 DOUBLE-CHECK BACKFLOW-PREVENTION ASSEMBLIES:

- A. Basis of Design Product: Subject to compliance with requirements, provide Ames Waterworks Model Colt 200-BFG or a comparable product by FEBCO, Wilkins or approved equal.
- B. UL and FM approved, ASSE 1015 double check valve assembly.
- C. Two independent check modules within a single housing, sleeve access port, four test cocks and two drip tight shutoff valves. Check valves shall be removable and serviceable, without the use of special tools. The housing shall be constructed of 304 (Schedule 40) stainless steel pipe with groove end connections. Check valves shall have reversible elastomer discs and in operation shall produce drip tight closure against the reverse flow of liquid caused by backpressure or backsiphonage.
- D. Size: As indicated on the drawings.
- E. Configuration: Designed for vertical, straight through flow.
- F. Valves: UL and FM approved grooved butterfly valves on inlet and outlet with tamper switches.

2.06 DIELECTRIC FITTINGS:

- A. Assembly shall be copper alloy, ferrous, and insulating materials with ends matching piping system.
- B. Dielectric Unions: Factory-fabricated assembly, designed for 250-psig minimum working pressure at 180°F. Include insulating material that isolates dissimilar materials and ends with inside threads according to ASME B1.20.1.
- C. Dielectric Flanges: Factory-fabricated companion-flange assembly, for 175-psig minimum working-pressure rating as required for piping system.
- D. Dielectric Flange Insulation Kits: Components for field assembly shall include CR or phenolic gasket, PE or phenolic bolt sleeves, phenolic washers, and steel backing washers.

SECTION 211000 - FIRE-SUPPRESSION PIPING: continued

- E. Dielectric Couplings: Galvanized steel with inert and noncorrosive thermoplastic lining and threaded ends and 300-psig working-pressure rating at 225°F.
- F. Dielectric Nipples: Electroplated steel with inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved ends and 300-psig working-pressure rating at 225°F.

2.07 SPRINKLER SPECIALTY FITTINGS:

- A. Sprinkler specialty fittings shall be UL-listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping.
- B. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.
 - 1. Manufacturers:
 - a. Central Sprinkler Corp.
 - b. Viking Corp.
 - c. Victaulic Co. of America.
- C. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
- D. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.
- E. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.

2.08 LISTED FIRE-PROTECTION VALVES:

- A. Valves shall be UL-listed or FMG approved, with 175-psig minimum pressure rating.
- B. Ball Valves: Comply with UL 1091, except with ball instead of disc.
 - 1. NPS 1-1/2 and Smaller: Bronze body with threaded ends.
 - 2. NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
 - 3. NPS 3: Ductile-iron body with grooved ends.
- C. Butterfly Valves: UL 1091.
 - 1. NPS 2 and Smaller: Bronze body with threaded ends.
 - 2. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.
 - a. Manufacturers:
 - (1) Central Sprinkler Corp.
 - (2) Mueller Company.
 - (3) NIBCO.
 - (4) Victaulic Co. of America.
- D. Wafer Check Valves: Class 125, Iron, compact-wafer, center-guided check valve with resilient seat.
 - 1. Manufacturer:
 - a. Cla-Val.
 - b. Mueller Company.
 - c. NIBCO.
- E. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.
 - 1. Manufacturers:
 - a. Central Sprinkler Corp.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.

SECTION 211000 - FIRE-SUPPRESSION PIPING: continued

- d. Grinnell Fire Protection.
 - e. Mueller Company.
 - f. NIBCO.
 - g. Reliable Automatic Sprinkler Co., Inc.
 - h. Stockham.
 - i. Victaulic Co. of America.
 - j. Watts Industries, Inc.; Water Products Div.
- F. Gate Valves: UL 262, OS&Y type.
- 1. NPS 2 and Smaller: Bronze body with threaded ends.
 - a. Manufacturers:
 - (1) Crane Co.; Crane Valve Group; Crane Valves.
 - (2) Hammond Valve.
 - (3) NIBCO.
 - 2. NPS 2-1/2 and Larger: Cast-iron body with flanged ends.
 - a. Manufacturers:
 - (1) Crane Co.; Crane Valve Group; Crane Valves.
 - (2) Crane Co.; Crane Valve Group; Jenkins Valves.
 - (3) Milwaukee Valve Company.
 - (4) Mueller Company.
 - (5) NIBCO.
- 2.09 UNLISTED GENERAL-DUTY VALVES:
- A. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded ends.
 - B. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.
 - C. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.
 - D. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.
- 2.10 SPECIALTY VALVES:
- A. Sprinkler System Control Valves: UL-listed or FMG approved, cast- or ductile-iron body with flanged or grooved ends, and 175-psig minimum pressure rating.
 - 1. Manufacturers:
 - a. Central Sprinkler Corp.
 - b. Grinnell Fire Protection.
 - c. Reliable Automatic Sprinkler Co., Inc.
 - d. Star Sprinkler Inc.
 - e. Victaulic Co. of America.
 - f. Viking Corp.
 - B. Automatic Drain Valves: UL 1726, NPS 3/4, ball-check device with threaded ends.
- 2.11 SPRINKLERS:
- A. Sprinklers shall be UL-listed or FMG approved, with 175-psig minimum pressure rating.
 - B. Manufacturers:
 - 1. Central Sprinkler Corp.
 - 2. Grinnell Fire Protection.
 - 3. Reliable Automatic Sprinkler Co., Inc.

SECTION 211000 - FIRE-SUPPRESSION PIPING: continued

4. Star Sprinkler Inc.
5. Victaulic Co. of America.
6. Viking Corp.
- C. Automatic Sprinklers: With heat-responsive element complying with the following:
 1. UL 199, for nonresidential applications.
 2. Quick Response per UFC 3-600-01 requirements.
- D. Sprinkler Types and Categories: Nominal 1/2-inch orifice, K=5.6, 155°F or 165°F temperature classification rating, unless otherwise indicated or required by application.
- E. Sprinkler types, features, and options as follows:
 1. Pendent sprinklers.
 2. Pendent, dry-type sprinklers.
 3. Quick-response sprinklers.
 4. Recessed sprinklers, including escutcheon.
 5. Sidewall sprinklers.
 6. Upright sprinklers.
- F. Sprinkler Finishes: Chrome plated, bronze, and painted.
- G. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
 1. Ceiling Mounting: Chrome-plated steel, 2 piece, with 1-inch vertical adjustment.
 2. Sidewall Mounting: Chrome-plated steel, one piece, flat.
- H. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

2.12 FIRE DEPARTMENT CONNECTIONS:

- A. Manufacturers:
 1. Central Sprinkler Corp.
 2. Elkhart Brass Mfg. Co., Inc.
 3. Guardian Fire Equipment Incorporated.
 4. Potter-Roemer; Fire-Protection Div.
 5. Reliable Automatic Sprinkler Co., Inc.
- B. Wall-Type, Fire Department Connection: UL 405, 175-psig minimum pressure rating; with corrosion-resistant-metal body with brass inlets, brass wall escutcheon plate, brass lugged caps with gaskets and brass chains, and brass lugged swivel connections. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking similar to "AUTO SPKR."
 1. Type: Exposed, projecting, with two inlets and round escutcheon plate.
 2. Finish: Polished chrome-plated or Polished brass.

2.13 ALARM DEVICES:

- A. Alarm-device types shall match piping and equipment connections.
- B. Electrically Operated Alarm: UL 464, with 8-inch minimum-diameter, vibrating-type, metal alarm bell with red-enamel factory finish and suitable for outdoor use.
Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125Vac and 0.25 A, 24Vdc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

SECTION 211000 - FIRE-SUPPRESSION PIPING: continued

1. Manufacturers:
 - a. Grinnell Fire Protection.
 - b. ITT McDonnell & Miller.
 - c. Potter Electric Signal Company.
 - d. System Sensor.
 - e. Viking Corp.
 - f. Watts Industries, Inc.; Water Products Div.
- C. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.
 1. Manufacturers:
 - a. McWane, Inc.; Kennedy Valve Div.
 - b. Potter Electric Signal Company.
 - c. System Sensor.

2.14 PRESSURE GAUGES:

- A. Description: UL 393, 3-1/2- to 4-1/2-inch diameter, dial pressure gauge with range of 0 to 250 psig minimum.
 1. Water System Piping: Include caption "WATER" or "AIR/WATER" on dial face.

PART 3 - EXECUTION

3.01 EARTHWORK:

- A. Refer to DIVISION 31 for excavating, trenching, and backfilling.

3.02 EXAMINATION:

- A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.
- B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 PIPING APPLICATIONS, GENERAL:

- A. Shop-weld pipe joints where welded piping is indicated.
- B. Do not use welded joints for galvanized-steel pipe.
- C. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
- D. Piping between Fire Department Connections and Check Valves: Galvanized, Schedule 40 steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded or grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- E. Underground Service-Entrance Piping: Ductile-iron, mechanical-joint pipe and fittings and restrained joints. Include corrosion-protective encasement.

3.04 SPRINKLER SYSTEM PIPING APPLICATIONS:

- A. Installation of cleated flanges (split-ring flanges) on piping is prohibited. Do not use grooved or rolled end connections upstream of each riser check valve on piping greater than 4 inches.

SECTION 211000 - FIRE-SUPPRESSION PIPING: continued

- B. Standard-Pressure, Wet-Pipe Sprinkler System, 175-psig Maximum Working Pressure:
 - 1. NPS 4 and Smaller: Threaded-end, black, Schedule 40 steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
 - 2. NPS 8 and Smaller: Plain-end, black, Schedule 40 steel pipe; steel welding fittings; and welded joints.
 - 3. NPS 8 and Smaller: Grooved-end, Schedule 40 steel pipe, grooved-end fittings; grooved-end pipe couplings; and grooved joints.

- 3.05 VALVE APPLICATIONS:
 - A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Listed Fire-Protection Valves: UL-listed and FMG approved for applications where required by NFPA 13.
 - a. Shutoff Duty: Use ball, butterfly, or gate valves.
 - 2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13.
 - a. Shutoff Duty: Use ball, butterfly, or gate valves.
 - b. Throttling Duty: Use ball or globe valves.

- 3.06 JOINT CONSTRUCTION:
 - A. Refer to SECTION 230500 for basic piping joint construction.
 - B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.
 - C. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
 - 1. Ductile-Iron Pipe: Radius-cut-groove ends of piping. Use grooved-end fittings and grooved-end-pipe couplings.
 - 2. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
 - D. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials.
 - 1. NPS 2 and Smaller: Use dielectric unions, couplings, or nipples.
 - 2. NPS 2-1/2 to NPS 4: Use dielectric flanges.
 - 3. NPS 5 and Larger: Use dielectric flange insulation kits.

- 3.07 SERVICE-ENTRANCE PIPING:
 - A. Connect fire-suppression piping to water-service piping of size and in location indicated for service entrance to building. Refer to SECTION 331100 - PRESSURE PIPING for exterior piping.
 - B. Service entrance piping shall be sleeved and sealed through the facility floor. Thrust blocks shall be installed on underground piping at all changes in direction.
 - C. Install shutoff valve, backflow preventer, pressure gauge, drain, and other accessories indicated at connection to water-service piping.

- 3.08 PIPING INSTALLATION:
 - A. Refer to SECTION 230500 for basic piping installation.
 - B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

SECTION 211000 - FIRE-SUPPRESSION PIPING: continued

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Contracting Officer before deviating from approved working plans.
- C. Install underground ductile-iron service-entrance piping according to NFPA 24 and with restrained joints. After installation, rods, nuts, bolts, washers, clamps, and other restraining devices shall be cleaned and thoroughly coated with a bituminous or other acceptable corrosion-retarding material. Encase piping in corrosion-protective encasement.
- D. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- F. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install drain valves on standpipes.
- K. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.
- L. Install alarm devices in piping systems.
- M. Hangers and Supports: Comply with NFPA 13 for hanger materials.
 1. Install sprinkler system piping according to NFPA 13.
 2. Do not support sprinkler piping from the roof deck or from other equipment.
- N. Earthquake Protection: Install piping according to NFPA 13 to protect from earthquake damage. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they will not be subject to freezing.
- O. Fill wet-pipe sprinkler system piping with water.

3.09 VALVE INSTALLATION:

- A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install backflow preventers in potable-water supply sources.

3.10 SPRINKLER APPLICATIONS:

- A. Drawings indicate sprinkler types to be used. Where specific types are not indicated, use the following sprinkler types:
 1. Rooms without Ceilings: Upright sprinklers.
 2. Rooms with Suspended Ceilings: Semi-recessed sprinklers.
 3. Wall Mounting: Sidewall sprinklers.

SECTION 211000 - FIRE-SUPPRESSION PIPING: continued

4. Sprinkler Finishes:
 - a. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.
 - b. Semi-recessed Sprinklers: Bright chrome, with bright chrome escutcheon.

- 3.11 SPRINKLER INSTALLATION:
 - A. Coordinate sprinkler placement carefully with all other trades.
 - B. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels and tiles.
 - C. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

- 3.12 FIRE DEPARTMENT CONNECTION INSTALLATION:
 - A. Install wall-type, fire department connections in vertical wall.
 - B. Install ball drip valve at each check valve for fire department connection.

- 3.13 CONNECTIONS:
 - A. Drawings indicate general arrangement of piping, fittings, and specialties.
 - B. Install piping adjacent to equipment to allow service and maintenance.
 - C. Connect water-supply piping to fire-suppression piping. Include backflow preventer.
 - D. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.
 - E. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.
 - F. Electrical Connections: Power wiring is specified in DIVISION 26.
 - G. Connect alarm devices to fire alarm.
 - H. Ground equipment according to DIVISION 26.
 - I. Connect wiring according to DIVISION 26.
 - J. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

- 3.14 LABELING AND IDENTIFICATION:
 - A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and in SECTION 230553 - MECHANICAL IDENTIFICATION.

- 3.15 FIELD QUALITY CONTROL:
 - A. Perform the following field tests and inspections and prepare test reports:
 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 3. Energize circuits to electrical equipment and devices.
 4. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 5. Coordinate with fire alarm tests. Operate as required.
 6. Verify that equipment hose threads are same as local fire department equipment.

SECTION 211000 - FIRE-SUPPRESSION PIPING: continued

- B. Report test results promptly and in writing to Contracting Officer and authorities having jurisdiction.

3.16 CLEANING AND PROTECTION:

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.
- C. Protect sprinklers from damage until Substantial Completion.

3.17 DEMONSTRATION:

- A. Engage a factory-authorized service representative to train Contracting Officer's maintenance personnel to adjust, operate, and maintain specialty valves.

END OF SECTION 211000

SECTION 213113 - ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS (BID OPTION 2 ONLY)

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section Includes:
1. In-line fire pumps.
 2. Multistage, pressure-maintenance pumps.
 3. Fire-pump accessories and specialties.
 4. Flowmeter systems.

1.02 REFERENCES:

- A. Applicable Standards (Latest Edition):
1. American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI):
 - a. 7 - Minimum Design Loads for Buildings and Other Structures.
 2. American Society for Testing and Materials (ASTM):
 - a. A53 - Pipe, Steel, Black and Hot Dipped, Zinc-Coated, Welded and Seamless.
 - b. C1107 - Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
 3. ASME International (ASME):
 - a. B1.20.1 - Pipe Threads, General Purpose (Inch).
 - b. B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
 - c. B16.4 - Gray Iron Threaded Fittings.
 4. Hydraulic Institute (HI):
 - a. 1.1-1.2 - Centrifugal Pumps for Nomenclature and Definitions.
 - b. 1.3 - Centrifugal Pumps for Design and Application.
 - c. 1.4 - Centrifugal Pumps for Installation, Operation, and Maintenance.
 - d. 2.1-2.2 - Vertical Pumps for Nomenclature and Definitions.
 - e. 2.3 - Vertical Pumps for Design and Applications.
 5. National Electrical Manufacturers Association (NEMA):
 - a. 250 - Enclosures for Electrical Equipment (1,000V Maximum).
 - b. MG1 - Motors and Generators.
 6. National Fire Protection Association (NFPA):
 - a. 20 - Stationary Pumps for Fire Protection.
 - b. 70 - National Electrical Code.
 - c. 1963 - Fire Hose Connections.
 7. Underwriters Laboratories Inc. (UL):
 - a. 50 - Enclosures for Electrical Equipment.
 - b. 218 - Fire Pump Controllers.
 - c. 393 - Indicating Pressure Gauges for Fire-Protection Service.
 - d. 405 - Fire Department Connection.
 - e. 448 - Pumps for Fire-Protection Service.
 - f. 1004A - Fire Pump Motors.
 - g. 1726 - Automatic Drain Valves for Standpipe Systems.

1.03 PERFORMANCE REQUIREMENTS:

- A. Pump Equipment, Accessory, and Specialty Pressure Rating: 175 psig minimum unless higher pressure rating is indicated.

SECTION 213113 - ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS: continued

1.04 SUBMITTALS:

- A. General: Submit each item in this Article in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.
- C. Shop Drawings: For fire pumps, motor drivers, and fire-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail Equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- D. Product Certificates: For each fire pump, from manufacturer.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Operation and Maintenance Data: For fire pumps to include in operation and maintenance manuals.

1.05 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 20.

1.06 COORDINATION:

- A. Coordinate sizes and locations of concrete bases with actual Equipment provided.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR CENTRIFUGAL FIRE PUMPS:

- A. Description: Factory-assembled and -tested fire-pump and driver unit.
- B. Finish: Red paint applied to factory-assembled and -tested unit before shipping.

2.02 IN-LINE FIRE PUMPS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. A-C Fire Pump Systems; a business of ITT Industries.
 - 2. Patterson Pump Company; a subsidiary of the Gorman-Rupp Company.
 - 3. Pentair Pump Group; Aurora Pump.
 - 4. Pentair Pump Group; Fairbanks Morse.
 - 5. Approved Equal.
- B. Pump:
 - 1. Standard: UL 448, for in-line pumps for fire service.
 - 2. Casing: Radially split case, cast iron with ASME B16.1 pipe-flange connections.
 - 3. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
 - 4. Wear Rings: Replaceable bronze.
 - 5. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - a. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
 - b. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.

SECTION 213113 - ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS: continued

- 6. Mounting: Pump and driver shaft is vertical, with motor above pump and pump on base.
- C. Coupling: None or rigid.
- D. Driver:
 - 1. Standard: UL 1004A.
 - 2. Type: Electric motor; NEMA MG 1, polyphase Design B.
- E. Capacities and Characteristics:
 - 1. As Scheduled on the Drawings.

2.03 MULTISTAGE, PRESSURE-MAINTENANCE PUMPS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 - 1. A-C Fire Pump Systems; a business of ITT Industries.
 - 2. Grundfos Management A/S; Grundfos Pumps Corporation U.S.A.
 - 3. PACO Pumps; Grundfos Pumps Corporation U.S.A.
 - 4. Sterling Peerless Pumps; Sterling Fluid Systems Group.
 - 5. TACO Incorporated.
- B. Description: Factory-assembled and -tested, multistage, barrel-type vertical pump as defined in HI 2.1-2.2 and HI 2.3; designed for surface installation with pump and motor direct coupled and mounted vertically.
- C. Pump Construction:
 - 1. Barrel: Stainless steel.
 - 2. Suction and Discharge Chamber: Cast iron with flanged inlet and outlet.
 - 3. Pump Head/Motor Mount: Cast iron.
 - 4. Impellers: Stainless steel, balanced, and keyed to shaft.
 - 5. Pump Shaft: Stainless steel.
 - 6. Seal: Mechanical type with carbon rotating face and silicon-carbide stationary seat.
 - 7. Intermediate Chamber Bearings: Aluminum-oxide ceramic or bronze.
 - 8. Chamber-Base Bearing: Tungsten carbide.
 - 9. O-Rings: EPDM, NBR, or Viton.
- D. Motor: Single speed with permanently lubricated ball bearings and rigidly mounted to pump head. Comply with requirements in SECTION 230513 - MOTORS.
- E. Nameplate: Permanently attached to pump and indicating capacity and characteristics.
- F. Accessories and Specialties: Match pump suction and discharge ratings.
 - 1. Suction and discharge pressure gauges.
- G. Capacities and Characteristics: As scheduled on the Drawings.

2.04 FIRE-PUMP CONTROLLERS:

- A. Fire-Pump Controllers, General: UL 218 and NFPA 20; listed for electric-drive, fire-pump service and service entrance; combined automatic and manual operation; factory assembled and wired; and factory tested for capacities and electrical characteristics.
 - 1. Manufacturers:
 - a. Cutler-Hammer.
 - b. Firetrol, Inc.
 - c. Joslyn Clark.
 - d. Master Control Systems, Inc.
 - e. Metron, Inc.
 - f. Approved Equal.

SECTION 213113 - ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS: continued

2. Rate controllers for scheduled fire-pump horsepower and short-circuit withstand rating at least equal to short-circuit current available at controller location. Take into account cable size and distance from substation or supply transformers.
 3. Enclosure: UL 50, Type 2, dripproof, indoor, unless special-purpose enclosure is indicated. Include manufacturer's standard red paint applied to factory-assembled and -tested unit before shipping.
 4. Controls, devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used, and specific items listed.
 - a. Isolating means and circuit breaker.
 - b. "Power on" pilot lamp.
 - c. Fire-alarm system connections for indicating motor running condition, loss-of-line power, and line-power phase reversal.
 - d. Automatic and manual operation, and minimum run-time relay to prevent short cycling.
 - e. Water-pressure-actuated switch with independent high and low calibrated adjustments responsive to water pressure in fire-suppression piping.
 - f. Automatic and manual shutdown.
 - g. System pressure recorder, electric ac driven with spring backup.
 5. Nameplate: Complete with capacity, characteristics, approvals and listings, and other pertinent data.
 6. Controller Sensing Pipes: Fabricate pipe and fittings according to NFPA 20 with nonferrous-metal sensing piping, NPS 1/2, with globe valves for testing controller mechanism from system to pump controller as indicated. Include bronze check valve with 3/32-inch orifice in clapper or ground-face union with noncorrosive diaphragm having 3/32-inch orifice.
- B. Full-Service Fire-Pump Controllers:
1. Type Starting: Reduced voltage.
 2. Mounting: Floor-stand type for field electrical connections.
- 2.05 FIRE-PUMP ACCESSORIES AND SPECIALTIES:
- A. Automatic Air-Release Valves: Comply with NFPA 20 for installation in fire-pump casing.
 - B. Inlet Fitting: Eccentric tapered reducer at pump suction inlet.
 - C. Outlet Fitting: Concentric tapered reducer at pump discharge outlet.
 - D. Hose Valve Manifold Assembly:
 1. Standard: Comply with requirements in NFPA 20.
 2. Header Pipe: ASTM A53, Schedule 40, galvanized steel with ends threaded according to ASME B1.20.1.
 3. Header Pipe Fittings: ASME B16.4, galvanized cast-iron threaded fittings.
 4. Automatic Drain Valve: UL 1726.
 5. Manifold:
 - a. Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
 - b. Body: Exposed type, brass, with number of outlets required by NFPA 20.
 - c. Escutcheon Plate: Brass or bronze; round.
 - d. Exposed Parts Finish: Polished brass or chrome plated.
 - e. Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."

SECTION 213113 - ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS: continued

2.06 GROUT:

- A. Standard: ASTM C1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink and recommended for interior and exterior applications.
- C. Design Mix: 5,000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.07 SOURCE QUALITY CONTROL:

- A. Testing: Test and inspect fire pumps according to UL 448 requirements for "Operation Test" and "Manufacturing and Production Tests."
 - 1. Verification of Performance: Rate fire pumps according to UL 448.
- B. Fire pumps will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine Equipment bases and anchorage provisions, with Installer present, for compliance with requirements and for conditions affecting performance of fire pumps.
- B. Examine roughing-in for fire-suppression piping systems to verify actual locations of piping connections before fire-pump installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. Fire-Pump Installation Standard: Comply with NFPA 20 for installation of fire pumps, relief valves, and related components.
- B. Install fire-pump suction and discharge piping equal to or larger than sizes required by NFPA 20.
- C. Support piping and pumps separately so weight of piping does not rest on pumps.
- D. Install valves that are same size as connecting piping. Comply with requirements for fire-protection valves specified in SECTION 211000 - FIRE-SUPPRESSION PIPING.
- E. Install pressure gauges on fire-pump suction and discharge flange pressure-gauge tappings. Comply with requirements for pressure gauges specified in SECTION 211000 - FIRE SUPPRESSION PIPING.
- F. Install piping hangers and supports, anchors, valves, gauges, and Equipment supports according to NFPA 20.
- G. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.
- H. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

3.03 ALIGNMENT:

- A. Align piping connections.
- B. Align pump and driver shafts for angular and parallel alignment according to HI 1.4 and to tolerances specified by manufacturer.

SECTION 213113 - ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS: continued

3.04 CONNECTIONS:

- A. Comply with requirements for piping and valves specified in SECTION 211000 - FIRE-SUPPRESSION PIPING. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps and equipment to allow service and maintenance.
- C. Connect relief-valve discharge to drainage piping or point of discharge.
- D. Connect fire pumps to their controllers.

3.05 IDENTIFICATION:

- A. Identify system components. Comply with requirements for fire-pump marking according to NFPA 20.

3.06 FIELD QUALITY CONTROL:

- A. Test each fire pump with its controller as a unit.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Tests and Inspections:
 - 1. After installing components, assemblies, and equipment including controller, test for compliance with requirements.
 - 2. Test according to NFPA 20 for acceptance and performance testing.
 - 3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Components, assemblies, and equipment will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Hoses are for tests only and do not convey to Contracting Officer.

3.07 STARTUP SERVICE:

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.08 DEMONSTRATION:

- A. Engage a factory-authorized service representative to train Contracting Officer's maintenance personnel to adjust, operate, and maintain fire pumps. Comply with requirements of SECTION 017900 - DEMONSTRATION AND TRAINING.

END OF SECTION 213113

SECTION 213910 - FIRE PROTECTION SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The purpose of this section is to describe the commissioning process specific to the Fire Protection/Suppression Systems and equipment.

1.2 RESPONSIBILITIES

- A. Fire Protection Contractor. The commissioning responsibilities applicable to the fire protection contractor are as follows (*all references apply to commissioned equipment only*):

Construction and Acceptance Phases

1. Include the cost of commissioning in the contract price.
2. Attend a commissioning scoping meeting and other necessary meetings scheduled by the CA to facilitate the Cx process.
3. Contractors shall provide normal cut sheets and shop drawing submittals to the Commissioning Agent (CA) of equipment.
4. Provide additional requested documentation, prior to normal O&M manual submittals, to the CA for development of start-up and functional testing procedures.
 - a. Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedure, pump curves, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Agent.
 - b. The Commissioning Agent may request further documentation necessary for the commissioning process.
 - c. This data request may be made prior to normal submittals.
5. Provide a copy of the O&M manuals submittals of commissioned equipment, through normal channels, to the CA for review and approval.
6. Contractor shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, drawings or equipment documentation is not sufficient for writing detailed testing procedures.
7. Provide assistance to the CA in preparation of the specific functional performance test procedures. Subs shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
8. Develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the pre-functional checklists from the CA. Submit manufacturer's detailed start-up procedures and the full start-up plan and procedures and other requested equipment documentation to CA for review.

9. During the startup and initial checkout process, execute and document the fire protection-related portions of the pre-functional checklists provided by the CA for all commissioned equipment.
10. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CA.
11. Address current A/E punch list items before functional testing.
12. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests and adjustments.
13. Perform functional performance testing under the direction of the CA for specified equipment in Section 019113.
14. Correct deficiencies (differences between specified and observed performance) as interpreted by the CA and retest the equipment.
15. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
16. During construction, maintain as-built red-line drawings for all drawings and final as-builts for contractor-generated coordination drawings. Update after completion of commissioning. Prepare red-line as-built drawings for all drawings and final as-builts for contractor-generated coordination drawings.
17. Provide training of the Owner's operating personnel as specified.
18. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

Warranty Period

- a. Execute seasonal or deferred functional performance testing, witnessed by the CA, according to the specifications.
- b. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

1.3 RELATED WORK

- A. Refer to Section 019113 for contractor requirements in support of the commissioning process. Refer to Division 21 specifications, plans and contractor shop drawings for system configuration and details of required construction.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 SUBMITTALS

- A. Division 21 shall provide submittal documentation relative to commissioning to the CA as requested by the CA. Refer to Section 019113 for additional Division 21 requirements.

3.2 CONSTRUCTION OBSERVATION

- A. Obtain and review design documents for overall design intent and the overall required system configurations.
- B. Obtain and review shop drawings and submittals for installation criteria and the required construction details, as they support and further define the system's features.
- C. The Commissioning Agent shall make general inspections at the job site and shall review the following for configuration, quality of construction, adherence to design requirements, and conformance with shop drawings and submittal information.
 - a. Distribution systems/piping
 - 1) Size and configuration
 - 2) Fittings
 - 3) Connections
 - 4) Hangers and bracing
 - 5) Materials per specifications
 - 6) Check installation and placement of heads for compliance with NFPA 13 standards.
 - 7) Verify that the proper type and temperature rating of sprinklers are installed (i.e. institutional sprinklers in detention areas).
 - b. Controls
 - 1) Components and configurations per shop drawings
 - 2) Devices in proper locations
 - 3) Wiring and/or pneumatic piping per specifications
 - 4) Labeling and identification/all components, wiring, and piping

END OF SECTION 213910

DIVISION 22 – PLUMBING

SECTION 220910 - PLUMBING SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The purpose of this section is to specify Division 22 responsibilities in the commissioning (Cx) process which are being directed by the Commissioning Authority (CA).
 - a. The list of commissioned equipment is found in Section 019113.
- B. Commissioning (Cx) requires the participation of Division 22 to ensure that the Domestic Hot Water systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Section 019113. Division 22 shall be familiar with all parts of Section 019113 and the commissioning plan issued by the CA and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

1.2 RESPONSIBILITIES

- A. Plumbing Contractor. The commissioning responsibilities applicable to the plumbing contractor are as follows (*all references apply to commissioned equipment only*):

Construction and Acceptance Phases

1. Include the cost of commissioning in the contract price.
2. Attend a commissioning scoping meeting and other necessary meetings scheduled by the CA to facilitate the Cx process.
3. Contractors shall provide normal cut sheets and shop drawing submittals to the Commissioning Agent (CA) of domestic hot water equipment.
4. Provide additional requested documentation, prior to normal O&M manual submittals, to the CA for development of start-up and functional testing procedures.
 - a. Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedure, pump curves, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Agent.
 - b. The Commissioning Agent may request further documentation necessary for the commissioning process.
 - c. This data request may be made prior to normal submittals.
5. Provide a copy of the O&M manuals submittals of commissioned equipment, through normal channels, to the CA for review and approval.
6. Contractor shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, plumbing drawings or equipment documentation is not sufficient for writing detailed testing procedures.

SECTION 220910 PLUMBING SYSTEMS COMMISSIONING: continued

7. Provide assistance to the CA in preparation of the specific functional performance test procedures. Subs shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
8. Develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the pre-functional checklists from the CA. Submit manufacturer's detailed start-up procedures and the full start-up plan and procedures and other requested equipment documentation to CA for review.
9. During the startup and initial checkout process, execute and document the plumbing-related portions of the pre-functional checklists provided by the CA for all commissioned equipment.
10. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CA.
11. Address current A/E punch list items before functional testing.
12. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests and adjustments.
13. Perform functional performance testing under the direction of the CA for specified equipment in Section 019113.
14. Correct deficiencies (differences between specified and observed performance) as interpreted by the CA and retest the equipment.
15. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
16. During construction, maintain as-built red-line drawings for all drawings and final as-builts for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing). Prepare red-line as-built drawings for all drawings and final as-builts for contractor-generated coordination drawings.
17. Provide training of the Owner's operating personnel as specified.
18. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

Warranty Period

- a. Execute seasonal or deferred functional performance testing, witnessed by the CA, according to the specifications.
- b. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

1.3 RELATED WORK

- A. Refer to Section 019113 for a listing of all sections where commissioning requirements are found.
- B. Refer to Section 019113 for systems to be commissioned and section 019113 for functional testing requirements.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Division 22 shall provide all test equipment necessary to fulfill the testing requirements of this Division.

SECTION 220910 PLUMBING SYSTEMS COMMISSIONING: continued

- B. Refer to Section 019113 for additional Division 22 requirements.

PART 3 - EXECUTION

3.1 SUBMITTALS

- A. Division 22 shall provide submittal documentation relative to commissioning to the CA as requested by the CA. Refer to Section 019113 for additional Division 22 requirements.

3.2 STARTUP

- A. The plumbing contractor shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in Section 019113. Division 22 has start-up responsibility and is required to complete the solar domestic hot water preheating and the domestic hot water systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the Commissioning Agent or Owner.
- B. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems, or sub-systems at the discretion of the CA. Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all pre-functional checklists as soon as possible.

3.3 FUNCTIONAL PERFORMANCE TESTS

- A. Refer to Section 019113 for a list of systems to be commissioned and for a description of the process

3.4 TESTING DOCUMENTATION, NON-CONFORMANCE AND APPROVALS

- A. Refer to Section 019113 for specific details on non-conformance issues relating to pre-functional checklists and tests.
- B. Refer to Section 019113 for issues relating to functional performance tests.

3.5 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. Division 22 shall compile and prepare documentation for the domestic hot water systems and deliver to the CA for inclusion in the O&M manuals.
- B. The CA shall receive a preliminary copy of the O&M manuals for review.

3.6 TRAINING OF OWNER PERSONNEL

- A. The Plumbing Contractor shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed. Refer to Section 019113 for additional details.

SECTION 220910 PLUMBING SYSTEMS COMMISSIONING: continued

- B. The CA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment. Refer to Section 019113 for additional details.
- C. Plumbing Contractor. The Plumbing Contractor shall have the following training responsibilities:
 - 1. Provide the CA with a training plan two weeks before the planned training according to the outline described in Section 019113.
 - 2. Provide designated Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of the domestic hot water system.
 - 3. Training shall consist of hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, power failure, etc.
 - 4. During any demonstration, should the domestic hot water system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
 - 5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.
 - 6. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
 - 7. Training shall include:
 - a. Use the printed installation, operation and maintenance instruction material included in the O&M manuals.
 - b. Include a review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
 - c. Discuss relevant health and safety issues and concerns.
 - d. Discuss warranties and guarantees.
 - e. Cover common troubleshooting problems and solutions.
 - f. Explain information included in the O&M manuals and the location of all plans and manuals in the facility.
 - g. Discuss any peculiarities of equipment installation or operation.
 - 8. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and maintenance of all pieces of equipment.
 - 9. Training shall occur after functional testing is complete, unless approved otherwise by the CA.

3.7 DEFERRED TESTING

- A. Refer to Section 019113, Part 3.7 for requirements of deferred testing.

SECTION 220910 PLUMBING SYSTEMS COMMISSIONING: continued

3.8 WRITTEN WORK PRODUCTS

- A. Written work products of Contractors will consist of the startup and initial checkout plan described in Section 019113 and the filled out startup, initial checkout and pre-functional checklists.

END OF SECTION 220910

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes domestic water piping and water meters inside the building.
- B. Related Work Specified Elsewhere:
 - 1. Water-service piping outside the building from source to the point where water-service piping enters the building: DIVISION 33.
 - 2. Thermometers, pressure gauges, and fittings: SECTION 230519 - METERS AND GAUGES.
 - 3. Water distribution piping specialties: SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American Society for Testing and Materials (ASTM):
 - a. B32 - Solder Metal.
 - b. B75 - Seamless Copper Tube.
 - c. B88 - Seamless Copper Water Tube.
 - d. B584 - Copper Alloy Sand Castings for General Applications.
 - e. B813 - Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.
 - f. B828 - Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
 - g. F877 - Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems.
 - h. F1807 - Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Crosslinked Polyethylene (PEX) Tubing.
 - 2. American Water Works Association (AWWA):
 - a. C606 - Grooved and Shouldered Joints.
 - b. C651 - Disinfecting Water Mains.
 - c. C652 - Disinfection of Water-Storage Facilities.
 - d. C701 - Cold-Water Meters - Turbine Type, for Customer Service.
 - e. M6 - Water Meters - Selection, Installation, Testing, and Maintenance.
 - 3. ASME International (ASME):
 - a. B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - b. B16.22 - Wrought copper and Copper Alloy Solder Joint Pressure Fittings.
 - c. B16.24 - Cast Copper Alloy Pipe-Flanges, Class 150, 300, 400, 600, 900, 1500, and 2500, and Flanged Fittings, Class 150 and 300.
 - 4. Copper Development Association, Inc.
 - a. Copper Tube Handbook.
 - 5. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
 - a. SP-69 - Pipe Hangers and Supports - Selection and Application.
 - b. SP-123 - Non-Ferrous Threaded and Solder-Joint Unions for Use with Copper Water Tube.
 - 6. NSF International (NSF):
 - a. 61 - Drinking Water System Components - Health Effects.

SECTION 221116 - DOMESTIC WATER PIPING: continued

1.03 PERFORMANCE REQUIREMENTS:

- A. Provide components and installation capable of producing domestic water piping systems with 125 psig, unless otherwise indicated.

1.04 SUBMITTALS:

- A. General: Submit the following in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Product Data: For pipe, tube, fittings, and couplings and water meters.
- C. Water Samples: Specified in PART 3 "Cleaning" Article.
- D. Field quality-control test reports.

1.05 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

2.01 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.

2.02 PIPING MATERIALS:

- A. Refer to PART 3 "Pipe and Fitting Applications" Article for applications of pipe, tube, fitting, and joining materials.
- B. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.03 COPPER TUBE AND FITTINGS:

- A. Soft Copper Tube: ASTM B88, Types K and L, water tube, annealed temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
 - 3. 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.
- B. Hard Copper Tube: ASTM B88, Types L and M, water tube, drawn temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
 - 3. 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.
 - 4. Copper, Grooved-End Fittings: ASTM B75 copper tube or ASTM B584 bronze castings.
 - a. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.

SECTION 221116 - DOMESTIC WATER PIPING: continued

2.04 PEX TUBE AND FITTINGS:

- A. PEX Distribution System: ASTM F877, SDR 9 tubing.
 - 1. Fittings for PEX Tube: ASTM F1807, metal-insert type with copper or stainless-steel crimp rings and matching PEX tube dimensions.
 - 2. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F877; with plastic or corrosion-resistant-metal valve for each outlet.

2.05 VALVES:

- A. Bronze and cast-iron, general-duty valves are specified in SECTION 230523 - VALVES.
- B. Balancing and drain valves are specified in SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES.

2.06 WATER METERS:

- A. Turbine-Type Water Meters: AWWA C701, totalization meter with 150-psig minimum working-pressure rating; with registration in gallons or cubic feet as required by utility; and with the following end connections:
 - 1. NPS 2: Threaded.
 - 2. Provide water meter with local register and high frequency pulse output compatible for monitoring by the building Johnson Controls Metasys DDC system.
- B. Displacement Water Meters (for Hydronic System Make-up): AWWA C700 nutating disc, totalization meter with 150-psig minimum working-pressure rating; with registration in gallons.
 - 1. NPS 1: Threaded.
 - 2. Provide water meter with high frequency pulse output compatible for monitoring by the building DDC system.

PART 3 - EXECUTION

3.01 EXCAVATION:

- A. Excavating, trenching, and backfilling are specified in DIVISION 31.

3.02 PIPE AND FITTING APPLICATIONS:

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground piping, unless otherwise indicated.
- C. Grooved joints may be used on aboveground grooved-end piping.
- D. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- E. Under-Building-Slab, Water-Service Piping on Service Side of Water Meter: Refer to DIVISION 33.
- F. Under-Building-Slab, Domestic Water Piping on House Side of Water Meter, NPS 4 and Smaller: Soft copper tube, Type K (Type A); copper pressure fittings; and soldered joints.
- G. Aboveground Domestic Water Piping: Use the following piping materials for each size range:
 - 1. NPS 4 and Smaller: Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
- H. Non-Potable-Water Piping: Use the following piping materials for each size range:
 - 1. NPS 3-1/2 and Smaller: Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
- I. Trap seal primer piping: PEX Tube, fittings for PEX tube; and crimped joints.

SECTION 221116 - DOMESTIC WATER PIPING: continued

3.03 VALVE APPLICATIONS:

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use bronze ball or gate valves for piping NPS 2 and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 and larger.
 - 2. Throttling Duty: Use bronze ball or globe valves for piping NPS 2 and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
 - 3. Drain Duty: Hose-end drain valves.
- B. Cast-iron, grooved-end valves may be used with grooved-end piping.
- C. 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 or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- D. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 - 1. Install hose-end drain valves at low points in water mains, risers, and branches.
 - 2. Install stop-and-waste drain valves where indicated.

3.04 PIPING INSTALLATION:

- A. Basic piping installation requirements are specified in SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Install under-building-slab copper tubing according to CDA's "Copper Tube Handbook."
- C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in SECTION 230500.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gauge, and test tee with valve, inside the building at each domestic water service entrance. Pressure gauges are specified in SECTION 230519 - METERS AND GAUGES, and drain valves and strainers are specified in SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES.
- E. Install water-pressure regulators downstream from shutoff valves. Water-pressure regulators are specified in SECTION 221119.
- F. Install domestic water piping level without pitch and plumb.
- G. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

3.05 JOINT CONSTRUCTION:

- A. Basic piping joint construction requirements are specified in SECTION 230500.
- B. Soldered Joints: Use ASTM B813, water-flushable, lead-free flux; ASTM B32, lead-free-alloy solder; and ASTM B828 procedure, unless otherwise indicated.
- C. Grooved Joints: Assemble joints with grooved-end-pipe or grooved-end-tube coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- D. PEX Piping Joints: Join according to ASTM F1807.

3.06 WATER METER INSTALLATION:

- A. Rough-in domestic water piping and install water meters according to utility company's requirements.
- B. Install water meters according to AWWA M6 and utility's requirements.

SECTION 221116 - DOMESTIC WATER PIPING: continued

1. Install turbine-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.
2. Coordinate connection of water meter pulsed output with DDC System controls contractor.

3.07 HANGER AND SUPPORT INSTALLATION:

- A. Seismic-restraint devices are specified in SECTION 230548 - MECHANICAL VIBRATION AND SEISMIC CONTROLS.
- B. Pipe hanger and support devices are specified in SECTION 230529 - HANGERS AND SUPPORTS. Install the following:
 1. Vertical Piping: MSS Type 8 or Type 42 clamps.
 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer than 100 Feet: MSS Type 49, spring cushion rolls, if indicated.
 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install supports according to SECTION 230529.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.
- F. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 6. NPS 6: 10 feet with 5/8-inch rod.
 7. NPS 8: 10 feet with 3/4-inch rod.
- G. Install supports for vertical copper tubing every 10 feet.
- H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.08 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, and extend and connect to the following:
 1. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to DIVISION 22 Section "Plumbing Fixtures."
 3. 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.

SECTION 221116 - DOMESTIC WATER PIPING: continued

3.09 FIELD QUALITY CONTROL:

- A. Inspect domestic water piping as follows:
 - 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 24 hours 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. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test domestic water piping as follows:
 - 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 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 required corrective action.

3.10 ADJUSTING:

- A. Perform the following adjustments before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Adjust calibrated balancing valves to flows indicated.
 - 5. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
 - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 7. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING:

- A. Clean and disinfect potable and non-potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.

SECTION 221116 - DOMESTIC WATER PIPING: continued

2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as 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 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.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Strainers.
 - 5. Hose bibbs.
 - 6. Wall hydrants.
 - 7. Drain valves.
 - 8. Water hammer arresters.
 - 9. Air vents.
 - 10. Trap-seal primer systems.
- B. Related Work Specified Elsewhere:
 - 1. Thermometers, pressure gauges, and flowmeters in domestic water piping: SECTION 230519 - METERS AND GAUGES.
 - 2. Water meters: SECTION 221116 - DOMESTIC WATER PIPING.

1.02 REFERENCES:

- A. Applicable Standards (Latest Edition):
 - 1. American Society of Sanitary Engineering (ASSE):
 - a. 1003 - Water Pressure Reducing Valves.
 - b. 1010 - Water Hammer Arresters.
 - c. 1011 - Hose Connection Vacuum Breakers.
 - d. 1013 - Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers.
 - e. 1017 - Temperature Actuated Mixing Valves for Hot Water Distribution System.
 - f. 1018 - Trap Seal Primer Valves - Water Supply Fed.
 - g. 1044 - Trap Seal Primer Devices - Drainage Types and Electronic Design Types.
 - h. 1052 - Hose Connection Backflow Preventers.
 - 2. American Water Works Association (AWWA):
 - a. C550 - Protective Epoxy Interior Coatings for Valves and Hydrants.
 - 3. ASME International (ASME):
 - a. A112.1.2 - Air Gap Fittings in Plumbing Systems.
 - b. A112.18.1 - Plumbing Fixture Fittings.
 - c. B1.20.7 - Hose Coupling Screw Threads (Inch).
 - 4. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
 - a. SP-80 - Bronze Gate, Globe, Angle and Check Valves.
 - b. SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
 - 5. NSF International (NSF):
 - a. 14 - Plastics Piping Components and Related Materials.
 - b. 61 - Drinking Water System Components - Health Effects; Sections 1 through 9.
 - 6. Plumbing & Drainage Institute (PDI):
 - a. WH 201 - Water Hammer Arrestors.

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES: continued

1.03 PERFORMANCE REQUIREMENTS:

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.04 SUBMITTALS:

- A. General: Submit each item in this Article in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Product Data: For each type of product indicated.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE:

- A. NSF Compliance:
 - 1. Comply with NSF 14 for plastic domestic water piping components.
 - 2. Comply with NSF 61.

PART 2 - PRODUCTS

2.01 VACUUM BREAKERS:

- A. Hose-Connection Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 - a. Conbraco Industries, Inc.
 - b. MIFAB, Inc.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Woodford Manufacturing Company.
 - e. Zurn Plumbing Products Group; Light Commercial Operation.
 - f. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1011.
 - 3. Body: Bronze, nonremovable, with manual drain.
 - 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 - 5. Finish: Chrome or nickel plated.

2.02 BACKFLOW PREVENTERS:

- A. Reduced-Pressure-Principle Backflow Preventers:
 - 1. Basis of Design Product: Subject to compliance with requirements, provide product by one of the following or an approved equal:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1013.
 - 3. Operation: Continuous-pressure applications.
 - 4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
 - 5. Size: As indicated on the Drawings.
 - 6. Body: Bronze for NPS 2 and smaller; cast iron or steel with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
 - 7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES: continued

8. Configuration: Designed for horizontal, straight through or vertical flow as indicated on the Drawings.
 9. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
- 2.03 WATER PRESSURE-REDUCING VALVES:
- A. Water Regulators:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 - a. Conbraco Industries, Inc.
 - b. Honeywell Water Controls.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1003.
 3. Pressure Rating: Initial working pressure of 150 psig.
 4. Size: As indicated on the Drawings.
 5. Design Inlet Pressure: 150 psig.
 6. Design Outlet Pressure Setting: As indicated on the Drawings.
 7. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
 8. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.
- 2.04 STRAINERS FOR DOMESTIC WATER PIPING:
- A. Y-Pattern Strainers:
 1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
 2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
 3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 4. Screen: Stainless steel with round perforations, unless otherwise indicated.
 5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.020 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
 6. Drain: Factory-installed, hose-end drain valve.
- 2.05 HOSE BIBBS:
- A. Hose Bibbs:
 1. Basis of Design: Provide Woodford Model 24 or approved equal.
 2. Standard: ASME A112.18.1 for sediment faucets.
 3. Body Material: Bronze.
 4. Seat: Bronze, replaceable.
 5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
 6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
 7. Pressure Rating: 125 psig.
 8. Vacuum Breaker: Integral, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
 9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES: continued

10. Finish for Service Areas: Chrome or nickel plated.
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Equipment Rooms: Wheel handle.
13. Operation for Service Areas: Wheel handle.
14. Operation for Finished Rooms: Wheel handle.

2.06 WALL HYDRANTS:

A. Nonfreeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide Woodford Model 65 or a comparable product by one of the following or an approved equal:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Watts Drainage Products Inc.
 - e. Woodford Manufacturing Company.
 - f. Zurn Plumbing Products Group; Light Commercial Operation.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.21.3M for exposed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4.
7. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Nozzle and Wall-Plate Finish: Polished nickel bronze.
9. Operation: Loose key.

2.07 DRAIN VALVES:

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES: continued

2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.08 WATER HAMMER ARRESTERS:

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. PPP Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products Inc.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.09 AIR VENTS:

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140°F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.10 TRAP-SEAL PRIMER VALVES:

A. Electronic Trap-Seal Primer Systems (Automatic):

1. Standard: ASSE 1044.
2. Piping: ASTM B88, Type L, NPS 3/4; copper, water tubing.
3. Cabinet: Surface-mounting steel box with stainless-steel cover. Recessed if located in a public space and surface-mounting steel box with stainless-steel cover if located in a mechanical space.
4. Electronic Controls: 24-hour timer, solenoid valve, and manual switch for 120Vac power.
5. Vacuum Breaker: ASSE 1001.
6. Number Outlets: As required.

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES: continued

7. Size Outlets: NPS 1/2.
- B. Supply-Type, Trap-Seal Primer Valves:
 1. Standard: ASSE 1018.
 2. Pressure Rating: 125 psig minimum.
 3. Body: Bronze.
 4. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
 5. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
 6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.
 7. Number Outlets: As indicated on Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Refer to SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- C. Install water regulators with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.
- D. Install balancing valves in locations where they can easily be adjusted.
- E. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.
- F. Install water hammer arresters in water piping according to PDI-WH 201.
- G. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.
- H. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1%, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.02 CONNECTIONS:

- A. Piping installation requirements are specified in other DIVISION 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.03 LABELING AND IDENTIFYING:

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 1. Reduced-pressure-principle backflow preventers.
 2. Water pressure-reducing valves.
 3. Calibrated balancing valves.
 4. Electronic, trap-seal primer systems.

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES: continued

- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in SECTION 230553 - MECHANICAL IDENTIFICATION.

3.04 FIELD QUALITY CONTROL:

- A. Perform the following tests and prepare test reports:
 - 1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.05 ADJUSTING:

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following for soil, waste, and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.

1.02 REFERENCES: (Latest Edition):

- A. Applicable Standards:
 - 1. American Society of Civil Engineers (ASCE):
 - a. 7 - Minimum Design Loads for Buildings and Other Structures.
 - 2. ASME International (ASME):
 - a. B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
 - b. B16.4 - Gray Iron Threaded Fittings.
 - c. B16.12 - Cast Iron Threaded Drainage Fittings.
 - d. B16.39 - Malleable Iron Threaded Pipe Unions.
 - 3. ASTM International (ASTM):
 - a. A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - b. A74 - Cast Iron Soil Pipe and Fittings.
 - c. A106 - Seamless Carbon Steel Pipe for High-Temperature Service.
 - d. A733 - Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples.
 - e. A888 - Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 - f. B29 - Refined Lead.
 - g. C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
 - h. C1173 - Flexible Transition Couplings for Underground Piping Systems.
 - i. C1277 - Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
 - j. C1460 - Shield Transition Couplings for Use with Dissimilar DWV Pipe and Fittings Above Ground.
 - k. D2665 - Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
 - l. D3311 - Drain, Waste, and Vent (DWV) Plastic Fittings Patterns.
 - 4. Cast Iron Soil Pipe Institute (CISPI):
 - a. 301 - Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 - b. 310 - Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 - c. Cast Iron Soil Pipe and Fittings Handbook, 2002.
 - 5. Copper Development Association Inc.
 - 6. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
 - a. SP-69 - Pipe Hangers and Supports - Selection and Application.
 - 7. NSF International (NSF):
 - a. 14 - Plastics Piping System Components and Related Materials.

1.03 DEFINITIONS:

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. PVC: Polyvinyl chloride plastic.

SECTION 221316 - SANITARY WASTE AND VENT PIPING: continued

1.04 PERFORMANCE REQUIREMENTS:

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to ASCE 7.

1.05 SUBMITTALS:

- A. General: Submit the following as specified in SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Product Data: For pipe, tube, fittings, and couplings.
- C. Shop Drawings:
 - 1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.
- D. Field quality-control inspection and test reports.

1.06 QUALITY ASSURANCE:

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.01 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.

2.02 PIPING MATERIALS:

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.03 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS:

- A. Pipe and Fittings: ASTM A74, Service class.
- B. Gaskets: ASTM C564, rubber.
- C. Lead and Oakum: ASTM B29, pure lead and oakum or hemp fiber.

2.04 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS:

- A. Pipe and Fittings: ASTM A888 or CISPI 301.
- B. Shielded Couplings: ASTM C1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - 1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C564, rubber sleeve.

2.05 STEEL PIPE AND FITTINGS:

- A. Steel Pipe: ASTM A53, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching joining method.

SECTION 221316 - SANITARY WASTE AND VENT PIPING: continued

- B. Drainage Fittings: ASME B16.12, galvanized, threaded, cast-iron drainage pattern.
- C. Pressure Fittings:
 - 1. Steel Pipe Nipples: ASTM A733, made of ASTM A53 or ASTM A106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
 - 2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
 - 3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
 - 4. Cast-Iron Flanges: ASME B16.1, Class 125.
 - 5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.

2.06 PVC PIPE AND FITTINGS:

- A. Solid-Wall PVC Pipe: ASTM D2665, drain, waste, and vent.
 - 1. PVC Socket Fittings: ASTM D2665, socket type, made to ASTM D3311, drain, waste, and vent patterns.

2.07 SPECIAL PIPE FITTINGS:

- A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Shielded Nonpressure Pipe Couplings: ASTM C1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

PART 3 - EXECUTION

3.01 EXCAVATION:

- A. Refer to DIVISION 31 Section for excavating, trenching, and backfilling.

3.02 PIPING APPLICATIONS:

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:
 - 1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
- C. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
 - 1. Steel pipe, drainage fittings, and threaded joints.
 - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be the following:
 - 1. Service class, cast-iron soil piping; gaskets; and gasketed joints.

3.03 PIPING INSTALLATION:

- A. Sanitary sewer piping outside the building is specified in DIVISION 33.
- B. Basic piping installation requirements are specified in SECTION 230500.
- C. Install seismic restraints on piping. Seismic-restraint devices are specified in SECTION 230548 - MECHANICAL VIBRATION AND SEISMIC CONTROLS.
- D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- E. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- F. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to

SECTION 221316 - SANITARY WASTE AND VENT PIPING: continued

- make installation watertight. Sleeves and mechanical sleeve seals are specified in SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- G. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A674 or AWWA C105.
 - H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
 - I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
 - J. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2% downward in direction of flow for piping NPS 3 and smaller; 1.5% downward in direction of flow for piping NPS 4 and larger.
 - 2. Aboveground Horizontal Sanitary Drainage Piping: 2% downward in direction of flow.
 - 3. Vent Piping: 1% down toward vertical fixture vent or toward vent stack.
 - K. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
 - L. Install PVC vent piping according to ASTM D2665.
 - M. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- 3.04 JOINT CONSTRUCTION:
- A. Basic piping joint construction requirements are specified in SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
 - B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
 - C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
 - D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
 - E. PVC Nonpressure Piping Joints: Join piping according to ASTM D2665.
- 3.05 VALVE INSTALLATION:
- A. General valve installation requirements are specified in SECTION 230500 - VALVES.
- 3.06 HANGER AND SUPPORT INSTALLATION:
- A. Seismic-restraint devices are specified in SECTION 230548 - MECHANICAL VIBRATION AND SEISMIC CONTROLS.

SECTION 221316 - SANITARY WASTE AND VENT PIPING: continued

- B. Pipe hangers and supports are specified in SECTION 230529 - HANGERS AND SUPPORTS. Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42 clamps.
 - 2. Install individual, straight, horizontal piping runs according to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install supports according to SECTION 230529 - HANGERS AND SUPPORTS.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 - 3. NPS 2: 10 feet with 3/8-inch rod.
 - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 - 5. NPS 3: 12 feet with 1/2-inch rod.
 - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
- I. Install supports for vertical steel piping every 15 feet.
- J. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
 - 2. NPS 3: 48 inches with 1/2-inch rod.
 - 3. NPS 4 and 5: 48 inches with 5/8-inch rod.
- K. Install supports for vertical PVC piping every 48 inches.
- L. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.07 CONNECTIONS:

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.

SECTION 221316 - SANITARY WASTE AND VENT PIPING: continued

4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- 3.08 FIELD QUALITY CONTROL:
- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
 - C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 - D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 1. 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 separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 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 required corrective action.
- 3.09 CLEANING:
- A. Clean interior of piping. Remove dirt and debris as work progresses.
 - B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
 - C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- 3.10 PROTECTION:
- A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Cleanouts.
 - 2. Floor drains.
 - 3. Miscellaneous sanitary drainage piping specialties.
 - 4. Flashing materials.

1.02 REFERENCES:

- A. Applicable Standards (latest edition):
 - 1. ASME International (ASME):
 - a. A112.1.2 - Air Gaps in Plumbing Systems.
 - b. A112.6.3 - Floor and Trench Drains.
 - 2. ASTM International (ASTM):
 - a. A74 - Cast Iron Soil Pipe and Fittings.
 - b. A653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - c. B32 - Solder Metal.
 - d. B152 - Copper Sheet, Strip, Plate, and Rolled Bar.
 - e. B749 - Lead and Lead Alloy Strip, Sheet, and Plate Products.
 - f. C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
 - g. D4068 - Chlorinated Polyethylene (CPE) Sheeting for Concealed Water-Containment Membrane.
 - 3. National Fire Protection Association (NFPA):
 - a. 70 - National Electric Code.
 - 4. NSF International (NSF):
 - a. 14 - Plastics Piping Components and Related Materials.
 - 5. The Society for Protective Coatings (SSPC):
 - a. Paint 12 - Paint Specification No. 12: Cold-Applied Asphalt Mastic (Extra Thick Film).

1.03 QUALITY ASSURANCE:

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14 for plastic sanitary piping specialty components.

1.04 COORDINATION:

- A. Coordinate size and location of roof penetrations.

1.05 SUBMITTALS:

- A. Submit the following in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES: continued

- B. Product Data: For each product indicated. Provide capacities, characteristics and accessories.
 - 1. Floor drains.
 - 2. Cleanouts.

PART 2 - PRODUCTS

2.01 CLEANOUTS:

- A. Exposed Metal Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
 - 3. Size: Same as connected drainage piping
 - 4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
 - 5. Closure: Countersunk or raised-head plug.
 - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Metal Floor Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 - a. Josam Company; Josam Div.
 - b. Sioux Chief Manufacturing Company, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Light Commercial Operation.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M for adjustable housing cleanout.
 - 3. Size: Same as connected branch.
 - 4. Type: Adjustable housing.
 - 5. Body or Ferrule: Cast iron.
 - 6. Clamping Device: Required.
 - 7. Outlet Connection: Spigot or threaded.
 - 8. Closure: Brass plug with straight threads and gasket.
 - 9. Adjustable Housing Material: Cast iron with threads.
 - 10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
 - 11. Frame and Cover Shape: As scheduled on the Drawings.
 - 12. Top Loading Classification: As scheduled on the Drawings.
 - 13. Riser: ASTM A74, Extra-Heavy or Service class, cast-iron drainage pipe fitting and riser to cleanout.
- C. Cast-Iron Wall Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 - a. Josam Company; Josam Div.

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES: continued

- b. MIFAB, Inc.
- c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
- d. Tyler Pipe; Wade Div.
- e. Watts Drainage Products Inc.
- f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head in unfinished spaces drilled-and-threaded with cover plate in finished spaces. Provide brass or cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.02 FLOOR DRAINS:

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide product indicated or a comparable product by one of the following or an approved equal:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Light Commercial Operation.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Floor Drains in Finished Areas; FD-A:

1. Basis of Design: JR Smith Model 2005.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Cast iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Coating on Interior and Exposed Exterior Surfaces: Not required.
10. Sediment Bucket: Not required.
11. Top or Strainer Material: Bronze.
12. Top of Body and Strainer Finish: Polished bronze.
13. Top Shape: Round, 5 inches.
14. Top Loading Classification: Light duty.
15. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
16. Trap Material: Bronze or Cast iron.
17. Trap Pattern: Standard P-trap.

C. Floor Drains in Unfinished Areas; FD-B:

1. Basis of Design: JR Smith Model 2120.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Cast iron.
5. Seepage Flange: Required.

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES: continued

6. Anchor Flange: Required.
 7. Clamping Device: Required.
 8. Outlet: Bottom.
 9. Top or Strainer Material: Cast iron.
 10. Top Shape: Round, 8 inches.
 11. Top Loading Classification: Heavy-duty.
 12. Funnel: Not required.
 13. Inlet Filling: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 14. Trap Material: Cast iron.
 15. Trap Pattern: Deep-seal P-trap.
- D. Funnel Floor Drains; FD-C:
1. Basis of Design: JR Smith Model 2120.
 2. Standard: ASME A112.6.3.
 3. Pattern: Floor funnel drain.
 4. Body Material: Cast iron.
 5. Seepage Flange: Required.
 6. Anchor Flange: Required.
 7. Clamping Device: Required.
 8. Outlet: Bottom.
 9. Sediment Bucket: Not required.
 10. Top or Strainer Material: Cast iron.
 11. Top Shape: Round, 8 inches.
 12. Top Loading Classification: Heavy-duty.
 13. Funnel: Required.
 14. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 15. Trap Material: Cast iron.
 16. Trap Pattern: Deep-seal P-trap.

2.03 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES:

- A. Floor-Drain, Trap-Seal Primer Fittings:
1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 2. Size: Same as floor drain outlet with NPS 1/2 side inlet.
- B. Air-Gap Fittings:
1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
 2. Body: Bronze or cast iron.
 3. Inlet: Opening in top of body.
 4. Outlet: Larger than inlet.
 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
- C. Vent Caps:
1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
 2. Size: Same as connected stack vent or vent stack.

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES: continued

2.04 FLASHING MATERIALS:

- A. Fasteners: Metal compatible with material and substrate being fastened.
- B. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- C. Solder: ASTM B32, lead-free alloy.
- D. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Refer to SECTION 230500 - MECHANICAL MATERIALS AND METHODS for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 inches or Less: Equivalent to 1% slope, but not less than 1/4-inch total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- I. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- J. Install vent caps on each vent pipe passing through roof.
- K. Install wood-blocking reinforcement for wall-mounting-type specialties.
- L. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES: continued

- M. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

- 3.02 CONNECTIONS:
 - A. Piping installation requirements are specified in other DIVISION 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
 - B. Install piping adjacent to equipment to allow service and maintenance.

- 3.03 FLASHING INSTALLATION:
 - A. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to DIVISION 07.
 - B. Fabricate and install flashing and pans, sumps, and other drainage shapes.

- 3.04 FIELD QUALITY CONTROL:
 - A. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- 3.05 PROTECTION:
 - A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
 - B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 223300 - ELECTRIC WATER HEATERS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following electric water heaters:
 - 1. Flow-control, instantaneous electric water heaters.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. ASME International (ASME):
 - a. B1.20 - Pipe Threads, General Purpose (Inch).
 - 2. NFPA International (NFPA):
 - a. 70 - National Electrical Code.
 - 3. NSF International (NSF):
 - a. 61 - Drinking Water System Components - Health Effects; Sections 1 through 9.
 - 4. Underwriters Laboratories Inc. (UL):
 - a. 499 - Electric Heating Appliances.

1.03 SUBMITTALS:

- A. General: Submit the following as specified in SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- C. Shop Drawings: Diagram power, signal, and control wiring.
- D. Product Certificates: For each type of instantaneous electric water heater, signed by product manufacturer.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For electric water heaters to include in emergency, operation, and maintenance manuals.
- G. Warranty: Special warranty specified in this Section.

1.04 QUALITY ASSURANCE:

- A. Source Limitations: Obtain same type of electric water heaters through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of electric water heaters and are based on the specific system indicated. Refer to DIVISION 01.
- C. 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.
- D. Comply with NSF 61 for all components that will be in contact with potable water.

1.05 WARRANTY:

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric 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.

SECTION 223300 - ELECTRIC WATER HEATERS: continued

2. Warranty Period(s): From date of Substantial Completion:
 - a. Instantaneous Electric Water Heaters: Five years.

PART 2 - PRODUCTS

2.01 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.

2.02 INSTANTANEOUS ELECTRIC WATER HEATERS:

- A. Flow-Control, Instantaneous Electric Water Heaters: Comply with UL 499 for tankless electric (water heater) heating appliance.
 1. Manufacturers:
 - a. Chronomite Laboratories, Inc.
 - b. Eemax, Inc.
 - c. Stiebel Eltron, Inc.
 - d. Approved Equal.
 2. Construction: Copper piping or tubing complying with NSF 61 barrier materials for potable water, without storage capacity.
 - a. Connections: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Heating Element: Resistance heating system.
 - d. Temperature Control: Flow-control fitting.
 - e. Safety Control: High-temperature-limit cutoff device or system.
 - f. Jacket: Aluminum or steel with enameled finish or plastic.
 3. Support: Bracket for wall mounting.
 4. Capacity and Characteristics: As scheduled on the Drawings.

PART 3 - EXECUTION

3.01 WATER HEATER INSTALLATION:

- A. 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.
- B. Fill water heaters with water.

3.02 CONNECTIONS:

- A. Piping installation requirements are specified in other DIVISION 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- C. Ground equipment according to DIVISION 26.
- D. Connect wiring according to DIVISION 26.

3.03 FIELD QUALITY CONTROL:

- A. Perform the following field tests and inspections and prepare test reports:
 1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.

SECTION 223300 - ELECTRIC WATER HEATERS: continued

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.
- B. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

END OF SECTION 223300

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following conventional plumbing fixtures and related components:
 - 1. Faucets for lavatories and sinks.
 - 2. Flushometers.
 - 3. Toilet seats.
 - 4. Protective shielding guards.
 - 5. Fixture supports.
 - 6. Disposers.
 - 7. Water closets.
 - 8. Urinals.
 - 9. Lavatories.
 - 10. Commercial sinks.
 - 11. Service basins.
- B. Related Work Specified Elsewhere:
 - 1. DIVISION 10 for toilet and bath accessories.
 - 2. SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES for backflow preventers, hose bibbs and wall hydrants.
 - 3. SECTION 221319 - SANITARY WASTE PIPING SPECIALITIES for floor drains and cleanouts.
 - 4. SECTION 224700 - DRINKING FOUNTAINS AND WATER COOLERS.

1.02 REFERENCES:

- A. Applicable Standards (Latest Edition):
 - 1. American National Standards Institute (ANSI):
 - a. Z124.5 - Plastic Toilet (Water Closet) Seats.
 - 2. American Society of Sanitary Engineering (ASSE):
 - a. 1001 - Pipe Applied Atmospheric Type Vacuum Breakers.
 - b. 1008 - Household Food Waste Disposer Units.
 - c. 1011 - Hose Connection Vacuum Breakers.
 - d. 1037 - Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures.
 - 3. ASME International (ASME):
 - a. A112.6.1M - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use.
 - b. A112.18.1 - Plumbing Fixture Fittings.
 - c. A112.18.2 - Plumbing Fixture Waste Fittings.
 - d. A112.18.3M - Performance Requirements for Backflow Protection Devices and Systems in Plumbing Fixture Fittings.
 - e. A112.18.6 - Flexible Water Connectors.
 - f. A112.19.1M - Enameled Cast-Iron Plumbing Fixtures.
 - g. A112.19.2M - Vitreous China Plumbing Fixtures.
 - h. A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use).
 - i. A112.19.4M - Porcelain Enameled Formed Steel Plumbing Fixtures.
 - j. A112.19.5 - Trim for Water-Closet Bowls, Tanks and Urinals.
 - k. B1.20.1 - Pipe Threads, General Purpose (Inch).
 - l. B1.20.7 - Hose Coupling Screw Threads (Inch).

SECTION 224000 - PLUMBING FIXTURES: continued

4. ASTM International (ASTM):
 - a. F409 - Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings.
 - b. F446 - Consumer Safety Specification for Grab Bars and Accessories Installed in the Bathing Area.
5. Federal Government:
 - a. Public Law 90-480 - Architectural Barriers Act.
 - b. Public Law 101-336 - Americans with Disabilities Act (ADA).
 - c. Public Law 102-486 - Energy Policy Act.
6. International Code Council, Inc. (ICC):
 - a. A117.1 - Accessible and Usable Buildings and Facilities (ANSI).
7. NFPA:
 - a. 70 - National Electrical Code.
8. NSF International (NSF):
 - a. 2 - Food Equipment.
 - b. 61 - Drinking Water System Components - Health Effects.
9. Underwriters Laboratories Inc. (UL):
 - a. 430 - Waste Disposers.
 - b. 1951 - Electric Plumbing Accessories.

1.03 DEFINITIONS:

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- C. PVC: Polyvinyl chloride plastic.

1.04 SUBMITTALS:

- A. General: Submit each item in this Article in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- C. Shop Drawings: Diagram power, signal, and control wiring.
- D. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- E. Warranty: Special warranty specified in this Section.

1.05 QUALITY ASSURANCE:

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- 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.

SECTION 224000 - PLUMBING FIXTURES: continued

- C. Regulatory Requirements: Comply with requirements in ICC A117.1, Public Law 90-480 and Public Law 101-336; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61 for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 - 3. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 4. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
 - 5. Stainless-Steel Residential Sinks: ASME A112.19.3.
 - 6. Vitreous-China Fixtures: ASME A112.19.2M.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - 2. Faucets: ASME A112.18.1.
 - 3. Hose-Connection Vacuum Breakers: ASSE 1011.
 - 4. Hose-Coupling Threads: ASME B1.20.7.
 - 5. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 - 6. NSF Potable-Water Materials: NSF 61.
 - 7. Pipe Threads: ASME B1.20.1.
 - 8. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - 9. Supply Fittings: ASME A112.18.1.
 - 10. Brass Waste Fittings: ASME A112.18.2.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
 - 1. Atmospheric Vacuum Breakers: ASSE 1001.
 - 2. Brass and Copper Supplies: ASME A112.18.1.
 - 3. Manual-Operation Flushometers: ASSE 1037.
 - 4. Plastic Tubular Fittings: ASTM F409.
 - 5. Brass Waste Fittings: ASME A112.18.2.
 - 6. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Disposers: ASSE 1008 and UL 430.
 - 2. Flexible Water Connectors: ASME A112.18.6.
 - 3. Grab Bars: ASTM F446.
 - 4. Hose-Coupling Threads: ASME B1.20.7.
 - 5. Off-Floor Fixture Supports: ASME A112.6.1M.
 - 6. Pipe Threads: ASME B1.20.1.
 - 7. Plastic Toilet Seats: ANSI Z124.5.
 - 8. Supply and Drain Protective Shielding Guards: ICC A117.1.

SECTION 224000 - PLUMBING FIXTURES: continued

1.06 WARRANTY:

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures of unit shell.
 - b. Faulty operation of controls, blowers, pumps, heaters, and timers.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Period for Commercial Applications: One year from date of Substantial Completion.

1.07 EXTRA MATERIALS:

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.01 LAVATORY FAUCETS:

- A. Lavatory Faucets, LAV-1, LAV-2:
 - 1. Basis of Design Product: Subject to compliance with requirements, provide Sloan model ETF-600 or a comparable product by one of the following or an approved equal:
 - a. American Standard Companies, Inc.
 - b. Delta Faucet Company.
 - c. Eljer.
 - d. Elkay Manufacturing Co.
 - e. Kohler Co.
 - f. Moen, Inc.
 - g. Sloan Valve Company.
 - h. T & S Brass and Bronze Works, Inc.
 - i. Zurn Plumbing Products Group; Commercial Brass Operation.
 - 2. Description: Sensor operated mixing valve. Coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 0.5 gpm.
 - d. Centers: Single hole.
 - e. Mounting: Deck, exposed.
 - f. Inlet(s): NPS 3/8 tubing, with NPS 1/2 male adaptor.
 - g. Spout: Rigid type.
 - h. Spout Outlet: Aerator.
 - i. Operation: Hard-wired, electric-sensor actuation.
 - j. Drain: Grid.
 - k. Tempering Device: Not required.

2.02 SINK FAUCETS:

- A. Sink Faucets, SK-1:
 - 1. Basis of Design Product: Subject to compliance with requirements, provide Zurn model Z871A4 or a comparable product by one of the following or an approved equal:
 - a. Chicago Faucets.

SECTION 224000 - PLUMBING FIXTURES: continued

- b. Delta Faucet Company.
 - c. Kohler Co.
 - d. Moen, Inc.
 - e. T & S Brass and Bronze Works, Inc.
 - f. Zurn Plumbing Products Group; Commercial Brass Operation.
2. Description: Kitchen faucet without spray. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
- a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 1.5 gpm, unless otherwise indicated.
 - d. Backflow Protection Device for Hose Outlet: Not required.
 - e. Centers: 8 inches.
 - f. Mounting: Deck, exposed.
 - g. Handle(s): Wrist blade, 4 inches.
 - h. Inlet(s): NPS 1/2 female shank.
 - i. Spout Type: Swivel gooseneck.
 - j. Spout Outlet: Aerator.
 - k. Vacuum Breaker: Not required.
 - l. Operation: Compression, manual.
 - m. Drain: Not required.
- B. Sink Faucets, MB-1:
1. Basis of Design Product: Subject to compliance with requirements, provide Zurn model Z841M1 or a comparable product by one of the following or an approved equal:
- a. Chicago Faucets.
 - b. Delta Faucet Company.
 - c. Kohler Co.
 - d. Moen, Inc.
 - e. T & S Brass and Bronze Works, Inc.
 - f. Zurn Plumbing Products Group; Commercial Brass Operation.
2. Description: Service sink faucet with stops in shanks, vacuum breaker, hose-thread outlet, and pail hook. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
- a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
 - d. Mixing Valve: Two-lever handle.
 - e. Backflow Protection Device for Hose Outlet: Required.
 - f. Centers: 8 inches.
 - g. Mounting: Back/wall, exposed.
 - h. Handle(s): Lever.
 - i. Inlet(s): NPS 1/2 female shank.
 - j. Spout Type: Rigid, solid brass with wall brace.
 - k. Spout Outlet: Hose thread.
 - l. Vacuum Breaker: Required.
 - m. Drain: Not required.
 - n. Hose: Provide with 5-foot vinyl hose.

SECTION 224000 - PLUMBING FIXTURES: continued

2.03 FLUSHOMETERS:

A. Flushometers, U-1, U-2:

1. Basis of Design Product: Subject to compliance with requirements, provide Sloan Royal model 186-0.13 ES-S or a comparable product by one of the following or an approved equal:
 - a. Sloan Valve Company.
 - b. TOTO USA, Inc.
 - c. Zurn Plumbing Products Group; Commercial Brass Operation.
2. Description: Flushometer for urinal-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
 - a. Internal Design: Diaphragm operation.
 - b. Style: Exposed.
 - c. Inlet Size: NPS 3/4.
 - d. Trip Mechanism: Hard-wired, electric-sensor actuator.
 - e. Consumption: 0.125 gal./flush.
 - f. Tailpiece Size: NPS 3/4 length to top of bowl.

B. Flushometers, WC-1, WC-2:

1. Basis of Design Product: Subject to compliance with requirements, provide Sloan Royal 111-1.28 ES-S or a comparable product by one of the following or an approved equal:
 - a. Sloan Valve Company.
 - b. TOTO USA, Inc.
 - c. Zurn Plumbing Products Group; Commercial Brass Operation.
2. Description: Flushometer for water closet type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
 - a. Internal Design: Diaphragm operation.
 - b. Style: Exposed.
 - c. Inlet Size: NPS 1.
 - d. Trip Mechanism: Hard-wired, electric-sensor actuator.
 - e. Consumption: 1.28 gal./flush.
 - f. Tailpiece Size: NPS 1 length to top of bowl.
 - g. Transformers: Provide manufacturer's standard 24V transformer and wiring.

2.04 TOILET SEATS:

A. Toilet Seats, WC-1, WC-2:

1. Basis of Design Product: Subject to compliance with requirements, provide product by one of the following or an approved equal:
 - a. American Standard.
 - b. Bemis Manufacturing Company.
 - c. Church Seats.
 - d. Kohler Co.
2. Description: Toilet seat for water-closet-type fixture.
 - a. Material: Molded, solid plastic.
 - b. Configuration: Open front without cover.
 - c. Size: Elongated.
 - d. Class: Heavy-duty commercial.

SECTION 224000 - PLUMBING FIXTURES: continued

e. Color: White.

2.05 PROTECTIVE SHIELDING GUARDS:

A. Protective Shielding Piping Enclosures, LAV-2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 - a. TRUEBRO, Inc.
2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.06 FIXTURE SUPPORTS:

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

1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Water-Closet Supports, WC-1, WC-2:

1. Description: Combination carrier designed for accessible or standard mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

C. Urinal Supports, U-1, U-2:

1. Description: Type II, urinal carrier with hanger and bearing plates for wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

D. Lavatory Supports, LAV-2:

1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

2.07 DISPOSERS:

A. Disposers, SK-1:

1. Basis of Design Product: Subject to compliance with requirements, provide In-Sink-Erator model Badger 5 or a comparable product by one of the following or an approved equal:
 - a. Franke Consumer Products, Inc.; Kitchen Systems Div.
 - b. In-Sink-Erator; a div. of Emerson Electric Co.
 - c. KitchenAid.
 - d. Maytag Co.
2. Description: Continuous-feed household, food-waste disposer. Include reset button; wall switch; corrosion-resistant chamber with jam-resistant, cutlery- or stainless-steel grinder or shredder; NPS 1-1/2 outlet; quick-mounting, stainless-steel sink flange; antisplash guard; and combination cover/stopper.
 - a. Type: Continuous-feed household.
 - b. Motor: 115Vac, 1,725 rpm, 1/2 hp with overload protection.

SECTION 224000 - PLUMBING FIXTURES: continued

2.08 WATER CLOSETS:

A. Water Closets, WC-1, WC-2:

1. Basis of Design Product: Subject to compliance with requirements, provide American Standard model AFWALL 3351.128 or a comparable product by one of the following or an approved equal:
 - a. American Standard Companies, Inc.
 - b. Kohler Co.
 - c. Sloan Valve Company.
 - d. TOTO USA, Inc.
 - e. Zurn.
2. Description: Accessible, wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.
 - a. Style: Flushometer valve.
 - (1) Bowl Type: Elongated with siphon-jet design.
 - (2) Design Consumption: 1.28 gal./flush.
 - (3) Color: White.
 - b. Flushometer: WC-1, WC-2.
 - c. Toilet Seat: WC-2, WC-2.
 - d. Fixture Support: Water-closet support combination carrier.

2.09 URINALS:

A. Urinals, U-1, U-2:

1. Basis of Design Product: Subject to compliance with requirements, provide American Standard model Washbrook 6590.125 or a comparable product by one of the following or an approved equal:
 - a. American Standard Companies, Inc.
 - b. Kohler Co.
 - c. Sloan Valve Company.
 - d. TOTO USA, Inc.
 - e. Zurn.
2. Description: Accessible, wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.
 - a. Type: Washout with extended shields.
 - b. Strainer or Trapway: Open trapway with integral trap.
 - c. Design Consumption: 0.125 gal./flush.
 - d. Color: White.
 - e. Supply Spud Size: NPS 3/4.
 - f. Outlet Size: NPS 2.
 - g. Flushometer: U-1, U-2.
 - h. Fixture Support: U-1, U-2.

2.10 LAVATORIES:

A. Lavatories, LAV-1:

1. Solid surface counter with integral bowls is specified by Architect.
2. Faucet: Lavatory LAV-1.
3. Supplies: NPS 3/8 chrome-plated copper with stops.
4. Drain: Grid.
5. Drain Piping: NPS 1-1/4 by NPS 1-1/2 chrome-plated, cast-brass P-trap; NPS 1-1/2, thick tubular brass waste to wall; and wall escutcheon.

SECTION 224000 - PLUMBING FIXTURES: continued

6. Protective Shielding Guard(s): Not required.
 - B. Lavatories, LAV-2:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide American model Declyn 0321.075 or a comparable product by one of the following or an approved equal:
 - a. American Standard Companies, Inc.
 - b. Crane Plumbing, L.L.C./Fiat Products.
 - c. Eljer.
 - d. Kohler Co.
 - e. TOTO USA, Inc.
 - f. M. Zurn.
 2. Description: Accessible, wall-mounting, vitreous-china fixture.
 - a. Type: Ledge back.
 - b. Size: 20 by 18 inches rectangular.
 - c. Faucet Hole Punching: To match faucet.
 - d. Faucet Hole Location: Top.
 - e. Color: White.
 - f. Faucet: LAV-1.
 - g. Supplies: NPS 3/8 chrome-plated copper with stops.
 - h. Drain: Grid.
 - (1) Location: Near back of bowl.
 - i. Drain Piping: NPS 1-1/4 by NPS 1-1/2 chrome-plated, cast-brass P-trap; NPS 1-1/2 thick tubular brass waste to wall; and wall escutcheon.
 - j. Protective Shielding Guard(s): Required.
 - k. Fixture Support: Lavatory.
- 2.11 COMMERCIAL SINKS:
- A. Commercial Sinks, SK-1:
 1. Basis of Design Product: Subject to compliance with requirements, provide Elkay model DLR221910 or a comparable product by one of the following or an approved equal:
 - a. Elkay Manufacturing Co.
 - b. Just Manufacturing Company.
 2. Description: One-compartment, counter-mounting, stainless-steel commercial sink with backsplash.
 - a. Overall Dimensions: 22 by 19-1/2 inches.
 - b. Metal Thickness: 0.050 inch.
 - c. Compartment:
 - (1) Dimensions: 18 by 14 by 10 inches.
 - (2) Drain: NPS 1-1/2 tailpiece.
 - (a) Location: Centered in compartment.
 - d. Faucet(s): Sink SK-1.
 - (1) Number Required: One.
 - (2) Mounting: Deck.
 - e. Supplies: NPS 1/2 chrome-plated copper with stops or shutoff valves.
 - f. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; waste to wall; and wall escutcheon(s).
 - g. Disposer: Required.

SECTION 224000 - PLUMBING FIXTURES: continued

2.12 SERVICE BASINS:

- A. Service Basins, MB-1:
 - 1. Basis of Design Product: Subject to compliance with requirements, provide Stern-Williams model SBC-1700 or a comparable product by one of the following or an approved equal:
 - a. Acorn Engineering Company.
 - b. Crane Plumbing, L.L.C./Fiat Products.
 - c. Florestone Products Co., Inc.
 - d. Precast Terrazzo Enterprises, Inc.
 - e. Stern-Williams Co., Inc.
 - 2. Description: Flush-to-wall, floor-mounting, precast terrazzo fixture with rim guard.
 - a. Shape: Five sided.
 - b. Size: 24 by 24 inches.
 - c. Height: 12 inches with dropped front.
 - d. Tiling Flange: Not required.
 - e. Rim Guard: On front top surfaces.
 - f. Color: Not applicable.
 - g. Faucet: Sink MB-1.
 - h. Drain: Grid with NPS 3 outlet.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on attachments to piping or building substrate.
- E. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- F. Install counter-mounting fixtures in and attached to casework.
- G. Install fixtures level and plumb according to roughing-in drawings.
- H. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in SECTION 230523 - VALVES.
- I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

SECTION 224000 - PLUMBING FIXTURES: continued

- J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
 - K. Install toilet seats on water closets.
 - L. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
 - M. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
 - N. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
 - O. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
 - P. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
 - Q. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
 - R. Set service basins in leveling bed of cement grout. Grout is specified in SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
 - S. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in DIVISION 07.
- 3.03 CONNECTIONS:
- A. Piping installation requirements are specified in other DIVISION 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
 - B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
 - C. Ground equipment in accordance with DIVISION 26.
 - D. Connect wiring in accordance with DIVISION 26.
- 3.04 FIELD QUALITY CONTROL:
- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
 - B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
 - C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
 - D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- 3.05 ADJUSTING:
- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
 - B. Operate and adjust disposers. Replace damaged and malfunctioning units.
 - C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
 - D. Replace washers and seals of leaking and dripping faucets and stops.

SECTION 224000 - PLUMBING FIXTURES: continued

3.06 CLEANING:

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.07 PROTECTION:

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Contracting Officer.

END OF SECTION 224000

SECTION 224700 - DRINKING FOUNTAINS AND WATER COOLERS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following water coolers and related components:
 - 1. Pressure water coolers.
 - 2. Fixture supports.

1.02 REFERENCES:

- A. Applicable Standards (Latest Edition):
 - 1. Air-Conditioning & Refrigeration Institute (ARI):
 - a. 1010 - Self-Contained, Mechanically Refrigerated Drinking-Water Coolers.
 - b. Directory of Certified Drinking-Water Coolers.
 - 2. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - a. 34 - Designation and Safety Classification of Refrigerants.
 - 3. ASME International (ASME):
 - a. A112.6.1M - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use.
 - b. A112.18.1 - Plumbing Fixture Fittings.
 - 4. NFPA:
 - a. 70 - National Electrical Code.
 - 5. NSF International (NSF):
 - a. 61 - Drinking Water System Components - Health Effects.

1.03 DEFINITIONS:

- A. Accessible Water Cooler: Fixture that can be approached and used by people with disabilities.
- B. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.
- C. Fitting: Device that controls flow of water into or out of fixture.
- D. Fixture: Drinking fountain or water cooler unless one is specifically indicated.
- E. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.04 SUBMITTALS:

- A. General: Submit each item in this Article in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.
- C. Shop Drawings: Diagram power, signal, and control wiring.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

1.05 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. NSF Standard: Comply with NSF 61 for fixture materials that will be in contact with potable water.

SECTION 224700 - DRINKING FOUNTAINS AND WATER COOLERS: continued

- C. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.
- D. ARI Standard: Comply with ARI 1010 for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
- E. ASHRAE Standard: Comply with ASHRAE 34 for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

PART 2 - PRODUCTS

2.01 PRESSURE WATER COOLERS:

- A. Water Coolers, EWC-1:
 - 1. Basis of Design Product: Subject to compliance with requirements, provide Elkay model EZTL8C or a comparable product by one of the following or an approved equal:
 - a. Elkay Manufacturing Co.
 - b. Halsey Taylor.
 - c. Haws Corporation.
 - d. Oasis Corporation.
 - 2. Description: Accessible, ARI 1010, Type PB, pressure with bubbler, Style W, wall-mounting water cooler for adult-mounting height.
 - a. Cabinet: Bi-level with two attached cabinets, vinyl-covered steel with stainless-steel top.
 - b. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
 - c. Control: Push bar.
 - d. Supply: NPS 3/8 with ball, gate, or globe valve.
 - e. Drain(s): Grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A112.18.1.
 - f. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
 - (1) Capacity: 8 gph of 50°F° cooled water from 80°F° inlet water and 90°F° ambient air temperature.
 - (2) Electrical Characteristics: 1/3 hp; 120Vac; single phase; 60 Hz.
 - g. Support: Type II, water cooler carrier. Refer to "Fixture Supports" Article.

2.02 FIXTURE SUPPORTS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Josam Co.
 - 2. MIFAB Manufacturing, Inc.
 - 3. Smith, Jay R. Mfg. Co.
 - 4. Tyler Pipe; Wade Div.
 - 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 - 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
 - 1. Type I: Hanger-type carrier with two vertical uprights.
 - 2. Type II: Bi-level, hanger-type carrier with three vertical uprights.
 - 3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

SECTION 224700 - DRINKING FOUNTAINS AND WATER COOLERS: continued

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.
- B. Examine walls and floors for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS:

- A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.
- B. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.03 INSTALLATION:

- A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.
- B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.
- C. Install fixtures level and plumb. Install at height as scheduled on Drawings.
- D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in SECTION 230523 - VALVES.
- E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in DIVISION 07.

3.04 CONNECTIONS:

- A. Piping installation requirements are specified in other DIVISION 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment in accordance with DIVISION 26.
- D. Connect wiring in accordance with DIVISION 26.

3.05 FIELD QUALITY CONTROL:

- A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
 - 1. Remove and replace malfunctioning units and retest as specified above.
 - 2. Report test results in writing.

3.06 ADJUSTING:

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust water cooler temperature settings.

SECTION 224700 - DRINKING FOUNTAINS AND WATER COOLERS: continued

3.07 CLEANING:

- A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 224700

DIVISION 23 - HVAC

SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following basic mechanical materials and methods to complement other DIVISIONS 21, 22, and 23 Sections:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Painting and finishing.
 - 10. Concrete bases.
 - 11. Supports and anchorages.
- B. Related Work Specified Elsewhere: The following sections contain requirements that relate to this section.
 - 1. Adhesives, Sealants, Grout and Solvent Cements: SECTION 018113 - SUSTAINABLE DESIGN REQUIREMENTS.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American Society for Testing and Materials (ASTM):
 - a. A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - b. B32 - Solder Metal.
 - c. B813 - Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube.
 - d. B828 - Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
 - e. C1107 - Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
 - f. C1173 - Flexible Transition Couplings for Underground Piping Systems.
 - g. D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
 - h. D2235 - Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
 - i. D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
 - j. D2672 - Joints for IPS PVC Pipe Using Solvent Cement.
 - k. D2846 - Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot-and Cold-Water Distribution Systems.
 - l. D2855 - Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
 - m. F405 - Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermostatic Pipe and Fittings.
 - n. F656 - Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS: continued

2. American Water Works Association (AWWA):
 - a. C110 - Ductile-Iron and Gray-Iron Fittings, 3 Inches through 48 Inches through for Water and Other Liquids.
 - b. C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe.
 3. American Welding Society (AWS):
 - a. A5.8 - Filler Metals for Brazing and Braze Welding.
 - b. D1.1 - Structural Welding Code - Steel.
 - c. D10.12 - Recommended Practices and Procedures for Welding Low Carbon Steel pipe.
 - d. Brazing Handbook.
 4. ASME International (ASME):
 - a. B1.20.1 - Pipe Threads, General Purpose (Inch).
 - b. B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges.
 - c. B18.2.1 - Square and Hex Bolts and Screws - Inch Series.
 - d. B31 Series - Code for Pressure Piping.
 - e. 1998 ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 5. Copper Development Association Inc.:
 - a. Copper Tube Handbook.
 6. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):
 - a. SP-107 - Transition Union Fittings for Joining Metal and Plastic Products.
- 1.03 DEFINITIONS:
- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
 - B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
 - C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
 - D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
 - E. 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.
 - F. The following are industry abbreviations for plastic materials:
 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 2. CPVC: Chlorinated polyvinyl chloride plastic.
 3. PE: Polyethylene plastic.
 4. PVC: Polyvinyl chloride plastic.
 - G. The following are industry abbreviations for rubber materials:
 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 2. NBR: Acrylonitrile-butadiene rubber.
- 1.04 SUBMITTALS:
- A. General: Submit the following and items in other DIVISIONS 21, 22, and 23 Sections as required in SECTION 013000 - SUBMITTAL PROCEDURES.
 - B. Product Data: For the following:
 1. Transition fittings.

SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS: continued

- 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Escutcheons.
 - C. Welding certificates.
 - D. LEED® Submittals:
 - 1. Product Data for Credit IEQc4.1: For adhesives, sealants, mastics, grouts and solvent cements installed inside the weatherproofing barrier of the building, submit documentation including manufacturer's printed statement (MSDS Sheet) of VOC content of each product.
- 1.05 OPERATION AND MAINTENANCE DATA:
- A. Prepare operation and maintenance manuals in accordance with SECTION 017823 - OPERATION AND MAINTENANCE DATA.
- 1.06 QUALITY ASSURANCE:
- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1.
 - 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 Mechanical 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.
 - D. Electronic Equipment Compliance:
 - 1. Contractor warrants that all equipment, devices, items, systems, software, hardware, or firmware provided shall properly, appropriately, and consistently function and accurately process date and time data (including without limitation: calculating, comparing, and sequencing). This warranty supersedes anything in the Specifications or other Contract Documents which might be construed inconsistently. This warranty is applicable whether the equipment, device, item, system, software, hardware, or firmware is specified with or without reference to a manufacturer's name, make, or model number.
- 1.07 DELIVERY, STORAGE, AND HANDLING:
- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
 - B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.
- 1.08 COORDINATION:
- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.
 - B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
 - C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in DIVISION 08.

SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS: continued

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS:

- A. Refer to individual DIVISIONS 21, 22, and 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.

2.03 JOINING MATERIALS:

- A. Refer to individual DIVISIONS 21, 22, and 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-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.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM D2235. VOC content shall not exceed 490 g/L.
 - 2. PVC Piping: ASTM D2564. Include primer according to ASTM F656. VOC content shall not exceed 510 g/L.

2.04 TRANSITION FITTINGS:

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 - 2. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
 - 3. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS: continued

- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C1173 with elastomeric sleeve ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.05 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°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-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225°F.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225°F.

2.06 MECHANICAL SLEEVE SEALS:

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: NBR 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. Include two for each sealing element.
 - 3. 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.

2.07 SLEEVES:

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A53, 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.

2.08 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.

SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS: continued

- 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. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- E. Split-Plate, Stamped-Steel Type: With concealed set screw or spring clips, and chrome-plated finish.
- F. One-Piece, Floor-Plate Type: Cast-iron floor plate.

2.09 GROUT:

- A. Description: ASTM C1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5,000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.
 - 4. VOC Content: VOC content shall not exceed 250 g/L.

PART 3 - EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS:

- A. Install piping according to the following requirements and DIVISIONS 21, 22, and 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.
- 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.
- 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 according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.

SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS: continued

- f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to DIVISION 07 for flashing.
 - (1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to DIVISION 07 for materials and installation.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using 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.
- 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. 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.
- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- 1. 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.
- P. 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 for materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS: continued

3.02 PIPING JOINT CONSTRUCTION:

- A. Join pipe and fittings according to the following requirements and DIVISIONS 21, 22, and 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 B813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B32.
- 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. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D2846 Appendix.
 - 3. PVC Pressure Piping: Join schedule number ASTM D1785M PVC pipe and PVC socket fittings according to ASTM D2855.
 - 4. PVC Nonpressure Piping: Join according to ASTM D2855.

3.03 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.

3.04 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.

SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS: continued

- C. Install mechanical 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.

3.05 PAINTING:

- A. Painting of mechanical systems, equipment, and components is specified in DIVISION 09.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.06 CONCRETE BASES:

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in DIVISION 03.

3.07 ERECTION OF METAL SUPPORTS AND ANCHORAGES:

- A. Refer to DIVISION 05 for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.08 ERECTION OF WOOD SUPPORTS AND ANCHORAGES:

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical 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.

3.09 GROUTING:

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.

SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS: continued

- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 230500

SECTION 230513 - MOTORS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes basic requirements for factory-installed motors.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. 29 CFR - Labor, Chapter XVII - Occupational Safety and Health Administration, Department of Labor, Part 1910 - "Occupational Safety and Health Standards," Subpart B - "Regulations Relating to Labor," Section 1910.7 - "Definition and Requirements for a Nationally Recognized Testing Laboratory."
 - 2. InterNational Electrical Testing Association (NETA):
 - a. ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
 - 3. National Electrical Manufacturers Association (NEMA):
 - a. MG 1 - Motors and Generators.
 - 4. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code.

1.03 DEFINITIONS:

- A. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.

1.04 SUBMITTALS:

- A. General: Submit the following in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Manufacturer Seismic Qualification Certification: Submit certification that motors, accessories, and components will withstand seismic forces defined in SECTION 230548 - MECHANICAL VIBRATION AND SEISMIC CONTROLS. Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. 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."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Qualification Data: For testing agency.
- D. Source quality-control test reports.
- E. Field quality-control test reports.

1.05 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.

SECTION 230513 - MOTORS: continued

1.06 COORDINATION:

- A. Coordinate features of motors, installed units, and accessory devices and features that comply with the following:
 - 1. Compatible with the following:
 - a. Magnetic controllers.
 - b. Multispeed controllers.
 - c. Reduced-voltage controllers.
 - 2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
 - 3. Matched to torque and horsepower requirements of the load.
 - 4. Matched to ratings and characteristics of supply circuit and required control sequence.
- B. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.

PART 2 - PRODUCTS

2.01 MOTOR REQUIREMENTS:

- A. Motor requirements apply to factory- and field-installed motors except as follows:
 - 1. Different ratings, performance, or characteristics for motor are specified in another Section.
 - 2. Motorized-equipment manufacturer requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.

2.02 MOTOR CHARACTERISTICS:

- A. Motors 1/2 HP and Larger: Three phase.
- B. Motors Smaller Than 1/2 HP: Single phase.
- C. Frequency Rating: 60 Hz.
- D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
- E. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
- F. Duty: Continuous duty at ambient temperature of 105°F (40°C) and at altitude of 3,300 feet (1,005 m) above sea level.
- G. 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.
- H. Enclosure: Open dripproof.

2.03 POLYPHASE MOTORS:

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: NEMA Premium rated, as defined in NEMA MG 1.
- C. Stator: Copper windings, unless otherwise indicated.
 - 1. Multispeed motors shall have separate winding for each speed.
- D. Rotor: Squirrel cage, unless otherwise indicated.
- E. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.
- F. Temperature Rise: Match insulation rating, unless otherwise indicated.
- G. Insulation: Class F, unless otherwise indicated.
- H. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.

SECTION 230513 - MOTORS: continued

2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
 - I. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp.
 1. Finish: Gray enamel.
- 2.04 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS:
- A. Motors Used with Reduced-Inrush 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. Designed with critical vibration frequencies outside operating range of controller output.
 2. Temperature Rise: Matched to rating for Class B insulation.
 3. Insulation: Class H.
 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- 2.05 SINGLE-PHASE MOTORS:
- A. Type: One of the following, to suit starting torque and requirements of specific motor application:
 1. Permanent-split capacitor.
 2. Capacitor start, capacitor run.
 - B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.
 - C. 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.
 - D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, prelubricated-sleeve type for other single-phase motors.

PART 3 - EXECUTION

- 3.01 EXAMINATION:
- A. Examine roughing-in for conduit systems to verify actual locations of conduit connections before motor installation.
 - B. Proceed with installation only after unsatisfactory conditions have been corrected.

END OF SECTION 230513

SECTION 230519 - METERS AND GAUGES

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following meters and gauges for mechanical systems:
 - 1. Thermometers.
 - 2. Gauges.
 - 3. Test plugs.
- B. Related Work Specified Elsewhere:
 - 1. Domestic and water service meters inside the building: SECTION 221116 - DOMESTIC WATER PIPING.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. ASME International (ASME):
 - a. B40.5 - Snubbers.
 - b. B40.100 - Pressure Gauges and Gauge Attachments.

1.03 DEFINITIONS:

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.04 SUBMITTALS:

- A. General: Submit the following in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Product Data: For each type of product indicated; include performance curves.
- C. Shop Drawings: Schedule for thermometers and gauges indicating manufacturer's number, scale range, and location for each.
- D. Product Certificates: For each type of thermometer and gauge, signed by product manufacturer.

PART 2 - PRODUCTS

2.01 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 or an approved equal.

2.02 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS:

- A. Manufacturers:
 - 1. Trerice, H. O. Co.
 - 2. Weiss Instruments, Inc.
 - 3. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Case: Die-cast aluminum or brass, 7 inches long.
- C. Tube: Red or blue reading, organic-liquid filled, with magnifying lens.
- D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- E. Window: Glass or plastic.

SECTION 230519 - METERS AND GAUGES: continued

- F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
- G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
- H. Accuracy: $\pm 1\%$ of range or ± 1 scale division to maximum of 1.5% of range.

2.03 THERMOWELLS:

- A. Manufacturers:
 - 1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
 - 2. Ernst Gage Co.
 - 3. Trerice, H. O. Co.
 - 4. Weiss Instruments, Inc.
 - 5. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Manufacturers: Same as manufacturer of thermometer being used.
- C. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.04 PRESSURE GAUGES:

- A. Manufacturers:
 - 1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
 - 2. Ernst Gage Co.
 - 3. Trerice, H. O. Co.
 - 4. Weiss Instruments, Inc.
 - 5. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Direct-Mounting, Dial-Type Pressure Gauges: Indicating-dial type complying with ASME B40.100.
 - 1. Case: Liquid-filled type, drawn steel or cast aluminum, 6-inch diameter.
 - 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
 - 3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
 - 4. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
 - 6. Pointer: Red or other dark-color metal.
 - 7. Window: Glass.
 - 8. Ring: Brass or Stainless steel.
 - 9. Accuracy: Grade B, $\pm 2\%$ of middle half scale.
 - 10. Vacuum-Pressure Range: 30-inch Hg of vacuum to 60 psig of pressure.
 - 11. Range for Fluids under Pressure: Two times operating pressure.
- C. Pressure-Gauge Fittings:
 - 1. Valves: NPS 1/4 brass or stainless-steel needle type.
 - 2. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.05 TEST PLUGS:

- A. Manufacturers:
 - 1. National Meter, Inc.
 - 2. Peterson Equipment Co., Inc.
 - 3. Trerice, H. O. Co.
 - 4. Watts Industries, Inc.; Water Products Div.

SECTION 230519 - METERS AND GAUGES: continued

- B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.
- C. Minimum Pressure and Temperature Rating: 500 psig at 200°F.
- D. Core Inserts: One or two self-sealing rubber valves.
 - 1. Insert material for water service at 20 to 200°F shall be CR.

PART 3 - EXECUTION

3.01 THERMOMETER APPLICATIONS:

- A. Install liquid-in-glass thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic zone.
- B. Provide the following temperature ranges for thermometers:
 - 1. Domestic Cold Water: 0 to 100°F, with 2-degree scale divisions.
 - 2. Geothermal Water: 0 to 150°F, with 2-degree scale divisions.

3.02 GAUGE APPLICATIONS:

- A. Install liquid-filled-case-type pressure gauges at suction and discharge of each pump with range of 30 inches vacuum to 60 psig.
- B. Unless otherwise noted, all other pressure gauges shall have 0 to 100 psig range.

3.03 INSTALLATIONS:

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.
- C. Install direct-mounting pressure gauges in piping tees with pressure gauge located on pipe at most readable position.
- D. Install needle-valve and snubber fitting in piping for each pressure gauge for fluids.
- E. Install test plugs in tees in piping.

3.04 CONNECTIONS:

- A. Install meters and gauges adjacent to machines and equipment to allow service and maintenance for meters, gauges, machines, and equipment.

3.05 ADJUSTING:

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjust faces of meters and gauges to proper angle for best visibility.

END OF SECTION 230519

SECTION 230523 - VALVES

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following general-duty valves:
 - 1. Bronze angle valves.
 - 2. Cast-iron angle valves.
 - 3. Copper-alloy ball valves.
 - 4. Ferrous-alloy ball valves.
 - 5. Ferrous-alloy butterfly valves.
 - 6. Bronze check valves.
 - 7. Spring-loaded, lift-disc check valves.
 - 8. Bronze gate valves.
 - 9. Cast-iron gate valves.
 - 10. Bronze globe valves.
- B. Related Work Specified Elsewhere:
 - 1. For general-duty and specialty valves for site construction piping: DIVISION 33.
 - 2. Fire-suppression piping Sections for fire-protection valves: DIVISION 21.
 - 3. For valve tags and charts: SECTION 230553 - MECHANICAL IDENTIFICATION.
 - 4. For control valves and actuators: SECTION 230900 - HVAC INSTRUMENTATION AND CONTROLS.
 - 5. For specialty valves applicable to those Sections only: DIVISION 22 AND 23 Sections.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American Society for Testing and Materials (ASTM):
 - a. B32 - Solder Metal.
 - b. B813 - Liquid and Past Fluxes for Soldering Applications of Copper and Copper Alloy Tube.
 - c. B828 - Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
 - 2. American Society of Mechanical Engineers (ASME):
 - a. B1.20.1 - Pipe Threads, General Purpose (Inch).
 - b. B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
 - c. B16.5 - Pipe Flanges and Flanged Fittings.
 - d. B16.10 - Face-to-Face and End-to-End Dimensions of Valves.
 - e. B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - f. B16.24 - Cast Copper Alloy Pipe Flanges, Class 150, 300, 400, 600, 900, 1,500, and 2,500, and Flanged Fittings, Class 150 and 300.
 - g. B16.34 - Valves - Flanged, Threaded, and Welding End.
 - h. B31.9 - Building Services Piping.
 - 3. American Water Works Association (AWWA):
 - a. C606 - Grooved and Shoulder Joints.
 - 4. Fluid Controls Institute (FCI):
 - a. 74-1 - Spring Loaded Lift Disc Check Valve Standard.
 - 5. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):
 - a. SP-45 - Bypass and Drain Connections.
 - b. SP-67 - Butterfly Valves.
 - c. SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
 - d. SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service.

SECTION 230523 - VALVES: continued

- e. SP-80 - Bronze Gate, Globe, Angle and Check Valves.
 - f. SP-85 - Cast Iron Globe and Angle Valves, Flange and Threaded Ends.
 - g. SP-110 - Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
6. NSF International (NSF):
- a. 61 - Drinking Water System Components - Health Effects, Sections 1 through 9.
- 1.03 DEFINITIONS:
- A. The following are standard abbreviations for valves:
 - 1. CWP: Cold working pressure.
 - 2. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 3. NBR: Acrylonitrile-butadiene rubber.
 - 4. PTFE: Polytetrafluoroethylene plastic.
 - 5. SWP: Steam working pressure.
 - 6. TFE: Tetrafluoroethylene plastic.
- 1.04 SUBMITTALS:
- A. General: Submit the following in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
 - B. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.
- 1.05 QUALITY ASSURANCE:
- A. ASME Compliance: ASME B31.9 for building services piping valves.
 - 1. Exceptions: Domestic hot- and cold-water piping valves unless referenced.
 - B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
 - C. NSF Compliance: NSF 61 for valve materials for potable-water service.
- 1.06 DELIVERY, STORAGE, AND HANDLING:
- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
 - B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
 - C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

SECTION 230523 - VALVES: continued

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. In other PART 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified or an approved equal.

2.02 VALVES, GENERAL:

- A. Refer to PART 3 "Valve Applications" Article for applications of valves.
- B. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.
- C. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.
- D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- F. Valve Actuators:
 - 1. Gear Drive: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
 - 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
- G. Extended Valve Stems: On insulated valves.
- H. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- I. Valve Grooved Ends: AWWA C606.
- J. Solder Joint: With sockets according to ASME B16.18.
 - 1. Caution: Use solder with melting point below 840°F for angle, check, gate, and globe valves; below 421°F for ball valves.
- K. Threaded: With threads according to ASME B1.20.1.
- L. Valve Bypass and Drain Connections: MSS SP-45.

2.03 BRONZE ANGLE VALVES:

- A. Manufacturers:
 - 1. Type 2, Bronze Angle Valves with Nonmetallic Disc:
 - a. Anvil International, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. NIBCO INC.
 - f. Powell, Wm. Co.
- B. Bronze Angle Valves, General: MSS SP-80, with ferrous-alloy handwheel.
- C. Type 2, Class 125, Bronze Angle Valves: Bronze body with nonmetallic disc and union-ring bonnet.

2.04 CAST-IRON ANGLE VALVES:

- A. Manufacturers:
 - 1. Type II, Cast-Iron Angle Valves with Metal Seats:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.

SECTION 230523 - VALVES: continued

- c. Crane Co.; Crane Valve Group; Stockham Div.
 - d. NIBCO INC.
 - B. Cast-Iron Angle Valves, General: MSS SP-85, Type II.
 - C. Class 125, Cast-Iron Angle Valves: Bronze mounted with gray-iron body and bronze seats.
- 2.05 COPPER-ALLOY BALL VALVES:
 - A. Manufacturers:
 - 1. Two-Piece, Copper-Alloy Ball Valves:
 - a. Anvil International, Inc.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Crane Co.; Crane Valve Group; Jenkins Valves.
 - e. Crane Co.; Crane Valve Group; Stockham Div.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Watts Industries, Inc.; Water Products Div.
 - B. Copper-Alloy Ball Valves, General: MSS SP-110.
 - C. Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 400 psig minimum CWP rating and blowout-proof stem.
- 2.06 FERROUS-ALLOY BALL VALVES:
 - A. Manufacturers:
 - 1. American Valve, Inc.
 - 2. Conbraco Industries, Inc.; Apollo Div.
 - 3. Cooper Cameron Corp.; Cooper Cameron Valves Div.
 - 4. Crane Co.; Crane Valve Group; Stockham Div.
 - 5. Jamesbury, Inc.
 - 6. Milwaukee Valve Company.
 - 7. NIBCO INC.
 - B. Ferrous-Alloy Ball Valves, General: MSS SP-72, with flanged ends.
 - C. Ferrous-Alloy Ball Valves: Class 150, full port.
- 2.07 FERROUS-ALLOY BUTTERFLY VALVES:
 - A. Manufacturers:
 - 1. Flanged, Ferrous-Alloy Butterfly Valves:
 - a. Anvil International, Inc.
 - b. Mueller Steam Specialty.
 - 2. Grooved-End, Ductile-Iron Butterfly Valves:
 - a. Anvil International, Inc.
 - b. Central Sprinkler Co.; Central Grooved Piping Products.
 - c. McWane, Inc.; Kennedy Valve Div.
 - d. Milwaukee Valve Company.
 - e. Mueller Steam Specialty.
 - f. NIBCO INC.
 - B. Ferrous-Alloy Butterfly Valves, General: MSS SP-67, Type I, for tight shutoff, with disc and lining suitable for potable water, unless otherwise indicated.
 - C. Flanged, 150-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Flanged-end type with one- or two-piece stem.

SECTION 230523 - VALVES: continued

- D. Grooved-End, 175-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Ductile-iron or steel body with grooved or shouldered ends.

2.08 BRONZE CHECK VALVES:

- A. Manufacturers:
 - 1. Type 2, Bronze, Horizontal Lift Check Valves with Nonmetallic Disc:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Div.
 - d. Walworth Co.
 - 2. Type 2, Bronze, Vertical Lift Check Valves with Nonmetallic Disc:
 - a. Anvil International, Inc.
 - b. Milwaukee Valve Company.
- B. Bronze Check Valves, General: MSS SP-80.
- C. Type 2, Class 150, Bronze, Horizontal Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.
- D. Type 2, Class 150, Bronze, Vertical Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

2.09 SPRING-LOADED, LIFT-DISC CHECK VALVES:

- A. Manufacturers:
 - 1. Type I, Wafer Lift-Disc Check Valves:
 - a. Mueller Steam Specialty.
 - 2. Type II, Compact-Wafer, Lift-Disc Check Valves:
 - a. Anvil International, Inc.
 - b. Milwaukee Valve Company.
 - c. Mueller Steam Specialty.
 - d. NIBCO INC.
 - e. SSI Equipment, Inc.
 - 3. Type IV, Threaded Lift-Disc Check Valves:
 - a. Anvil International, Inc.
 - b. Milwaukee Valve Company.
 - c. Mueller Steam Specialty.
 - d. NIBCO INC.
 - e. Watts Industries, Inc.; Water Products Div.
- B. Lift-Disc Check Valves, General: FCI 74-1, with spring-loaded bronze or alloy disc and bronze or alloy seat.
- C. Type I, Class 125, Wafer Lift-Disc Check Valves: Wafer style with cast-iron shell with diameter matching companion flanges.
- D. Type II, Class 125, Compact-Wafer, Lift-Disc Check Valves: Compact-wafer style with cast-iron shell with diameter made to fit within bolt circle.
- E. Type IV, Class 150, Threaded Lift-Disc Check Valves: Threaded style with bronze shell and threaded ends.

2.10 BRONZE GATE VALVES:

- A. Manufacturers:
 - 1. Type 1, Bronze, Nonrising-Stem Gate Valves:
 - a. Anvil International, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.

SECTION 230523 - VALVES: continued

- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Div.
- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Powell, Wm. Co.
- h. Watts Industries, Inc.; Water Products Div.
- B. Bronze Gate Valves, General: MSS SP-80, with ferrous-alloy handwheel.
- C. Type 1, Class 125, Bronze Gate Valves: Bronze body with nonrising stem and bronze solid wedge and union-ring bonnet.
- D. Type 3, Class 200, Bronze Gate Valves: Bronze body with rising stem and bronze split wedge and union-ring bonnet.

2.11 CAST-IRON GATE VALVES:

- A. Manufacturers:
 - 1. Type I, Cast-Iron, Rising-Stem Gate Valves:
 - a. Anvil International, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell, Wm. Co.
 - h. Watts Industries, Inc.; Water Products Div.
- B. Cast-Iron Gate Valves, General: MSS SP-70, Type I.
- C. Class 125, OS&Y, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, rising stem, and solid-wedge disc.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. 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.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. 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.
- F. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE APPLICATIONS:

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly, or gate valves.
 - 2. Throttling Service: Angle, ball or butterfly valves.

SECTION 230523 - VALVES: continued

3. Pump Discharge: Spring-loaded, lift-disc check valves.
- 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. Domestic Water Piping: Use the following types of valves:
 1. Angle Valves, NPS 2 and Smaller: Type 2, Class 125, bronze.
 2. Ball Valves, NPS 2 and Smaller: Two-piece, 400-psig CWP rating, copper alloy.
 3. Lift Check Valves, NPS 2 and Smaller: Type 2, Class 150, horizontal or vertical, bronze.
 4. Gate Valves, NPS 2 and Smaller: Type 1, Class 125, bronze.
- D. Geothermal Water Piping: Use the following types of valves:
 1. Ball Valves, NPS 2 and Smaller: Two-piece, 400-psig CWP rating, copper alloy.
 2. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
 3. Butterfly Valves, NPS 2-1/2 and Larger: Flanged, 150-psig CWP rating, ferrous alloy, with EPDM liner.
 4. Grooved-End, Ductile-Iron Butterfly Valves, NPS 2-1/2 and Larger: 175-psig CWP rating.
 5. Lift Check Valves, NPS 2 and Smaller: Type 2, Class 125, horizontal or vertical, bronze.
 6. Spring-Loaded, Lift-Disc Check Valves, NPS 2 and Smaller: Type IV, Class 125 minimum.
 7. Spring-Loaded, Lift-Disc Check Valves, NPS 2-1/2 and Larger: Type I or II, Class 125, cast iron.
- E. Select valves, except wafer and flangeless types, with the following end connections:
 1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for heating hot water services.
 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends.
 3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.

3.03 VALVE INSTALLATION:

- A. Piping installation requirements are specified in other DIVISION 22 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.
- F. Install check valves for proper direction of flow and as follows:
 1. Lift Check Valves: With stem upright and plumb.

3.04 JOINT CONSTRUCTION:

- A. Refer to SECTION 230500 for basic piping joint construction.
- B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- C. Soldered Joints: Use ASTM B813, water-flushable, lead-free flux; ASTM B32, lead-free-alloy solder; and ASTM B828 procedure, unless otherwise indicated.

SECTION 230523 - VALVES: continued

3.05 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.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following hangers and supports for mechanical system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Pipe stands.
 - 7. Pipe positioning systems.
 - 8. Equipment supports.
- B. Related Work Specified Elsewhere:
 - 1. For structural-steel shapes and plates for trapeze hangers for pipe and equipment supports: DIVISION 05.
 - 2. For pipe hangers for fire-protection piping: SECTION 211000 - FIRE-SUPPRESSION PIPING.
 - 3. For isolation devices: SECTION 230548 - MECHANICAL VIBRATION AND SEISMIC CONTROLS.
 - 4. For duct hangers and supports: SECTION 233113 - METAL DUCTS.
 - 5. For grout: SECTION 018113 - SUSTAINABLE DESIGN REQUIREMENTS.

1.02 REFERENCES:

- A. Applicable Standards (latest edition):
 - 1. American Welding Society (AWS):
 - a. D1.1 - Structural Welding Code - Steel.
 - b. D1.2 - Structural Welding Code - Aluminum.
 - c. D1.3 - Structural Welding Code - Sheet Steel.
 - d. D1.4 - Structural Welding Code - Reinforcing Steel.
 - 2. ASME International (ASME):
 - a. B31.1 - Power Piping.
 - b. B31.9 - Building Services Piping.
 - c. Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualification".
 - 3. ASTM International (ASTM):
 - a. A36 - Carbon Structural Steel.
 - b. C533 - Calcium Silicate Block and Pipe Thermal Insulation.
 - c. C552 - Cellular Glass Thermal Insulation.
 - d. C1107 - Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
 - 4. The International Association of Plumbing and Mechanical Officials (IAPMO):
 - a. PS42 - Pipe Alignment and Secondary Support Systems.
 - 5. Manufacturers Standardization Society of The Valve and Fittings Industry Inc. (MSS SP):
 - a. 58 - Pipe Hangers and Supports - Materials, Design and Manufacture.
 - b. 69 - Pipe Hangers and Supports - Selection and Application.
 - c. 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
 - d. 90 - Guidelines on Terminology for Pipe Hangers and Supports.

SECTION 230529 - HANGERS AND SUPPORTS: continued

6. Metal Framing Manufacturers Association (MFMA):
 - a. 3 - Metal Framing Standards Publication.
 - b. 102 - Guidelines for the Use of Metal Framing.
 7. The Society for Protective Coatings (SSPC):
 - a. PA1 - Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel.
- 1.03 DEFINITIONS:
- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.
 - B. Terminology: As defined in MSS SP-90.
- 1.04 PERFORMANCE REQUIREMENTS:
- A. Design supports for multiple pipes, including pipe stands, 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 and obtain approval from authorities having jurisdiction.
- 1.05 SUBMITTALS:
- A. General: Submit the following in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
 - B. Product Data: For the following:
 1. Steel pipe hangers and supports.
 2. Thermal-hanger shield inserts.
 3. Pipe positioning systems.
 - C. Shop Drawings: Signed and sealed by a qualified professional engineer. 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. Pipe stands. Include Product Data for components.
 4. Equipment supports.
 - D. Welding certificates.
 - E. LEED[®] Submittals:
 1. Product Data for Credit IEQc4.1: For adhesives, sealants, mastics, grouts and solvent cements installed inside the weatherproofing barrier of the building, submit documentation including manufacturer's printed statement (MSDS Sheet) of VOC content of each product.
- 1.06 QUALITY ASSURANCE:
- A. Welding: Qualify procedures and personnel according to the following:
 1. AWS D1.1.
 2. AWS D1.2.
 3. AWS D1.3.
 4. AWS D1.4.
 5. ASME Boiler and Pressure Vessel Code: Section IX.

SECTION 230529 - HANGERS AND SUPPORTS: continued

PART 2 - PRODUCTS

2.01 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 or an approved equal.

2.02 STEEL PIPE HANGERS AND SUPPORTS:

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components except as noted in PART 3. Refer to PART 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 - 1. Bergen-Power Pipe Supports.
 - 2. B-Line Systems, Inc.; a division of Cooper Industries.
 - 3. Grinnell Corp.
 - 4. PHS Industries, Inc.
 - 5. Piping Technology & Products, Inc.
- 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.

2.03 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.

2.04 METAL FRAMING SYSTEMS:

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. Power-Strut Div.; Tyco International, Ltd.
 - 3. 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.

2.05 THERMAL-HANGER SHIELD INSERTS:

- A. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
 - 1. Carpenter & Paterson, Inc.
 - 2. PHS Industries, Inc.
 - 3. Pipe Shields, Inc.
- C. Insulation-Insert Material for Geothermal Water Piping: Water-repellent treated, ASTM C533, Type I calcium silicate with vapor barrier.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

SECTION 230529 - HANGERS AND SUPPORTS: continued

- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.06 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. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Hilti, Inc.
 - c. ITW Ramset/Red Head.

2.07 PIPE POSITIONING SYSTEMS:

- A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.

2.08 EQUIPMENT SUPPORTS:

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.09 MISCELLANEOUS MATERIALS:

- A. Structural Steel: ASTM A36, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C1107, 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: 5,000-psi, 28-day compressive strength.
 - 3. VOC Content: VOC content of grout shall not exceed 250 g/L.

PART 3 - EXECUTION

3.01 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. Support fire protection piping independently of other piping systems.
- G. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Exception: The following figure types given in Figure 1 of MSS SP-69 will not be acceptable: Types 5, 6, 7, 9, 10, 11, and 12. However, Types 7, 9, 10, and 11 may be used for nonferrous and plastic piping systems 2 inches and smaller.
 - 2. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.

SECTION 230529 - HANGERS AND SUPPORTS: continued

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. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 6. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 8. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
 9. 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.
 10. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
 11. 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.
 12. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 13. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- H. 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.
- I. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Exception: The following figure type given in Figure 1 of MSS SP-69 will not be acceptable: Type 16.
 2. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 3. Steel Clevises (MSS Type 14): For 120 to 450°F piping installations.
 4. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450°F piping installations.
- J. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Exception: The following figure types given in Figure 1 of MSS SP-69 will not be acceptable: Types 19, 20, 23, 25, 27, 28, 29, 30, and 34.
 2. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 3. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.

SECTION 230529 - HANGERS AND SUPPORTS: continued

4. 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 l.
 - b. Medium (MSS Type 32): 1,500 lb.
 - c. Heavy (MSS Type 33): 3,000 lb.
5. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
6. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- K. 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.
- L. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25% to absorb expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25% to absorb expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25% to absorb expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- M. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- N. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- O. Use mechanical-expansion anchors instead of building attachments where required in concrete construction. Powder-actuated fasteners will not be permitted.
- P. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

SECTION 230529 - HANGERS AND SUPPORTS: continued

3.02 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, heavy-duty 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 A36, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. The following figure types given in Figure 1 of MSS SP-69 will not be acceptable: Types 5, 6, 7, 9, 10, 11, 12, 16, 19, 20, 23, 25, 27, 28, 29, and 30. However, Types 7, 9, 10, 11, 19, and 23 may be used for nonferrous and plastic piping systems 2 inches and smaller.
- D. Support fire-protection systems piping independently of other piping systems.
- E. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick. Powder-actuated fasteners will not be permitted.
- H. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to SECTION 224000 - PLUMBING FIXTURES for plumbing fixtures.
- I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- K. 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.
- L. Install lateral bracing with pipe hangers and supports to prevent swaying.
- M. 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.
- N. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- P. 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 O.D. of insert.

SECTION 230529 - HANGERS AND SUPPORTS: continued

- 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.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 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.
 5. Insert Material: Length at least as long as protective shield.
 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
- 3.03 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.
- 3.04 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.
- 3.05 ADJUSTING:
- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
 - B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.
- 3.06 PAINTING:
- A. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in DIVISION 09.
 - B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 230529

SECTION 230548 - MECHANICAL VIBRATION AND SEISMIC CONTROLS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following:
 - 1. Elastomeric isolation pads and mounts.
 - 2. Elastomeric hangers.
 - 3. Spring hangers.
 - 4. Spring hangers with vertical-limit stops.
 - 5. Thrust limits.
 - 6. Pipe riser resilient supports.
 - 7. Seismic snubbers.
 - 8. Restraining cables.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. M251 - Plain and Laminated Elastomeric Bridge Bearings.
 - 2. American Welding Society (AWS):
 - a. D1.1 - Structural Welding Code - Steel.
 - 3. International Code Council:
 - a. International Building Code, 2009 edition.
 - 4. Structural Engineering Institute/American Society of Civil Engineers (SEI/ASCE):
 - a. 7 - Minimum Design Loads for Buildings and Other Structures, 2005 edition.

1.03 DEFINITIONS:

- A. A_v : Effective peak velocity related acceleration coefficient.
- B. OSHPD: Office of Statewide Health Planning & Development for the State of California. OSHPD assigns a unique anchorage preapproval "R" number to each seismic restraint it tests. The number describes a specific device applied as tested.

1.04 PERFORMANCE REQUIREMENTS:

- A. Overhead items such as suspended ductwork, piping, and equipment weighing 31 lbs. or more shall be braced laterally as required by DOD Antiterrorism for Buildings Standard. Specifically, mounting will be designed to resist forces equal to 1.5 times the component weight in the downward direction and 0.5 times the component weight in any other direction.
- B. Mechanical vibration and seismic controls shall be designed to meet the requirements of Section 1613 of the 2009 International Building Code and Chapter 13 of ASCE 7-2005. The following factors shall be used:
 - 1. Importance Factor (I_p):
 - a. Fire Protection Components $I_p = 1.5$.
 - b. All other components $I_p = 1.0$.
 - 2. Seismic Design Category = B.
 - 3. Site Class = D.
 - 4. Building Occupancy Type II.
 - 5. $S_s = 0.132$.
 - 6. $S_1 = 0.054$.

SECTION 230548 - MECHANICAL VIBRATION AND SEISMIC CONTROLS: continued

1.05 SUBMITTALS:

- A. General: Submit the following in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Product Data: Include load deflection curves for each vibration isolation device.
- C. Delegated-Design Submittal: Signed and sealed by a qualified professional engineer. Include the following:
 - 1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - 2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
 - 3. Seismic-Restraint Details: Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.
 - 4. Submittals for Interlocking Snubbers: Include load deflection curves up to 1/2-inch deflection in x, y, and z planes.
- D. Welding certificates.
- E. Manufacturer Seismic Qualification Certification: Submit certification that all specified equipment will withstand seismic forces identified in "Performance Requirements" Article above. Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
 - a. 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."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.06 QUALITY ASSURANCE:

- A. Seismic-restraint devices shall have horizontal and vertical load testing and analysis performed according to OSHPD and shall bear anchorage preapproval "R" number, from OSHPD or another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer. Testing and calculations must include both shear and tensile loads and 1 test or analysis at 45 degrees to the weakest mode.
- B. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code-Steel."

1.07 COORDINATION:

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in DIVISION 03.

SECTION 230548 - MECHANICAL VIBRATION AND SEISMIC CONTROLS: continued

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. In other PART 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified or an approved equal.

2.02 VIBRATION ISOLATORS:

- A. Manufacturers:
 - 1. Amber/Booth Company, Inc.
 - 2. Mason Industries, Inc.
 - 3. Vibration Mountings & Controls/Korfund.
- B. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
 - 1. Material: Bridge-bearing neoprene, complying with AASHTO M 251.
 - 2. Durometer Rating: 50.
 - 3. Number of Layers: 2.
- C. Elastomeric Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 - 1. Durometer Rating: 50.
- D. Elastomeric Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
- E. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
 - 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80% of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50% of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80% of the rated vertical stiffness.
 - 5. Overload Capacity: Support 200% of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
- F. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
 - 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80% of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50% of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80% of the rated vertical stiffness.

SECTION 230548 - MECHANICAL VIBRATION AND SEISMIC CONTROLS: continued

5. Overload Capacity: Support 200% of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
- G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression and with a load stop. Include rod and angle-iron brackets for attaching to equipment.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80% of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50% of the required deflection at rated load.
 4. Lateral Stiffness: More than 80% of the rated vertical stiffness.
 5. Overload Capacity: Support 200% of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.
- H. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch thick, 60-durometer neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.

2.03 SEISMIC-RESTRAINT DEVICES:

- A. Manufacturers:
1. Amber/Booth Company, Inc.
 2. Mason Industries, Inc.
 3. Unistrut Diversified Products Co.; Wayne Manufacturing Division.
 4. Vibration Mountings & Controls/Korfund.
- B. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, ± 5 , with a flat washer face.
- C. Seismic Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, ± 5 .
- D. Restraining Cables: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement.
- E. Anchor Bolts: Seismic-rated, drill-in, and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

2.04 FACTORY FINISHES:

- A. Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
1. Powder coating on springs and housings.

SECTION 230548 - MECHANICAL VIBRATION AND SEISMIC CONTROLS: continued

2. All hardware shall be electrogalvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements, installation tolerances, and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. Install thrust limits at centerline of thrust, symmetrical on either side of equipment.
- B. Install seismic snubbers on isolated equipment. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
- C. Install restraining cables at each trapeze and individual pipe hanger. At trapeze anchor locations, shackle piping to trapeze. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.
- D. Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers. At trapeze anchor locations, shackle piping to trapeze. Requirements apply equally to hanging equipment. Do not weld angles to rods.
- E. Install resilient bolt isolation washers on equipment anchor bolts.

3.03 FIELD QUALITY CONTROL:

- A. Testing: Perform the following field quality-control testing:
 1. Isolator seismic-restraint clearance.
 2. Isolator deflection.
 3. Snubber minimum clearances.

3.04 ADJUSTING:

- A. Adjust isolators after piping systems have been filled and equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.
- D. Adjust active height of spring isolators.
- E. Adjust snubbers according to manufacturer's written recommendations.
- F. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.
- G. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.

SECTION 230548 - MECHANICAL VIBRATION AND SEISMIC CONTROLS: continued

3.05 CLEANING:

- A. After completing equipment installation, inspect vibration isolation and seismic-control devices. Remove paint splatters and other spots, dirt, and debris.

END OF SECTION 230548

SECTION 230553 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following mechanical identification materials and their installation:
 - 1. Equipment markers.
 - 2. Access panel and door markers.
 - 3. Pipe markers.
 - 4. Duct markers.
 - 5. Valve tags.
 - 6. Valve schedules.
 - 7. Warning tags.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American Society for Testing and Materials (ASTM):
 - a. C1036 - Flat Glass.
 - b. D709 - Laminated Thermosetting Materials.
 - 2. American Society of Mechanical Engineers (ASME):
 - a. A13.1 - Scheme for the Identification of Piping Systems.

1.03 SUBMITTALS:

- A. General: Submit the following as specified in SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Product Data: For each type of product indicated.
- C. Samples: For color, letter style, and graphic representation required for each identification material and device.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.04 QUALITY ASSURANCE:

- A. ASME Compliance: Comply with ASME A13.1 for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.05 COORDINATION:

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 EQUIPMENT IDENTIFICATION DEVICES:

- A. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
 - 1. Terminology: Match schedules as closely as possible.
 - 2. Data:
 - a. Name and plan number.

SECTION 230553 - MECHANICAL IDENTIFICATION: continued

- b. Equipment service.
- c. Design capacity.
- d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

- B. Access Panel and Door Markers: 1/16-inch thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.

- 1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.02 PIPING IDENTIFICATION DEVICES:

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

- 1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 - 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
 - 3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
 - 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
 - 5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

2.03 DUCT IDENTIFICATION DEVICES:

- A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

2.04 VALVE TAGS:

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Engineer. Provide 5/32-inch hole for fastener.

- 1. Material: 0.032-inch thick brass or aluminum.
 - 2. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

2.05 VALVE SCHEDULES:

- A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

- 1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
 - 2. Frame: Finished hardwood or extruded aluminum.
 - 3. Glazing: ASTM C1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

SECTION 230553 - MECHANICAL IDENTIFICATION: continued

2.06 WARNING TAGS:

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.01 APPLICATIONS, GENERAL:

- A. Products specified are for applications referenced in other DIVISION 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.02 EQUIPMENT IDENTIFICATION:

- A. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment.
 - 1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 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.
 - 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 - 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fire department hose valves and hose stations.
 - c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - d. Fans, blowers, primary balancing dampers, and mixing boxes.
 - e. Packaged HVAC central-station and zone-type units.
 - f. Tanks and pressure vessels.

3.03 PIPING IDENTIFICATION:

- A. Paint all exposed interior piping. The color should be the same as the walls and/or ceiling, or a complementing color. The use of red paint is not necessary. Exposed piping in fire protection equipment rooms and mechanical rooms and all unexposed piping in the facility may be left unpainted. Exposed plastic interior piping shall only be painted if permitted by its listing and the manufacturer's instructions. Exposed and unexposed stainless steel piping will be cleaned and remain unpainted.
- B. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
 - 1. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 3/4 inch wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.

SECTION 230553 - MECHANICAL IDENTIFICATION: continued

2. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.
- C. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed 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 nonaccessible 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 for Fire Protection piping and for all piping in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.
- D. Pipe:

Outside Diameter of Pipe or Covering (Inches)	Length of Color Field	Size of Letters and Numerals (Inches)
Less than 3/4"		Identify with valve tags
3/4" to 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"
8" to 10"	24"	2-1/2"
Over 10"	32"	3-1/2"
Over 13"	32"	3-1/2"

3.04 DUCT IDENTIFICATION:

- A. Install duct markers with permanent adhesive on air ducts in the following color codes:
1. Green: For cold-air supply ducts.
 2. Blue: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 3. ASME A13.1 Colors and Designs: For hazardous material exhaust.
 4. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 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.
- B. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.05 VALVE-TAG INSTALLATION:

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

SECTION 230553 - MECHANICAL IDENTIFICATION: continued

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:

1. Valve-Tag Size and Shape:
 - a. 1-1/2 inches round.

3.06 VALVE-SCHEDULE INSTALLATION:

A. Mount valve schedule on wall in accessible location in each major equipment room.

3.07 WARNING-TAG INSTALLATION:

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.08 ADJUSTING:

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.09 CLEANING:

A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 - 2. Balancing Hydronic Piping Systems:
 - a. Variable-flow hydronic systems.
 - 3. Other Systems/Equipment:
 - a. Heat exchangers.
 - b. Motors.
 - c. Condensing units.
 - d. Heat transfer coils.

1.02 REFERENCES:

- A. Applicable Standards (latest edition):
 - 1. Air Movement and Control Association International Inc. (AMCA):
 - a. 201 - Fans and Systems.
 - 2. American National Standards Institute (ANSI):
 - a. S1.4 - Specification for Sound Level Meters.
 - b. S1.11 - Specification for Octave Band and Fraction Octave Band Analog and Digital Filters.
 - c. S1.13 - Methods for the Measurement of Sound Pressure Levels.
 - d. S1.40 - Specification for Acoustical Calibrators.
 - 3. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - a. 62.1 - Ventilation for Acceptable Indoor Air Quality (ANSI).
 - b. 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
 - 4. Associated Air Balance Council (AABC):
 - a. National Standards for Total System Balance.
 - 5. National Environmental Balancing Bureau (NEBB):
 - a. Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
 - 6. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - a. HVAC Systems - Duct Design.
 - b. HVAC Systems - Testing, Adjusting, and Balancing.

1.03 DEFINITIONS:

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.
- F. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- G. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING: continued

- H. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- I. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin that is normally dissipated.
- J. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- K. Report Forms: Test data sheets for recording test data in logical order.
- L. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- M. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- N. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- O. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- P. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- Q. Test: A procedure to determine quantitative performance of systems or equipment.
- R. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.04 SUBMITTALS:

- A. Submit as specified in SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. LEED® Submittal:
 - 1. Air-Balance Report for LEED Prerequisite EQ 1: Documentation of work performed for ASHRAE 62.1, Section 7.2.2, "Air Balancing."
- C. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- D. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- E. Certified TAB reports.
- F. Sample report forms.
- G. 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.

1.05 QUALITY ASSURANCE:

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC or NEBB as a TAB technician.

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING: continued

- B. TAB Conference: Meet with Contracting Officer and Commissioning Representative on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items:
 - a. The TAB plan.
 - b. Coordination and cooperation of trades and subcontractors.
 - c. Coordination of documentation and communication flow.
- C. 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.
- D. TAB Report Forms: Use standard TAB contractor's forms approved by Commissioning Representative.
- E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
 - 1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.06 COORDINATION:

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS - NOT APPLICABLE.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine the Contract Documents to become familiar with Project requirements.
- B. Examine the approved submittals for HVAC systems and equipment.
- C. 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.
- D. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in SECTION 233113 - METAL DUCTS and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- 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.

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING: continued

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 filters and verify that bearings are greased, belts are aligned and tight, 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 three-way valves for proper installation for their intended function of 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.
 - P. Examine automatic temperature system components to verify the following:
 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 2. Dampers and valves are in the position indicated by the controller.
 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 6. Sensors are located to sense only the intended conditions.
 7. Sequence of operation for control modes in according to the Contract Documents.
 8. Controller set points are set at indicated values.
 9. Interlocked systems are operating.
 10. Changeover from heating to cooling mode occurs according to indicated values.
- 3.02 PREPARATION:
- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
 - B. Complete system-readiness checks and prepare reports. Verify the following:
 1. Permanent electrical-power wiring is complete.
 2. Hydronic systems are filled, clean, and free of air.
 3. Automatic temperature-control systems are operational.
 4. Equipment and duct access doors are securely closed.
 5. Balance, smoke, and fire dampers are open.
 6. Isolating and balancing valves are open and control valves are operational.
 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING: continued

8. Windows and doors can be closed so indicated conditions for system operations can be met.
- 3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING:
- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
 1. Comply with requirements in ASHRAE 62.1, 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. After testing and balancing, install test ports and duct access doors that comply with requirements in SECTION 233300 - DUCT ACCESSORIES.
 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to SECTION 230700 - MECHANICAL 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.
- 3.04 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 SECTION 233113 - METAL DUCTS.
- 3.05 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.

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING: continued

- 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. Obtain approval from Contracting Officer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in DIVISION 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 - 7. 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.
- 3.06 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

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING: continued

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.

3.07 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%.
- 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 gage 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, adjust variable speed drive so motor nameplate rating is not exceeded.
 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING: continued

3.08 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS:

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.09 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.
 - 8. 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.

3.10 PROCEDURES FOR CONDENSING UNITS:

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.11 PROCEDURES FOR HEAT-TRANSFER COILS:

- A. Measure, adjust, and record the following data for each water coil:
 - 1. Entering- and leaving-water temperature.
 - 2. Water flow rate.
 - 3. Water pressure drop.
 - 4. Dry-bulb temperature of entering and leaving air.
 - 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 - 6. Airflow.
 - 7. Air pressure drop.
- B. Measure, adjust, and record the following data for each electric heating coil:
 - 1. Nameplate data.
 - 2. Airflow.
 - 3. Entering- and leaving-air temperature at full load.
 - 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 - 5. Calculated kilowatt at full load.
 - 6. Fuse or circuit-breaker rating for overload protection.
- C. Measure, adjust, and record the following data for each refrigerant coil:
 - 1. Dry-bulb temperature of entering and leaving air.
 - 2. Wet-bulb temperature of entering and leaving air.
 - 3. Airflow.
 - 4. Air pressure drop.
 - 5. Refrigerant suction pressure and temperature.

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING: continued

3.12 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: $\pm 10\%$.
 - 2. Air Outlets and Inlets: 0 to +10%.
 - 3. Heating-Water Flow Rate: 0 to +10%.
 - 4. Cooling-Water Flow Rate: 0 to +10%.

3.13 REPORTING:

- A. Status Reports: Prepare monthly 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.

3.14 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.
- 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. Engineer's name and address.
 - 6. Contractor's name and address.
 - 7. Report date.
 - 8. Signature of TAB supervisor who certifies the report.
 - 9. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 10. 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.
 - 11. Nomenclature sheets for each item of equipment.
 - 12. Data for terminal units, including manufacturer's name, type, size, and fittings.
 - 13. Notes to explain why certain final data in the body of reports vary from indicated values.
 - 14. 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.

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- 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 (DOAS-1): 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, and bore.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - 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, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - 3. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Filter static-pressure differential in inches wg.
 - f. Reheat-coil static-pressure differential in inches wg.
 - g. Cooling-coil static-pressure differential in inches wg.
 - h. Heating-coil static-pressure differential in inches wg.
 - i. Outdoor airflow in cfm.
 - j. Outdoor-air damper position.
- F. Apparatus-Coil Test Reports:
- 1. Coil Data:
 - a. System identification.
 - b. Location.

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- c. Coil type.
- d. Number of rows.
- e. Fin spacing in fins per inch o.c.
- f. Make and model number.
- g. Face area in sq. ft.
- h. Tube size in NPS.
- i. Tube and fin materials.
- j. Circuiting arrangement.
- 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Average face velocity in fpm.
 - c. Air pressure drop in inches wg.
 - d. Outdoor-air, wet- and dry-bulb temperatures in °F.
 - e. Return-air, wet- and dry-bulb temperatures in °F.
 - f. Entering-air, wet- and dry-bulb temperatures in °F.
 - g. Leaving-air, wet- and dry-bulb temperatures in °F.
 - h. Water flow rate in gpm.
 - i. Water pressure differential in feet of head or psig.
 - j. Entering-water temperature in °F.
 - k. Leaving-water temperature in °F.
 - l. Refrigerant expansion valve and refrigerant types.
 - m. Refrigerant suction pressure in psig.
 - n. Refrigerant suction temperature in °F.
 - o. Inlet steam pressure in psig.
- G. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
 - 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btu/h.
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Air flow rate in cfm.
 - i. Face area in sq. ft.
 - j. Minimum face velocity in fpm.
 - 2. Test Data (Indicated and Actual Values):
 - a. Heat output in Btu/h.
 - b. Air flow rate in cfm.
 - c. Air velocity in fpm.
 - d. Entering-air temperature in °F.
 - e. Leaving-air temperature in °F.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- H. Heat Pump Reports: For water-to-air heat pumps, include the following:
 - 1. Unit Data:
 - a. Unit identification.
 - b. Location.

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- c. Unit make and model number.
 - d. Manufacturer serial numbers.
 - e. Refrigerant weight in lb.
 2. Fan and Motor Data:
 - a. Fan size.
 - b. Motor make and size.
 - c. Horsepower and RPM.
 - d. Volts, phase and hertz.
 - e. Full load amps.
 3. Test Data (Indicated and Actual Values):
 - a. Inlet-duct static pressure in inches wg.
 - b. Outlet-duct static pressure in inches wg.
 - c. Entering-air, dry-bulb temperature in °F.
 - d. Leaving-air, dry-bulb temperature in °F.
 - e. Geothermal entering-water temperature in °F.
 - f. Geothermal leaving-water temperature in °F.
 - g. Geothermal entering-water pressure in feet of head or psig.
 - h. Geothermal leaving-water pressure in feet of head or psig.
 - i. Geothermal -water pressure differential in feet of head or psig.
 - j. Low-pressure-cutout set point in psig.
 - k. High-pressure-cutout set point in psig.
 - l. Suction pressure in psig.
 - m. Suction temperature in °F.
 - n. Condenser refrigerant pressure in psig.
 - o. Condenser refrigerant temperature in °F.
 - p. Voltage at each connection.
 - q. Amperage for each phase.
 - r. Kilowatt input.
- I. 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, and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 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, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.

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- c. Fan rpm.
- d. Discharge static pressure in inches wg.
- e. Suction static pressure in inches wg.
- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 - 1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in °F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft.
 - g. Indicated air flow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual air flow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.
- K. Air-Terminal-Device Reports:
 - 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft.
 - 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary air flow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final air flow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in °F.
- L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
 - 1. Unit Data:
 - a. System and air-handling-unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
 - 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Entering-water temperature in °F.
 - c. Leaving-water temperature in °F.
 - d. Water pressure drop in feet of head or psig.
 - e. Entering-air temperature in °F.

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING: continued

- f. Leaving-air temperature in °F.
- M. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:
 - 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Unit make and model number.
 - d. Compressor make.
 - e. Compressor model and serial numbers.
 - f. Refrigerant weight in lb.
 - g. Low ambient temperature cutoff in °F.
 - 2. Test Data (Indicated and Actual Values):
 - a. Inlet-duct static pressure in inches wg.
 - b. Outlet-duct static pressure in inches wg.
 - c. Entering-air, dry-bulb temperature in °F.
 - d. Leaving-air, dry-bulb temperature in °F.
 - e. Condenser entering-water temperature in °F.
 - f. Condenser leaving-water temperature in °F.
 - g. Condenser-water temperature differential in °F.
 - h. Condenser entering-water pressure in feet of head or psig.
 - i. Condenser leaving-water pressure in feet of head or psig.
 - j. Condenser-water pressure differential in feet of head or psig.
 - k. Control settings.
 - l. Unloader set points.
 - m. Low-pressure-cutout set point in psig.
 - n. High-pressure-cutout set point in psig.
 - o. Suction pressure in psig.
 - p. Suction temperature in °F.
 - q. Condenser refrigerant pressure in psig.
 - r. Condenser refrigerant temperature in °F.
 - s. Voltage at each connection.
 - t. Amperage for each phase.
 - u. Kilowatt input.
 - v. Number of fans.
 - w. Condenser fan rpm.
 - x. Condenser fan airflow rate in cfm.
 - y. Condenser fan motor make, frame size, rpm, and horsepower.
 - z. Condenser fan motor voltage at each connection.
 - aa. Condenser fan motor amperage for each phase.
- N. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
 - 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.
 - f. Water flow rate in gpm.

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- g. Water pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
 - 2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig.
 - h. Final total pressure in feet of head or psig.
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.
 - l. VFD frequency.
 - O. Instrument Calibration Reports:
 - 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.
- 3.15 INSPECTIONS:
- A. Initial Inspection:
 - 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
 - 2. Check the following for each system:
 - a. Measure airflow of at least 10% of air outlets.
 - b. Measure water flow of at least 5% of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Verify that balancing devices are marked with final balance position.
 - e. Note deviations from the Contract Documents in the final report.
 - B. Final Inspection:
 - 1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Commissioning Representative.
 - 2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Contracting Officer and Commissioning Representative.

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING: continued

3. [Engineer] [Owner] [Construction Manager] [Commissioning Representative] shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10% of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
 4. 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."
 5. If the number of "FAILED" measurements is greater than 10% of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
1. 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, Contracting Officer may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.
- D. Prepare test and inspection reports.

3.16 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 - MECHANICAL INSULATION

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes mechanical insulation for boiler breeching, duct, equipment, and pipe, including the following:
 - 1. Insulation Materials:
 - a. Flexible elastomeric.
 - b. Mineral fiber.
 - 2. Fire-rated insulation systems.
 - 3. Insulating cements.
 - 4. Adhesives.
 - 5. Mastics.
 - 6. Lagging adhesives.
 - 7. Sealants.
 - 8. Factory-applied jackets.
 - 9. Field-applied jackets.
 - 10. Tapes.
 - 11. Securements.
 - 12. Corner angles.

1.02 REFERENCES:

- A. Applicable Standards (Latest Edition):
 - 1. American Society of Heating, Refrigerating and Air-Conditioning Engineers/Illuminating Engineering Society of North America (ASRAE/IESNA):
 - a. 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - 2. ASTM International (ASTM):
 - a. A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - b. A240 - Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - c. B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
 - d. C195 - Mineral Fiber Thermal Insulating Cement.
 - e. C196 - Expanded or Exfoliated Vermiculite Thermal Insulating Cement.
 - f. C449 - Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - g. C450 - Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
 - h. C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - i. C547 - Mineral Fiber Pipe Insulation.
 - j. C553 - Mineral Fiber Blanket and Thermal Insulation for Commercial and Industrial Applications.
 - k. C612 - Mineral Fiber Block and Board Thermal Insulation.
 - l. C795 - Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - m. C871 - Test Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate, and Sodium Ions.
 - n. C921 - Jackets for Thermal Insulation.
 - o. C1136 - Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
 - p. C1290 - Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.

SECTION 230700 - MECHANICAL INSULATION: continued

- q. C1393 - Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks.
- r. D1644 - Test Methods for Nonvolatile Content of Varnishes.
- s. E84 - Test Method for Surface Burning Characteristics of Building Materials.
- t. E96 - Test Methods for Water Vapor Transmission of Materials.
- 3. Midwest Insulation Contractors Association (MICA):
 - a. National Commercial and Industrial Insulation Standards.
- 4. Military Specifications (MIL):
 - a. A-24179A - Adhesive, Flexible Unicellular-Plastic Thermal Insulation.
 - b. A-3316C - Adhesives, Fire-Resistant, Thermal Insulation.
 - c. C-19565C - Coating Compounds, Thermal Insulation, Fire- and Water-Resistant, Vapor Barrier.
- B. Related Work Specified Elsewhere:
 - 1. Adhesives, sealants, mastics and grouts: SECTION 018113 - SUSTAINABLE DESIGN REQUIREMENTS.

1.03 DEFINITIONS:

- A. ASJ: All-service jacket.
- B. FSK: Foil, scrim, Kraft paper.
- C. PVDC: Polyvinylidene chloride.
- D. SSL: Self-sealing lap.

1.04 SUBMITTALS:

- A. General: Submit each item in this Article in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- C. Shop Drawings: Show details for the following:
 - 1. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 3. Removable insulation at piping specialties, equipment connections, and access panels.
 - 4. Application of field-applied jackets.
 - 5. Application at linkages of control devices.
 - 6. Field application for each equipment type.
 - 7. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.
- D. Installer Certificates: Signed by Contractor certifying that installers comply with requirements.
- E. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- F. Field quality-control inspection reports.
- G. LEED[®] Submittals:
 - 1. Product Data for Credit IEQc4.1: For adhesives, sealants, mastics, grouts and solvent cements installed inside the weatherproofing barrier of the building, submit documentation including manufacturer's printed statement (MSDS Sheet) of VOC content of each product.

SECTION 230700 - MECHANICAL INSULATION: continued

1.05 QUALITY ASSURANCE:

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, 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.

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.
- B. All of the insulation materials and accessories covered by this Specification shall be delivered to the Site and stored in a safe, dry place.
- C. Contractor shall use whatever means necessary to protect the insulation material and accessories before, during, and after installation. No insulation material shall be installed that has become damaged in any way. Contractor shall also use all means necessary to protect work and materials installed by others.
- D. If any insulation material has become wet because of transit or Site exposure to moisture or water, Contractor shall not install such material, and shall remove it from the Site.

1.07 COORDINATION:

- A. Coordinate size and location of supports, hangers, and insulation shields specified in SECTION 230529 - HANGERS AND SUPPORTS.
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.08 SCHEDULING:

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of those listed below or an approved equal.

SECTION 230700 - MECHANICAL INSULATION: continued

2.02 INSULATION MATERIALS:

- A. Refer to Part 3 schedule articles for requirements about 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 C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534, Type I for tubular materials and Type II for sheet materials.
 - 1. Products:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
 - 2. Provide high temperature rated flexible elastomeric insulation where indicated by insulation schedule. High temperature insulation shall be HT Armaflex or approved equal.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II and ASTM C1290, Type II with factory-applied vinyl jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
 - 1. Products:
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; All-Service Duct Wrap.
- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
 - 1. Products:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.
- I. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1,000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.

SECTION 230700 - MECHANICAL INSULATION: continued

2. Type I, 850°F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
- J. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100°F is 0.29 Btu by in./h by sq. ft. by °F or less. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
 1. Products:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.03 INSULATING CEMENTS:

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C195.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.
- D. VOC Content of Cements shall not exceed the requirements listed in SECTION 018113 for the application.

2.04 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 Adhesive: Solvent-based resin adhesive, with a service temperature range of -75 to +300°F.
- C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- F. VOC Content of Adhesives shall not exceed the requirements listed in SECTION 018113 for the application.

2.05 MASTICS:

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 1. Water-Vapor Permeance: ASTM E96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 2. Service Temperature Range: -20 to +180°F.
 3. Solids Content: ASTM D1644, 59% by volume and 71% by weight.
 4. Color: White.
 5. VOC Content of Mastic shall not exceed the requirements listed in SECTION 018113 for the application.

SECTION 230700 - MECHANICAL INSULATION: continued

2.06 LAGGING ADHESIVES:

- A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
 - 1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
 - 2. Service Temperature Range: -50 to +180°F.
 - 3. Color: White.
 - 4. VOC Content of Adhesives shall not exceed the requirements listed in SECTION 018113 for the application.

2.07 SEALANTS:

- A. Joint Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Permanently flexible, elastomeric sealant.
 - 3. Service Temperature Range: -100 to +300°F.
 - 4. Color: White or gray.
- B. FSK and Metal Jacket Flashing Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Fire- and water-resistant, flexible, elastomeric sealant.
 - 3. Service Temperature Range: -40 to +250°F.
 - 4. Color: Aluminum.
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Fire- and water-resistant, flexible, elastomeric sealant.
 - 3. Service Temperature Range: -40 to +250°F.
 - 4. Color: White.
- D. VOC Content of Sealants shall not exceed 250 g/L.

2.08 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 C1136, Type I.
 - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
 - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with Kraft-paper backing; complying with ASTM C1136, Type II.
 - 4. Vinyl Jacket: UL-rated white vinyl with a permeance of 1.3 perms when tested according to ASTM E96, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.09 FIELD-APPLIED JACKETS:

- A. Field-applied jackets shall comply with ASTM C921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with Kraft-paper backing.
- C. Metal Jacket:
 - 1. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Finish and thickness are indicated in field-applied jacket schedules.

SECTION 230700 - MECHANICAL INSULATION: continued

- c. Moisture Barrier for Indoor Applications: 3-mil thick, heat-bonded polyethylene and Kraft paper.
- d. Moisture Barrier for Outdoor Applications: 3-mil thick, heat-bonded polyethylene and Kraft paper or 2.5-mil thick Polysurlyn.
- e. Factory-Fabricated Fitting Covers:
 - (1) Same material, finish, and thickness as jacket.
 - (2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - (3) Tee covers.
 - (4) Flange and union covers.
 - (5) End caps.
 - (6) Beveled collars.
 - (7) Valve covers.
 - (8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.10 TAPES:

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136 and UL-listed.
 - 1. Width: 3 inches.
 - 2. Thickness: 11.5 mils.
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2%.
 - 5. Tensile Strength: 40 lbf/inch in width.
 - 6. 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 C1136 and UL-listed.
 - 1. Width: 3 inches.
 - 2. Thickness: 6.5 mils.
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2%.
 - 5. Tensile Strength: 40 lbf/inch in width.
 - 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL-listed.
 - 1. Width: 2 inches.
 - 2. Thickness: 3.7 mils.
 - 3. Adhesion: 100 ounces force/inch in width.
 - 4. Elongation: 5%.
 - 5. Tensile Strength: 34 lbf/inch in width.

2.11 SECUREMENTS:

- A. Bands:
 - 1. Stainless Steel: ASTM A167 or ASTM A240, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
 - 2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
 - 3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

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- B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated.
 2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 3. 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. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - b. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch diameter shank, length to suit depth of insulation indicated.
 - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 4. 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. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - b. Spindle: Nylon, 0.106-inch diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 5. 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. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - b. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch diameter shank, length to suit depth of insulation indicated.
 - c. Adhesive-backed base with a peel-off protective cover.
 6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
 7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.

2.12 CORNER ANGLES:

- A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

SECTION 230700 - MECHANICAL INSULATION: continued

PART 3 - EXECUTION

3.01 GENERAL:

- A. The configurations of installed insulation and jacketing materials shall comply with the applicable recommendations of the MICA National Commercial and Industrial Insulation Standards (hereinafter referred to as "MICA Standards") and this Specification. In case of conflict, this Specification shall have precedence.

3.02 EXAMINATION:

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 PREPARATION:

- A. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300°F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.04 COMMON 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. All inner layer(s) shall be non-jacketed.
- 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. Vapor seals at butt joints shall be applied at every fourth pipe section joint and at each fitting to provide isolation of water incursion.
 - 2. Install insulation continuously through hangers and around anchor attachments.

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3. 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.
4. 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.
5. 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 1-1/2 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 4 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% 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.

3.05 PENETRATIONS:

- A. 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.

SECTION 230700 - MECHANICAL INSULATION: continued

- 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. Firestopping and fire-resistive joint sealers are specified in SECTION 078413 - THROUGH-PENETRATION FIRESTOP SYSTEMS.
- D. Insulation Installation at Floor Penetrations:
 - 1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 - 2. Seal penetrations through fire-rated assemblies according to SECTION 078413 - THROUGH-PENETRATION FIRESTOP SYSTEMS.

3.06 DUCT AND PLENUM 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% 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.

3.07 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION:

- A. Secure insulation with adhesive and anchor pins and speed washers.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100% coverage of tank and vessel surfaces.
 - 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 - 3. Protect exposed corners with secured corner angles.
 - 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not overcompress insulation during installation.

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- e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. 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.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
 7. Stagger joints between insulation layers at least 3 inches.
 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100% coverage of adhesive to surface with manufacturer's recommended adhesive.
 2. Seal longitudinal seams and end joints.

3.08 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. On vertical runs, insulation support rings shall be used as indicated in MICA's "National Commercial and Industrial Insulation Standards," Plate No. 9.
- C. 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. (MICA Plates No. 10 and 11.)
 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. (MICA Plate No. 13.)

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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. (MICA Plate No. 14.)
 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.
- D. 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.
- E. 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.

SECTION 230700 - MECHANICAL INSULATION: continued

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.
- 3.09 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION:
- A. Seal longitudinal seams and end joints with manufacturers 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 manufacturers 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.
- 3.10 MINERAL-FIBER INSULATION INSTALLATION:
- A. Insulation Installation on Straight Pipes and Tubes:
 1. Secure each layer of preformed pipe 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 surfaces, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below ambient surfaces, 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 mineral-fiber blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

SECTION 230700 - MECHANICAL INSULATION: continued

- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install preformed sections of same material as straight segments of pipe insulation when available.
 - 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed sections of same material as straight segments of pipe insulation when available.
 - 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 - 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 4. Install insulation to flanges as specified for flange insulation application.
- E. 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% 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 1/2-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°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.

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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.
- F. Board 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% 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, space 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. 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 1/2-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°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. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 6. 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.

SECTION 230700 - MECHANICAL INSULATION: continued

3.11 FIELD-APPLIED JACKET INSTALLATION:

- A. 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.

3.12 FINISHES:

- A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in DIVISION 09.
 - 1. Flat Acrylic Finish: Two 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 Engineer. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.13 FIELD QUALITY CONTROL:

- A. Testing Agency: Engage a qualified independent inspecting agency to perform field inspections and prepare inspection reports.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Inspect ductwork, randomly selected by Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each duct system defined in the "Duct Insulation Schedule, General" Article.
 - 2. Inspect field-insulated equipment, randomly selected by Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location 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 Engineer, 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 locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three 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. Remove defective Work.
- D. Install new insulation and jackets to replace insulation and jackets removed for inspection. Repeat inspection procedures after new materials are installed.

3.14 DUCT INSULATION SCHEDULE, GENERAL:

- A. Plenums and Ducts Requiring Insulation:
 - 1. Indoor, concealed return, supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, exposed return located in nonconditioned space.

SECTION 230700 - MECHANICAL INSULATION: continued

- B. Items Not Insulated:
 - 1. Factory-insulated flexible ducts.
 - 2. Factory-insulated plenums and casings.
 - 3. Flexible connectors.
 - 4. Vibration-control devices.
 - 5. Factory-insulated access panels and doors.
 - 6. Exhaust ducts connected to exhaust fans EF-1 and EF-2.

3.15 INDOOR DUCT AND PLENUM INSULATION SCHEDULE:

- A. Round and flat-oval, air duct insulation shall be any of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
- B. Rectangular, air duct insulation shall be any of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
 - 3. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.
- C. Supply-air and return-air plenum insulation shall be any of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
 - 3. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.

3.16 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. Geothermal-water air-separator and expansion tank insulation shall be any of the following:
 - 1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
 - 2. Mineral-Fiber Pipe and Tank: 2 inches thick.

3.17 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. Fire-suppression piping.
 - 2. Below-grade piping.

3.18 INDOOR PIPING INSULATION SCHEDULE:

- A. Domestic Cold Water:
 - 1. All Sizes: Insulation shall be any of the following:
 - a. Flexible Elastomeric: 1/2 inch thick.
 - b. Mineral-Fiber Pipe Insulation, Type I: 1/2 inch thick.
- B. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
 - 1. All Pipe Sizes: Insulation shall be any of the following:
 - a. Flexible Elastomeric: 1/2 inch thick.
 - b. Mineral-Fiber Pipe Insulation, Type I: 1/2 inch thick.

SECTION 230700 - MECHANICAL INSULATION: continued

- C. Condensate and Equipment Drain Water below 60°F:
 - 1. All Pipe Sizes: Insulation shall be any of the following:
 - a. Flexible Elastomeric: 1/2 inch thick.
 - b. Mineral-Fiber Pipe Insulation, Type I: 1/2 inch thick.
- D. Geothermal Water Supply and Return, 200°F and below:
 - 1. NPS 12 and Smaller: Insulation shall be any of the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick.
- E. Refrigerant Suction and Hot-Gas Piping:
 - 1. All Pipe Sizes: Insulation shall be any of the following:
 - a. Flexible Elastomeric: 1/2 inch thick.
- F. Refrigerant Suction and Hot-Gas Flexible Tubing:
 - 1. All Pipe Sizes: Insulation shall be either of the following:
 - a. Flexible Elastomeric: 1/2 inch thick.

3.19 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE:

- A. All outdoor piping shall receive aluminum field applied jacket.
- B. Refrigerant Suction and Hot-Gas Piping:
 - 1. All Pipe Sizes: Insulation shall be any of the following:
 - a. Flexible Elastomeric: 3/4 inch thick.
- C. Refrigerant Suction and Hot-Gas Flexible Tubing:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 3/4 inch thick.

3.20 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. Ducts and Plenums, Concealed:
 - 1. None.
- D. Piping, Concealed:
 - 1. None.

3.21 OUTDOOR, ABOVEGROUND 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, Exposed Refrigerant Piping:
 - 1. Aluminum, Smooth: 0.024 inch thick.

END OF SECTION 230700

SECTION 230900 - HVAC INSTRUMENTATION AND CONTROL

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
- B. Related Work Specified Elsewhere:
 - 1. Electrical metallic tubing materials and installation: SECTION 260533 - RACEWAYS.
 - 2. Electronic and fiber optical cable for control wiring: SECTION 260516 - WIRES AND CABLES.
 - 3. Smoke detectors mounted in HVAC systems and equipment: SECTION 283100 - FIRE ALARM SYSTEMS.
 - 4. See Drawings for sequence of operations.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
 - a. 135 - BACnet-A Data Communication Protocol for Building Automation and Control Networks.
 - 2. Institute of Electrical and Electronics Engineers (IEEE):
 - a. DC3 - Residential Controls-Electrical Wall-Mounted Room Thermostats.
 - 3. National Electrical Manufacturers Association (NEMA)
 - a. DC3 - Residential controls - Electrical Wall-Mounted Room Thermostats.
 - 4. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code.
 - b. 90A - Installation of Air Conditioning and Ventilation Systems.
 - 5. Underwriters Laboratories Inc. (UL):
 - a. 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 - b. 486B - Wire Connectors for Use with Aluminum Conductors.

1.03 DEFINITIONS:

- A. DDC: Direct-Digital Controls.
- B. LAN: Local area network.
- C. MS/TP: Master-slave/token-passing.
- D. PICS: Protocol Implementation Conformance Statement.

1.04 SYSTEM DESCRIPTION:

- A. The heating, ventilating, and air conditioning (HVAC) systems shall be controlled automatically from an internet based Direct Digital Control (DDC) temperature control system. All set points shall be adjustable. Equipment identified as being interlocked shall be software interlocked through the DDC system unless noted otherwise or indicated on the electrical drawings. All installed DDC systems shall be compatible to Johnson Controls Metasys System.
- B. Control system consists of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. State standard for DDC systems is Johnson Controls Metasys System.

SECTION 230900 - HVAC INSTRUMENTATION AND CONTROL: continued

- C. HVAC system shall be installed with an emergency shut-down system. System shall be activated by pressing an "HVAC system emergency shut-down button" clearly labeled and located where shown on the drawings. When the button is pressed, all HVAC systems serving occupied areas of the building shall go into off mode; fans shall de-energize and outside air, intake air and relief air dampers shall close. Emergency shut-off shall communicate to all devices and located in open office, room 102. Refer to drawing M101 for location of emergency shut-off switch. Control panel shall contain "Emergency Shut-down", and "System Reset" buttons and be provided with all relays and contacts required for completed system operation.
- D. Electric meter shall be wired to trend to DDC system and Delaware Army National Guard E-Mon D-Mon systems.

1.05 SUBMITTALS:

- A. General: Submit the following as specified in SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 - 1. Each control device labeled with setting or adjustable range of control.
- C. 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.
 - 1. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 2. Electrical Schematic and Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 - 3. Details of control panel faces, including controls, instruments, and labeling.
 - 4. Written description of sequence of operation.
 - 5. Schedule of dampers including size, leakage, and flow characteristics.
 - 6. Schedule of valves including leakage and flow characteristics.
 - 7. Trunk cable schematic showing programmable control unit locations and trunk data conductors.
 - 8. Listing of connected data points, including connected control unit and input device.
 - 9. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
 - 10. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
- D. ASHRAE BACnet Statement: PICS for each DDC system component (panel, zone controller, field devices, and operator workstation) proposed.
- E. Samples: For each color required, of each type of thermostat cover.
- F. Software and Firmware Operational Documentation: Include the following:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.
 - 5. Software license required by and installed for DDC workstations and control systems.
- G. Software Upgrade Kit: For Owner to use in modifying software to suit future power system revisions or monitoring and control revisions.

SECTION 230900 - HVAC INSTRUMENTATION AND CONTROL: continued

- H. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- I. Maintenance Data: For systems to include in maintenance manuals specified in SECTION 230500. Include the following:
 - 1. Interconnection wiring diagrams with identified and numbered system components and devices.
 - 2. Keyboard illustrations and step-by-step procedures indexed for each operator function.
 - 3. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 - 4. Calibration records and list of set points.
- J. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- K. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.

1.06 QUALITY ASSURANCE:

- A. Installer Qualifications: An experienced installer who is a certified installer of the automatic control system manufacturer for both installation and maintenance of units required for this Project.
- B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.
- C. 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.
- D. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."
- E. Comply with ASHRAE 135 for DDC system control components.
- F. Electronic Equipment Compliance:
 - 1. Contractor warrants that all equipment, devices, items, systems, software, hardware, or firmware provided shall properly, appropriately, and consistently function and accurately process date and time date (including without limitation: calculating, comparing, and sequencing). This warranty supersedes anything in the Specifications or other Contract Documents which might be construed inconsistently. This warranty is applicable whether the equipment, device, item, system, software, hardware, or firmware is specified with or without reference to a manufacturer's name, make, or model number.

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.08 COORDINATION:

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment with SECTION 283100 - FIRE ALARM SYSTEMS to achieve compatibility with equipment that interfaces with that system.
- C. Coordinate supply of conditioned electrical circuits for control units and operator workstation.
- D. Coordinate equipment with DIVISION 26 to achieve compatibility with motor starters and annunciation devices.

SECTION 230900 - HVAC INSTRUMENTATION AND CONTROL: continued

1.09 EXTRA MATERIALS:

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Maintenance Materials: One thermostat adjusting key.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Approved equals may be supplied, controls shall be integrated and compatible to existing State system by Johnson Controls Metasys.

2.02 DDC EQUIPMENT:

- A. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
 - 1. Units monitor or control each input/output point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator station.
 - 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse input/output.
 - c. Monitoring, controlling, or addressing data points.
 - d. Testing and developing control algorithms without disrupting field hardware and controlled environment.
 - 3. Local operator interface provides for download from or upload to mobile operator station.
 - 4. Local connection port for laptop computer.
 - 5. BACnet Conformance: Reside on BACnet LAN in Ethernet IEEE 802.3, Class 3, minimum, with routers between LAN and other panels, with at least one communication port, and have minimum capabilities defined in PICS for the following areas:
 - a. Network.
 - b. Functional groups.
 - c. Standard application services supported.
 - d. Standard objects supported.
- B. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
 - 1. Units monitor or control each input/output point; process information; and download from or upload to operator station.
 - 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse input/output.
 - c. Monitoring, controlling, or addressing data points.
 - 3. Local operator interface provides for download from or upload to mobile operator station.
 - 4. BACnet Conformance: Reside on BACnet LAN using MS/TP, Class 2, minimum, with at least one communication port, and have minimum capabilities defined in PICS for the following areas:
 - a. Network.
 - b. Functional groups.

SECTION 230900 - HVAC INSTRUMENTATION AND CONTROL: continued

- c. Standard application services supported.
- d. Standard objects supported.
- C. Software: Update to latest version of software at Project completion. Include and implement the following capabilities from the control units:
 - 1. Units of Measure: Inch-pound and SI (metric).
 - 2. Load Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, DDC with fine tuning, and trend logging.
 - 3. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
 - 4. Programming Application Features: Include trend point, alarm messages, weekly scheduling, and interlocking.

2.03 CONTROL PANELS:

- A. Central (Master) Control Panels: Fully enclosed, steel-rack-type cabinet with locking doors or locking removable backs. Match finish of panels and provide multicolor graphic displays, schematically showing system being controlled. Include connection port for local laptop computer connection.
- B. Local Control Panels: Unitized cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Provide common keying for all panels.
 - 1. Fabricate panels of 0.06-inch thick, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish.
 - 2. Panel-Mounted Equipment: Temperature and humidity controllers, relays, and automatic switches; except safety devices. Mount devices with adjustments accessible through front of panel.
 - 3. Door-Mounted Equipment: Flush-mount (on hinged door) manual switches, including damper-positioning switches, changeover switches, thermometers, and gages.
 - 4. Graphics: Color-coded graphic, laminated-plastic displays on doors, schematically showing system being controlled, with protective, clear plastic sheet bonded to entire door.
- C. Alarm Panels: Indicating light for each alarm point, single horn, acknowledge switch, and test switch, mounted in hinged-cover enclosure.
 - 1. Alarm Condition: Indicating light flashes and horn sounds.
 - 2. Acknowledge Switch: Horn is silent and indicating light is steady.
 - 3. Second Alarm: Horn sounds and indicating light is steady.
 - 4. Alarm Condition Cleared: System is reset and indicating light is extinguished.
 - 5. Contacts in alarm panel allow remote monitoring by independent alarm company.

2.04 ANALOG CONTROLLERS:

- A. Step Controllers: Six- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.
- B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range -10 to +70°F, and single- or double-pole contacts.
- C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.

SECTION 230900 - HVAC INSTRUMENTATION AND CONTROL: continued

1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.
 - D. Receiver Controllers: Single- or multiple-input models with control-point adjustment, direct or reverse acting with mechanical set-point adjustment with locking device, proportional band adjustment, authority adjustment, and proportional control mode.
 1. Remote-control-point adjustment shall be $\pm 20\%$ of sensor span, input signal of 3 to 13 psig.
 2. Proportional band shall extend from 2 to 20% for 5 psig.
 3. Authority shall be 20 to 200%.
- 2.05 SENSORS:
- A. Electronic Sensors: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
 1. Thermistor temperature sensors as follows:
 - a. Accuracy: $\pm 0.5^\circ\text{F}$ at calibration point.
 - b. Wire: Twisted, shielded-pair cable.
 - c. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
 - d. Averaging Elements in Ducts: 36 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
 - e. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
 - f. Room Sensors: Match room thermostats, locking cover.
 - g. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 - h. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
 2. Resistance Temperature Detectors: Platinum.
 - a. Accuracy: $\pm 0.2\%$ at calibration point.
 - b. Wire: Twisted, shielded-pair cable.
 - c. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
 - d. Averaging Elements in Ducts: 36 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
 - e. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
 - f. Room Sensors: Match room thermostats, locking cover.
 - g. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 - h. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
 3. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
 - a. Accuracy: 2% of full scale with repeatability of 0.5%.
 - b. Output: 4 to 20 mA.
 - c. Building Static-Pressure Range: 0 to 0.25 inch wg.
 - d. Duct Static-Pressure Range: 0 to 5 inches wg.
 4. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; proportional output 4 to 20 mA.

SECTION 230900 - HVAC INSTRUMENTATION AND CONTROL: continued

- B. Equipment operation sensors as follows:
 - 1. Status Inputs for Fans: Differential-pressure switch with adjustable range of 0 to 5 inches wg.
 - 2. Status Inputs for Pumps: Differential-pressure switch piped across pump with adjustable pressure-differential range of 8 to 60 psig.
 - 3. Status Inputs for Electric Motors: Current-sensing relay with current transformers, adjustable and set to 175% of rated motor current.
- C. Electronic Valve/Damper Position Indication: Visual scale indicating percent of travel and 2- to 10Vdc, feedback signal.
- D. Carbon-Dioxide Sensor and Transmitter: Single detectors, using solid-state infrared sensors, suitable over a temperature range of 23 to 130°F, calibrated for 0 to 2%, with continuous or averaged reading, 4 to 20 mA output, and wall mounted. Mount at same height as room thermostat.
- E. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment, for flush mounting.
- F. Airflow Measuring Stations: Insertion probes with duct mounting hardware. Airflow accuracy shall be $\pm 3\%$ up to 5,000 feet per minute. Transmitter shall have BACnet compatible output, 24Vac power. Stations shall be Ebtron Model GTL116-PC or approved equal.

2.06 THERMOSTATS:

- A. Combination Thermostat and Fan Switches: Line-voltage thermostat with two-, three-, or four-position, push-button or lever-operated fan switch.
 - 1. Label switches "FAN ON-OFF," "FAN HIGH-LOW-OFF," "FAN HIGH-MED-LOW-OFF." Provide unit for mounting on two-gang switch box.
- B. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater.
- C. Room Thermostat Cover Construction: Manufacturer's standard locking covers.
 - 1. Set-Point Adjustment: Provide limited set-point adjustment and occupancy override button.
 - 2. Set-Point Indication: Concealed.
 - 3. Thermometer: Concealed.
 - 4. Color: White.
 - 5. Orientation: Vertical.
- D. Room thermostat accessories include the following:
 - 1. Insulating Bases: For thermostats located on exterior walls.
 - 2. Adjusting Key: As required for calibration and cover screws.
- E. Set-Point Adjustment: 2°F maximum differential.
- F. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type, with adjustable set point in middle of range and adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.
- G. Electric Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
 - 1. Bulb Length: Minimum 20 feet.
 - 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
- H. Electric High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.
 - 1. Bulb Length: Minimum 20 feet.

SECTION 230900 - HVAC INSTRUMENTATION AND CONTROL: continued

2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
 - I. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig, and cast housing with position indicator and adjusting knob.
- 2.07 HUMIDISTATS:
- A. Duct-Mounted Humidistats: Electric insertion, 2-position type with adjustable 2% throttling range, 20 to 80% operating range, single- or double-pole contacts.
- 2.08 ACTUATORS:
- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
 1. Comply with requirements in SECTION 230513 - MOTORS.
 2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 3. Nonspring-Return Motors for Valves Larger than NPS 2-1/2: Size for running torque of 150 inches by lbf and breakaway torque of 300 inches by lbf.
 4. Spring-Return Motors for Valves Larger than NPS 2-1/2: Size for running and breakaway torque of 150 inches by lbf.
 5. Nonspring-Return Motors for Dampers Larger than 25 Sq. Ft.: Size for running torque of 150 inches by lbf and breakaway torque of 300 inches by lbf.
 6. Spring-Return Motors for Dampers Larger than 25 Sq. Ft.: Size for running and breakaway torque of 150 inches by lbf.
 - B. Electronic Damper Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
 1. Valves: Size for torque required for valve close-off at maximum pump differential pressure.
 2. Dampers: Size for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-pounds/sq. ft. of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-pounds/sq. ft. of damper.
 - c. Parallel-Blade Damper without Edge Seals: 4 inch-pounds/sq. ft. of damper.
 - d. Opposed-Blade Damper without Edge Seals: 3 inch-pounds/sq. ft. of damper.
 - e. Dampers with 2 to 3 Inches wg of Pressure Drop or Face Velocities of 1,000 to 2,500 FPM: Multiply the minimum full-stroke cycles above by 1.5.
 - f. Dampers with 3 to 4 Inches wg of Pressure Drop or Face Velocities of 2,500 to 3,000 FPM: Multiply the minimum full-stroke cycles above by 2.0.
 3. Coupling: V-bolt and V-shaped, toothed cradle.
 4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.
 6. Power Requirements (Two-Position Spring Return): 24Vac.
 7. Power Requirements (Modulating): Maximum 10 VA at 24Vac or 8 W at 24Vdc.
 8. Proportional Signal: 2- to 10Vdc or 4 to 20 mA, and 2- to 10Vdc position feedback signal.
 9. Temperature Rating: -22 to +122°F.
 10. Temperature Rating (Smoke Dampers): -22 to +250°F.
 11. Run Time: 12 seconds open, 5 seconds closed.

SECTION 230900 - HVAC INSTRUMENTATION AND CONTROL: continued

2.09 CONTROL VALVES:

A. Control Valves.

1. General. Select body and trim materials in accordance with manufacturer's recommendations for design conditions and service shown.
2. Type. Provide two- or three-way control valves for two-position or modulating service as shown.
3. Water Valves.
 - a. Valves providing two-position service shall be quick opening. Two-way valves shall have replaceable disc or ball.
 - b. Close-off (Differential) Pressure Rating. Valve actuator and trim shall provide the following minimum close-off pressure ratings.
 - (1) Two-way: 150% of total system (pump) head.
 - (2) Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
 - c. Ports. Valves providing modulating service shall have equal percentage ports.
 - d. Sizing.
 - (1) Two-position service: As indicated on schedules.
 - (2) Two-way modulating service: Select pressure drop equal to the greatest of twice the pressure drop through heat exchanger (load), 50% if the pressure difference between supply and return mains, or 5 psi.
 - (3) Three-way modulating service: Select pressure drop equal to the smaller or twice the pressure drop through the coil exchanger (load) or 5 psi.
 - e. Fail Position. Water valves shall fail normally open or closed as follows unless otherwise specified.
 - (1) Geothermal water zone valves: Normally open.
 - (2) Other applications: As scheduled or as required by sequences of operation.

B. Terminal Unit Control Valves: Bronze body, bronze trim, two- or three-port as indicated, replaceable plugs and seats, union and threaded ends.

1. Rating: Class 125 for service at 125 psig and 250°F operating conditions.
2. Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.
3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

2.10 DAMPERS:

A. Dampers: AMCA-rated, parallel or opposed-blade design; 0.1084-inch minimum, galvanized-steel frames with holes for duct mounting; damper blades shall not be less than 0.0635-inch galvanized steel with maximum blade width of 8 inches.

1. Blades shall be secured to 1/2-inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From -40 to +200°F.
3. For standard applications, include optional closed-cell neoprene edging.

2.11 CONTROL CABLE:

A. Electronic and Fiber-Optic Cable for Control Wiring: As specified in SECTION 260516 - WIRES AND CABLES.

SECTION 230900 - HVAC INSTRUMENTATION AND CONTROL: continued

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Verify that conditioned power supply is available to control units.
- B. Verify that duct-, pipe-, and equipment-mounted devices and wiring are installed before proceeding with installation.

3.02 INSTALLATION:

- A. Install equipment level and plumb.
- B. Install software in control units. Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- C. Connect and configure equipment and software to achieve sequence of operation specified.
- D. Verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate all 60 inches above the floor.
 - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- E. Install guards on thermostats in the following locations:
 - 1. Entrances.
 - 2. Public areas.
 - 3. Where indicated.
- F. Install automatic dampers according to SECTION 233300 - DUCT ACCESSORIES.
- G. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- H. Install labels and nameplates to identify control components according to SECTION 230553 - MECHANICAL IDENTIFICATION.
- I. Install hydronic instrument wells, valves, and other accessories according to SECTION 232113 - HYDRONIC PIPING.
- J. Install refrigerant instrument wells, valves, and other accessories according to SECTION 232300 - REFRIGERANT PIPING.
- K. Install duct volume-control dampers according to DIVISION 23 Sections specifying air ducts.
- L. Install electronic and fiber-optic cables according to SECTION 260516 - WIRES AND CABLES.

3.03 ELECTRICAL WIRING AND CONNECTION INSTALLATION:

- A. Install raceways, boxes, and cabinets according to SECTION 260553 - RACEWAYS.
- B. Install building wire and cable according to SECTION 260516 -WIRES AND CABLES.
- C. Install signal and communication cable according to SECTION 260516 -WIRES AND CABLES.
 - 1. Conceal raceways, except in mechanical rooms and areas where other conduit and piping are exposed.
 - 2. Install cable in raceway.
 - 3. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 - 4. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 - 5. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
 - 6. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

SECTION 230900 - HVAC INSTRUMENTATION AND CONTROL: continued

- D. Connect hand-off-auto selector switches to override automatic interlock controls (but not safety interlocks) when switch is in hand position.

3.04 CONNECTIONS:

- A. Piping installation requirements are specified in other DIVISION 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
 - 1. Install piping adjacent to machine to allow service and maintenance.
- B. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.05 FIELD QUALITY CONTROL:

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.
 - 3. Calibration test electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
- B. Engage a factory-authorized service representative to perform startup service.
- C. Replace damaged or malfunctioning controls and equipment.
 - 1. Start, test, and adjust control systems.
 - 2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
 - 3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.
- D. Verify DDC as follows:
 - 1. Verify software including automatic restart, control sequences, scheduling, reset controls, and occupied/unoccupied cycles.
 - 2. Verify local control units including self-diagnostics.

3.06 DEMONSTRATION:

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control systems and components.
 - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
 - 2. Provide operator training on data display, alarm and status descriptors, requesting data, executing commands, calibrating and adjusting devices, resetting default values, and requesting logs. Include a minimum of 40 hours' dedicated instructor time on-site.
 - 3. Review data in maintenance manuals. Refer to SECTION 230500.
 - 4. Schedule training with Owner, through Engineer, with at least seven days' advance notice.
 - 5. Comply with training requirements in SECTION 017900 - DEMONSTRATION AND TRAINING.

END OF SECTION 230900

SECTION 230910 MECHANICAL SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The purpose of this section is to specify Division 23 responsibilities in the commissioning (Cx) process.
- B. The systems to be commissioned are listed in Section 019113, Part 1.6.
- C. Commissioning (Cx) requires the participation of Division 23 to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Section 019113. Division 23 shall be familiar with all parts of Section 019113 and the Commissioning Plan issued by the Commissioning Authority (CA) and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

1.2 RESPONSIBILITIES

- A. Mechanical, Building Automation System (BAS) and Testing, Adjusting, and Balancing (TAB) Contractors.

The commissioning responsibilities applicable to each of the Mechanical, Building Automation System (BAS) and Testing, Adjusting and Balancing (TAB) Contractors of Division 23 are as follows (all references apply to commissioned equipment only):

Construction and Acceptance Phases

1. Include the cost of commissioning in the contract price.
2. Attend a commissioning scoping meeting and additional meetings necessary to facilitate the Commissioning (Cx) process.
3. Contractors shall provide the CA with detailed cut sheets and shop drawing submittals of commissioned equipment.
4. Provide a copy of the preliminary O&M manuals and submittals of commissioned equipment, through normal channels, to the CA for review.
5. Contractors shall assist the CA in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
6. Mechanical, BAS, and TAB Contractors shall assist the CA in preparing the specific functional performance test procedures. Subs shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
7. Develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the pre-functional checklists for all commissioned equipment.
8. During the startup and initial checkout process, execute the mechanical-related portions of the pre-functional checklists for all commissioned equipment.
9. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CA.
10. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air- or water-related systems.

SECTION 230910 MECHANICAL SYSTEMS COMMISSIONING: continued

11. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
 12. Correct deficiencies (differences between specified and observed performance) as interpreted by the Engineer and CA & retest the equipment.
 13. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
 14. During construction, maintain as-built red-line drawings for all drawings and final as-builts for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing).
 15. Provide training of the Owner's operating staff using expert qualified personnel, as specified.
 16. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
- B. Mechanical Contractor. The responsibilities of the HVAC Mechanical Contractor, during construction and acceptance phases in addition to those listed in (A) are:
1. Provide startup for all HVAC equipment, except for the building automation control system.
 2. Assist and cooperate with the TAB contractor and CA by putting all HVAC equipment and systems into operation and continuing the operation during each working day of TAB and commissioning, as required.
 3. Prepare a preliminary schedule for Division 23 pipe and duct system testing, flushing and cleaning, equipment start-up and TAB start and completion for use by the CA. Update the schedule as appropriate.
- C. BAS Contractor. The commissioning responsibilities of the BAS Contractor, during construction and acceptance phases in addition to those listed in (A) are:
1. Sequences of Operation Submittals. The BAS Contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. They shall include:
 - a. An overview narrative of the system (1 or 2 paragraphs) generally describing its purpose, components and function.
 - b. All interactions and interlocks with other systems.
 - c. Detailed delineation of control between any packaged controls and the building automation system, listing what points the BAS monitors only and what BAS points are control points and are adjustable.
 - d. Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included, but will generally require additional narrative).
 - e. Start-up sequences.
 - f. Warm-up mode sequences.
 2. Normal operating mode sequences.
 3. Unoccupied mode sequences.
 4. Shutdown sequences.
 5. Capacity control sequences and equipment staging.

SECTION 230910 MECHANICAL SYSTEMS COMMISSIONING: continued

- a. Temperature and pressure control: setbacks, setups, resets, etc.
- b. Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
- c. Effects of power or equipment failure with all standby component functions.
- d. Sequences for all alarms and emergency shut downs.
- e. Seasonal operational differences and recommendations.
- f. Initial and recommended values for all adjustable settings, set points and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
- g. Schedules, if known.

D. Control Drawings Submittal

1. The control drawings shall have a key to all abbreviations.
2. The control drawings shall contain graphic schematic depictions of the systems and each component.
3. The schematics will include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
4. Provide a full points list with at least the following included for each point:
 - a. Controlled system
 - b. Point abbreviation
 - c. Point description
 - d. Display unit
 - e. Control point or setpoint (Yes / No)
 - f. Monitoring point (Yes / No)
 - g. Intermediate point (Yes / No)
 - h. Calculated point (Yes / No)

Key:

Point Description: DB temp, airflow, etc.

Control or Setpoint: Point that controls equipment and can have its setpoint changed (OSA, SAT, etc.)

Intermediate Point: Point whose value is used to make a calculation which then controls equipment (space temperatures that are averaged to a virtual point to control reset).

Monitoring Point: Point that does not control or contribute to the control of equipment, but is used for operation, maintenance, or performance verification.

Calculated Point: "Virtual" point generated from calculations of other point values.

The BAS Contractor shall keep the CA informed of all changes to this list during programming and setup.

- E. The BAS Contractor shall provide an updated, as-built version of the control drawings and sequences of operation. These documents shall be included in the final controls O&M manual submittal.
- F. The BAS Contractor shall assist and cooperate with the TAB contractor in the following manner:

SECTION 230910 MECHANICAL SYSTEMS COMMISSIONING: continued

1. Meet with the TAB contractor prior to beginning TAB and review the TAB Plan to determine the capabilities of the control system toward completing TAB. Provide the TAB any needed unique instruments for setting terminal unit boxes and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.).
 2. For a given area, have all required pre functional checklists, calibrations, startup and selected functional tests of the system completed and approved by the CA prior to TAB.
 3. Provide a qualified technician to operate the BAS to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.
- G. Control system checkout and testing by the BAS Contractor shall be performed in the following manner:
1. Startup Testing: All testing listed in this section shall be performed by the BAS Contractor and shall make up part of the necessary verification of the operating control system. This testing shall be completed before the Owner's Representative is notified that the system is ready for demonstration.
 2. The BAS Contractor shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.
 3. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that all terminations are tight.
 4. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures per manufacturer's recommendations.
 5. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.
 6. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The Contractor shall check all control valves and automatic dampers to ensure proper action and closure. The Contractor shall make any necessary adjustments to valve stem and damper blade travel.
 7. Verify that the system operation adheres to the Sequence of Operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimum Start/Stop routines.
 8. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
 9. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
 10. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.
- H. The BAS Contractor shall prepare a written plan indicating in a step-by-step manner, the procedures that will be followed to test, checkout and adjust the control system prior to functional performance testing, according to the process in Section 019113. At minimum, the plan shall include for each type of equipment controlled by the automatic controls:
1. System name.
 2. List of devices.
 3. Step-by-step procedures for testing each controller after installation, including:

SECTION 230910 MECHANICAL SYSTEMS COMMISSIONING: continued

- a. Process of verifying proper hardware and wiring installation.
 - b. Process of downloading programs to local controllers and verifying that they are addressed correctly.
 - c. Process of performing operational checks of each controlled component.
 - d. Plan and process for calibrating valve and damper actuators and all sensors.
 - e. A description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
4. A copy of the log and field checkout sheets that will document the process. This log must include a place for initial and final read values during calibration of each point and clearly indicate when a sensor or controller has “passed” and is operating within the contract parameters.
 5. A description of the instrumentation required for testing.
 6. Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the CA and TAB contractor for this determination.
 7. List and clearly identify on the as-built duct and piping drawings the locations of all static and differential pressure sensors (air, water and building pressure).
- I. TAB Contractor. The duties of the TAB contractor, in addition to those listed in (A) are:
1. Submit the outline of the TAB Plan and approach for each system and component to the CA for review and comments. This Plan will be developed after the TAB has some familiarity with the control system. The CA shall prepare a TAB Verification Test Plan based on these documents.
 2. The submitted plan will include:
 - a. Certification that the TAB contractor has reviewed the construction documents and the systems with the design engineers and contractors to sufficiently understand the design intent for each system.
 - b. An explanation of the intended use of the building control system. The controls contractor will comment on feasibility of the plan.
 - c. All field checkout sheets and logs to be used that list each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - e. Final test report forms to be used.
 - f. Detailed step-by-step procedures for TAB work for each system and issue: terminal flow calibration (for each terminal type), diffuser proportioning, branch /submain proportioning, total flow calculations, rechecking, diversity issues, expected problems and solutions, etc. Criteria for using air flow straighteners or relocating flow stations and sensors will be discussed. Provide the analogous explanations for the water side.
 - g. List of all airflow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - h. Details of how *total* flow will be determined (Air: sum of terminal flows via BAS calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations. Water: pump curves, circuit setter, flow station, ultrasonic, etc.).
 - i. The identification and types of measurement instruments to be used and their most recent calibration date.

SECTION 230910 MECHANICAL SYSTEMS COMMISSIONING: continued

- j. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and provide methods to verify this.
 - k. Confirmation that TAB understands the outside air ventilation criteria under all conditions.
 - l. Details of whether and how minimum outside air cfm will be verified and set and for what level (total building, zone, etc.).
 - m. Details of how building static and exhaust fan / relief damper capacity will be checked.
 - n. Proposed selection points for sound measurements and sound measurement methods.
 - o. Details of methods for making any specified coil or other system plant capacity measurements.
 - p. Details of any TAB work to be done in phases (by floor, etc.), or of areas to be built out later.
 - q. Details regarding specified deferred or seasonal TAB work.
 - r. Details of any specified false loading of systems to complete TAB work.
 - s. Details of all exhaust fan balancing and capacity verifications, including any required room pressure differentials.
 - t. Details of any required differential pressure measurements and calculations.
 - u. Plan for hand-written field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests.
 - v. Plan for formal progress reports (scope and frequency).
 - w. Plan for formal deficiency reports (scope, frequency and distribution).
- 3. A running log of events and issues shall be kept by the TAB field technicians. Submit hand-written reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests to the CA at least once a week.
 - 4. Communicate in writing to the BAS Contractor all setpoint and parameter changes made or problems and discrepancies identified during TAB which affect the control system set-up and operation.
 - 5. Provide a draft TAB report within two weeks of completion. A copy will be provided to the CA for his review and comments. The CA shall verify 10% of the data contained in the draft TAB report. The report will contain a full explanation of the methodology, assumptions and the results in a clear format with designations of all uncommon abbreviations and column headings. The report should follow the latest and most rigorous reporting recommendations by AABC, NEBB or ASHRAE Standard 111.
 - 6. Provide a final TAB report for the CA with details, as in the draft.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 QUALITY CONTROL

- A. See appropriate testing forms.

3.2 STARTUP

SECTION 230910 MECHANICAL SYSTEMS COMMISSIONING: continued

- A. The HVAC Mechanical and BAS Contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in 019113. Division 23 has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the CA, CM, or Owner.
- B. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the CA. Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all pre-functional checklists as soon as possible.

3.3 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

- A. Demonstration
 - 1. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the BAS Contractor has completed the installation, started up the system, and performed its own tests.
 - 2. The tests described in this section are to be performed in addition to the tests that the BAS Contractor performs as a necessary part of the installation, startup, and debugging process. The CA will be present to observe and review these tests. The CA shall be notified at least two (2) days in advance of the start of these functional testing procedures.
 - 3. The approved checklists and forms for the pre-functional testing shall be completed for all systems prior to the beginning of these functional tests.
 - 4. The BAS Contractor shall provide at least two persons with two-way communication, and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose of this test is to demonstrate the calibration, response, and action of every point and system. Any test equipment required to prove the proper operation shall be provided by and operated by the Contractor.
 - 5. As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed. A copy of this log shall be provided to the CA at the end of this functional testing.
 - 6. The BAS Contractor shall demonstrate compliance with Sequence of Operation through all modes of operation.
 - 7. Demonstrate the complete operation of the Operator Interface.
 - 8. The BAS Contractor shall demonstrate the HVAC interface to the building fire alarm system.
 - 9. The individual HVAC equipment supplier shall commission any device supplied by others, but connected to this Building Automation System (BAS), and verification of the interface interoperability shall be by this BAS Contractor (e.g. stand alone controllers that are monitored only by the BAS system).
 - 10. Any tests that fail to demonstrate the operation of this system shall be repeated at a later date. The BAS Contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.
- B. Acceptance

SECTION 230910 MECHANICAL SYSTEMS COMMISSIONING: continued

1. All tests described in this specification shall have been performed to the satisfaction of both the CA and Owner prior to the acceptance of the control system as meeting the requirements of Completion. Any tests that cannot be performed due to circumstances beyond the control of the BAS Contractor may be exempt from the Completion requirements if stated in writing by the CA. Such tests shall then be performed as part of the warranty.
2. The system shall not be accepted until the functional testing forms have been completed and signed by the CA.

3.4 OPERATION AND MAINTENANCE (O&M) MANUALS

- A. The following O&M manual requirements do not replace O&M manual documentation requirements elsewhere in these specifications.
- B. Division 23 shall compile and prepare documentation for all equipment and systems covered in Division 23 and deliver this documentation to the CA for inclusion in the O&M manuals, according to this section, prior to the training of owner personnel.
- C. Special TAB Documentation Requirements. The TAB will compile and submit the following with other documentation that may be specified elsewhere in the Specifications.
 1. Final report containing an explanation of the methodology, assumptions, test conditions and the results in a clear format with designations of all uncommon abbreviations and column headings.
 2. The TAB shall mark on the drawings where all traverse and other critical measurements were taken and cross reference the location in the TAB report.

3.5 TRAINING OF OWNER PERSONNEL

- A. The CA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment. Refer to Section 019113 for additional details.
- B. Mechanical Contractor. The mechanical contractor shall have the following training responsibilities:
 1. Provide the CA with a training plan two weeks before the planned training.
 2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of HVAC equipment including, but not limited to, pumps, heating equipment, air conditioning units, fans, terminal units, controls and water treatment systems, etc.
 3. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
 4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
 5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical build-

SECTION 230910 MECHANICAL SYSTEMS COMMISSIONING: continued

ing operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.

6. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
7. Training shall include:
 - a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
 - b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shutdown, seasonal changeover and any emergency procedures.
 - c. Discussion of relevant health and safety issues and concerns.
 - d. Discussion of warranties and guarantees.
 - e. Common troubleshooting problems and solutions.
 - f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.
 - g. Discussion of any peculiarities of equipment installation or operation.
8. Hands-on training shall include start-up, operation in all modes possible, including manual, shutdown and any emergency procedures and preventative maintenance for all pieces of equipment.
9. The Mechanical Contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.
10. Training shall occur after functional testing is complete, unless approved otherwise by the CA.

C. BAS Contractor. The BAS Contractor shall have the following training responsibilities:

1. Provide the CA with a training plan two weeks before the planned training.
2. The BAS Contractor shall provide designated Owner personnel training on the control system in this facility. The intent is to clearly and completely instruct the Owner's facility personnel on all the capabilities of the control system.
3. Training manuals. The standard operating manual for the system and any special training manuals will be provided for each trainee, with three extra copies left for the O&M manuals. In addition, copies of the system technical manual will be demonstrated during training and three copies submitted with the O&M manuals. Manuals shall include detailed description of the subject matter for each session. The manuals will cover all control sequences and have a definitions section that fully describes all relevant words used in the manuals and in all software displays.
4. The trainings will be tailored to the needs and skill-level of the trainees.
5. The trainers will be knowledgeable on the system and its use in buildings. For the on-site sessions, the most qualified trainer(s) will be used.
6. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
7. There shall be two training sessions:

SECTION 230910 MECHANICAL SYSTEMS COMMISSIONING: continued

- a. Training I. Control System. This training may be held on-site or in the supplier's facility. If held off-site, the training may occur prior to final completion of the system installation. Upon completion, each trainee, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.
- b. Training II. Building Systems. The second session shall be held on-site for actual hands-on training after the completion of system commissioning. The session shall include instruction on:
 - 1) Specific hardware configuration of installed systems in this building and specific instruction for operating the installed system, including HVAC systems, Automatic Temperature Controls and any interfaces to the building Fire Alarm System.
 - 2) Alarms, system start-up, shut-down, power outage and restart routines, changing set points and alarms and other typical changed parameters, overrides, manual operation of equipment, optional control strategies that can be considered, and set points that if changed will adversely affect energy consumption.
 - 3) Every screen shall be completely discussed, allowing time for questions. Use of remote access to the system via phone lines or networks shall be covered in detail. Graphics generation, trending, and point database entry and modifications shall be discussed.

END OF SECTION 230910

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Geothermal water piping inside the building.
 - 2. Makeup-water piping.
 - 3. Condensate-drain piping.
 - 4. Air-vent piping.
 - 5. Safety-valve-inlet and -outlet piping.
- B. Related Work Specified Elsewhere:
 - 1. Pumps, motors, and accessories for hydronic piping: SECTION 232123 - HYDRONIC PUMPS.
 - 2. For Geothermal water piping located outside the building: SECTION 232114 - OUTDOOR GEOTHERMAL PIPING.

1.02 REFERENCES:

- A. Applicable Standards (Latest Edition):
 - 1. American Welding Society (AWS):
 - a. D.1 - Structural Welding Code - Steel.
 - b. D10.12 - Guide for Welding Mild Steel Pipe.
 - 2. ASME International (ASME):
 - a. B1.20.1 - Pipe Threads, General Purpose, Inch.
 - b. B16.1 - Cast-Iron Pipe Flanges and Flanged Fittings.
 - c. B16.3 - Malleable Iron Threaded Fittings.
 - d. B16.4 - Cast Iron Threaded Fittings.
 - e. B16.5 - Pipe Flanges and Flanged Fittings, NPS 1/2 to NPS 24.
 - f. B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges.
 - g. B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - h. B16.39 - Malleable Iron Threaded Pipe Unions.
 - i. B18.2.1 - Square and Hex Bolts and Screws - Inch Series.
 - j. B31 - Code for Pressure Piping.
 - k. B31.9 - Building Services Piping.
 - l. Boiler and Pressure Vessel Code: Section IV, "Heating Boilers;" Section VIII, "Pressure Vessels," Division 1; Section IX, "Welding and Brazing Qualifications."
 - 3. ASTM International (ASTM):
 - a. A47 - Ferritic Malleable Iron Castings.
 - b. A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - c. A106 - Seamless Carbon Steel Pipe for High-Temperature Service.
 - d. A126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - e. A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Services.
 - f. A536 - Ductile Iron Castings.
 - g. A733 - Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples.
 - h. B32 - Solder Metal.
 - i. B75 - Seamless Copper Tube.
 - j. B88 - Seamless Copper Water Tube.
 - k. B584 - Copper Alloy Sand Castings for General Applications.

SECTION 232113 - HYDRONIC PIPING: continued

- l. B813 - Liquid and Paste Fluxes for Solder Applications of Copper and copper Alloy Tube.
 - m. B828 - Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
 4. Copper Development Association Inc. (CDA):
 - a. Copper Tube Handbook.
 5. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
 - a. SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture.
- 1.03 DEFINITIONS:
- A. PTFE: Polytetrafluoroethylene.
- 1.04 PERFORMANCE REQUIREMENTS:
- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
 1. Geothermal Water Piping: 175 psig at 200°F.
 2. Makeup-Water Piping: 80 psig at 150°F.
 3. Condensate-Drain Piping: 150°F.
 4. Air-Vent Piping: 200°F.
 5. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.
- 1.05 SUBMITTALS:
- A. General: Submit each item in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
 - B. 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. Hydronic specialties.
 - C. Shop Drawings: Detail, at 1/4 (1:50) scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
 - D. Welding certificates.
 - E. Qualification Data: For Installer.
 - F. Field quality-control test reports.
 - G. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.
- 1.06 QUALITY ASSURANCE:
- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1.
 - B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 1. Comply with provisions in ASME B31.
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
 - C. ASME Compliance: Comply with ASME B31.9 for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp

SECTION 232113 - HYDRONIC PIPING: continued

air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1.07 EXTRA MATERIALS:

- A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

PART 2 - PRODUCTS

2.01 COPPER TUBE AND FITTINGS:

- A. Drawn-Temper Copper Tubing: ASTM B88, Type L.
- B. Wrought-Copper Fittings: ASME B16.22.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide a product by one of the following or an approved equal:
 - a. Anvil International, Inc.
 - b. S. P. Fittings; a division of Star Pipe Products.
 - c. Victaulic Company of America.
 - 2. Grooved-End Copper Fittings: ASTM B75, copper tube or ASTM B584, bronze casting.
 - 3. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, prelubricated EPDM gasket rated for minimum 230°F for use with housing, and steel bolts and nuts.
- C. Wrought-Copper Unions: ASME B16.22.

2.02 STEEL PIPE AND FITTINGS:

- A. Steel Pipe: ASTM A53, 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-Steel Fittings: ASTM A234, wall thickness to match adjoining pipe.
- G. 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.
- H. Grooved Mechanical-Joint Fittings and Couplings:
 - 1. Basis of Design Product: Subject to compliance with requirements, provide a product by one of the following or an approved equal:
 - 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.

SECTION 232113 - HYDRONIC PIPING: continued

2. Joint Fittings: ASTM A536, Grade 65-45-12 ductile iron; ASTM A47, Grade 32510 malleable iron; ASTM A53, Type F, E, or S, Grade B fabricated steel; or ASTM A106, 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.
- I. Steel Pipe Nipples: ASTM A733, made of same materials and wall thicknesses as pipe in which they are installed.

2.03 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, 1/8-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 B32, lead-free alloys. Include water-flushable flux according to ASTM B813.
- D. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.04 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 - 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.
 2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180°F.
- D. Dielectric Flanges:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

SECTION 232113 - HYDRONIC PIPING: continued

- E. Dielectric-Flange Kits:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 3. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 - a. Calpico, Inc.
 - b. Lochinvar Corporation.
 - 2. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225°F.
- G. Dielectric Nipples:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 - a. Perfection Corporation; a subsidiary of American Meter Company.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Victaulic Company of America.
 - 2. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225°F.

2.05 VALVES:

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in SECTION 230523 - VALVES.
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in SECTION 230900 - HVAC INSTRUMENTATION AND CONTROLS.
- C. Bronze, Calibrated-Orifice, Balancing Valves:
 - 1. Basis of Design Product: Subject to compliance with requirements, provide a product by one of the following or an approved equal:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - 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.

SECTION 232113 - HYDRONIC PIPING: continued

9. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 250°F.
- D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:
 1. Basis of Design Product: Subject to compliance with requirements, provide a product by one of the following or an approved equal:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - c. Griswold Controls.
 - d. Taco.
 2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
 3. Ball: Brass or stainless steel.
 4. Stem Seals: EPDM O-rings.
 5. Disc: Glass and carbon-filled PTFE.
 6. Seat: PTFE.
 7. End Connections: Flanged or grooved.
 8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 9. Handle Style: Lever, with memory stop to retain set position.
 10. CWP Rating: Minimum 125 psig.
 11. Maximum Operating Temperature: 250°F.
- E. Diaphragm-Operated Safety Valves:
 1. Basis of Design Product: Subject to compliance with requirements, provide product by one of the following or an approved equal:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - c. Conbraco Industries, Inc.
 - d. 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. Wetted, Internal Work Parts: Brass and rubber.
 8. Inlet Strainer: Removable without system shutdown.
 9. Valve Seat and Stem: Noncorrosive.
 10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

2.06 AIR CONTROL DEVICES:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 1. Amtrol, Inc.
 2. Armstrong Pumps, Inc.
 3. Bell & Gossett Domestic Pump; a division of ITT Industries.
 4. Taco.
- B. Manual Air Vents:
 1. Body: Bronze.
 2. Internal Parts: Nonferrous.

SECTION 232113 - HYDRONIC PIPING: continued

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°F.
- C. Automatic Air Vents:
1. Body: Bronze or cast iron.
 2. Internal Parts: Nonferrous.
 3. Operator: Noncorrosive metal float.
 4. Inlet Connection: NPS 1/2.
 5. Discharge Connection: NPS 1/4.
 6. CWP Rating: 150 psig.
 7. Maximum Operating Temperature: 240°F.
- D. Bladder-Type Expansion Tanks:
1. Tank: Welded steel, rated for 125-psig working pressure and 375°F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 2. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
 3. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.
- E. Tangential-Type Air Separators:
1. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 375°F maximum operating temperature.
 2. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
 3. Tangential Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
 4. Blowdown Connection: Threaded.
 5. Size: Match system flow capacity.

2.07 HYDRONIC PIPING SPECIALTIES:

- A. Y-Pattern Strainers:
1. Body: ASTM A126, 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: 40-mesh startup strainer and perforated stainless-steel basket with 50% 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°F.

SECTION 232113 - HYDRONIC PIPING: continued

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS:

- A. Geothermal water piping, aboveground, NPS 2 and smaller, shall be any of the following:
 - 1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered or pressure-seal joints.
 - 2. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- B. Geothermal water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
 - 1. Type L (B), 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.
 - 3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
- C. Makeup-water piping installed aboveground shall be the following:
 - 1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- D. Condensate-Drain Piping: Type M (C), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- E. Air-Vent Piping:
 - 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
 - 2. Outlet: Type L (B), annealed-temper copper tubing with soldered or flared joints.
- F. Safety-Valve-Inlet and -Outlet Piping for 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.

3.02 VALVE APPLICATIONS:

- A. Install shut-off-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- B. Install calibrated-orifice, balancing valves at each branch connection to return main.
- C. Install calibrated-orifice, 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 pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.03 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.

SECTION 232113 - HYDRONIC PIPING: continued

- 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% 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 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 "Valves."
- 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 SECTION 230553 - MECHANICAL IDENTIFICATION.

3.04 HANGERS AND SUPPORTS:

- A. Hanger, support, and anchor devices are specified in SECTION 230529 - HANGERS AND SUPPORTS. Comply with the following requirements for maximum spacing of supports.
- B. Seismic restraints are specified in SECTION 230548 - MECHANICAL VIBRATION AND SEISMIC CONTROLS.
- C. 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.
- D. 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, 1/4 inch.
 - 2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
 - 6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
 - 7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.

SECTION 232113 - HYDRONIC PIPING: continued

- E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 - 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 - 3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.05 PIPE JOINT CONSTRUCTION:

- A. Join pipe and fittings according to the following requirements and DIVISION 15 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 B813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B32.
- E. 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.
- F. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

3.06 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 automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.
- C. Install piping from air separator or air purger to expansion tank with a 2% upward slope toward tank.
- D. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
- E. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.07 TERMINAL EQUIPMENT CONNECTIONS:

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

SECTION 232113 - HYDRONIC PIPING: continued

- B. Install control valves in accessible locations close to connected equipment.
- C. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to SECTION 230519 - METERS AND GAUGES.

3.08 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. Do not circulate water from exterior geothermal piping through interior piping system until exterior piping has been flushed separately before interior system.
 - 4. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens. Isolate interior piping from exterior geothermal piping during flush.
 - 5. 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.
 - 6. 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% of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9.
 - 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 to specified values.
 - 7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232114 - OUTDOOR GEOTHERMAL PIPING

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section Includes:
 - 1. Geothermal water piping located underground and outside of the building.

1.02 REFERENCES:

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
 - 1. ASTM International (ASTM):
 - a. ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing, and Fittings, 2008a.
 - b. ASTM D2657 - Heat Fusion Joining Polyolefin Pipe and Fittings, 2007.
 - c. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing, 2004.
 - d. ASTM D3035 - Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter, 2008.
 - e. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing, 2003.
 - f. ASTM D3350 - Polyethylene Plastics Pipe and Fittings Materials, 2008.
 - g. ASTM D3892 - Packaging/Packing of Plastics, 1993; R 2003.
 - h. ASTM F1290 - Electrofusion Joining Polyolefin Pipe and Fittings, 1998a; R 2004.
 - i. ASTM F402 - Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings, 2005.
 - 2. International Ground Source Heat Pump Association (IGSHPA):
 - a. IGSHPA 21010 - Grouting Procedures for Ground-Source Heat Pump Systems, 1991.
 - b. IGSHPA 21015 - Grouting for Vertical GHP Systems, 2000.
 - c. IGSHPA 21020 - Closed-Loop/Ground-Source Heat Pump System/Installation Guide, 1998.
 - d. IGSHPA 21030 - Design and Installation Standards, 2005.
 - e. IGSHPA 21060 - Soil and Rock Classification Field Manual, 1989.
 - 3. National Fire Protection Association (NFPA):
 - a. NFPA 704 - Identification of the Hazards of Materials for Emergency Response, 2006.
 - 4. U.S. National Archives and Records Administration (NARA):
 - a. 29 CFR 1910 - Occupational Safety and Health Standards.
 - 5. Underwriters Laboratories (UL):
 - a. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, 1996; Rev thru Jun 2006.

1.03 GROUND SOURCE HEAT PUMP INSTALLER:

- A. Work specified in this Section shall be performed by accredited ground source heat pump (GSHP) installers.
- B. The GSHP installer shall be an "Accredited Installer."
- C. Accreditation as an Accredited Installer shall be kept up to date and maintained with the International Ground Source Heat Pump Association (IGSHPA).
- D. The GSHP installer's Statement of Qualifications shall include a copy of IGSHPA Installer Certification.

SECTION 232114 - OUTDOOR GEOTHERMAL PIPING: continued

1.04 SUBMITTALS:

- A. Submit each item in this article in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS:
 - 1. Shop Drawings:
 - a. Well and piping system layout drawings.
 - b. Ground heat exchanger piping system As-Built Drawings.
 - 2. Product Data: Product data for integral space temperature controls (STC) supplied with the listed equipment shall include shall include point-to-point electrical wiring diagrams for each STC:
 - a. Ground source heat pump installer.
 - (1) A letter not later than 14 days after the Notice to Proceed, providing the name and Statement of Qualifications of the individual(s) who will serve as ground source heat pump (GSHP) Installer.
 - b. Cementitious thermally-enhanced grout.
 - c. Pipe, fittings and piping components.
 - d. U-bend assemblies.
 - 3. Test Reports:
 - a. Field quality control test reports.
 - 4. Certificates:
 - a. Qualifications of Ground Heat Exchanger Installers.
 - b. Hydrostatic Test.
 - c. Well Driller License.
 - d. Well Construction Log Record.

1.05 QUALITY ASSURANCE:

- A. Ground Heat Exchanger Piping System As-Built Drawings:
 - 1. Provide dimensioned As-Built Drawings of each complete ground heat exchanger piping system, depicting its relationship to other utilities and buildings in its proximity before burying, covering or concealing.
 - 2. Drawings shall be of a quality equivalent to the contract design drawings.
 - 3. The As-Built Drawings of the installed ground heat exchanger piping system shall be laminated or stored in a clear plastic envelope and affixed visibly on the wall in the mechanical room.
 - 4. As-Built Drawings shall be submitted with operation and maintenance data.
- B. Plastic Piping Heat Fusion Requirements:
 - 1. All plastic pipe shall be cut, made up and installed in accordance with the pipe manufacturer's recommendations.
 - 2. Heat joining shall be performed in accordance with ASTM D2657.
 - 3. Electrofusion joining shall be performed in accordance with ASTM F1290.
 - 4. Qualifications for plastic pipe fabricators are given in this Section under paragraph "Qualifications of Ground Heat Exchanger Fabricators".
 - 5. Heat fusion tests shall be conducted to verify the quality of the joints.
- C. Qualifications of Ground Heat Exchanger Fabricators:
 - 1. The only acceptable method for joining buried pipe systems is by a heat fusion process.
 - 2. Submit documentation substantiating the following qualifications:
 - a. Ground heat exchanger fabricators shall have completed a heat fusion school in which each participant has performed a heat fusion procedure under direct supervision of an approved manufacturing certification program.
 - b. DOT-certified heat fusion technician.

SECTION 232114 - OUTDOOR GEOTHERMAL PIPING: continued

- D. Qualifications of Ground Heat Exchanger Installers:
 - 1. Submit documentation substantiating the following qualifications:
 - a. Installers shall have completed an approved manufacturer's certification program.
 - b. In documentation, submit licensing requirements as regulated by local and state regulations for well drillers.
 - 2. Submit for each well driller, the Well Driller license.
 - 3. Certification and licenses for each well driller shall be in the state where the work occurs.
 - 4. All required certification and licenses shall be kept current.
 - 5. Out-of-date licenses and certification will not be accepted.
 - 6. Submit to contracting officer for approval the licenses and certification.

1.06 DELIVERY, STORAGE AND HANDLING:

- A. Materials delivered and placed in storage shall be stored with protection from the weather, excessive humidity variation, excessive temperature variation, dirt, dust and/or other contaminants.
- B. Proper protection and care of material before, during and after installation is the Contractor's responsibility.
- C. Any material found to be damaged shall be replaced at the Contractor's expense.
- D. During installation, piping shall be capped to keep out dirt and other foreign matter.
- E. A material safety data sheet in conformance with 29 CFR 1910 Section 1200(g) shall accompany each chemical delivered for use in pipe installation:
 - 1. At a minimum, this includes all solvents, solvent cements, glues and other materials that may contain hazardous compounds.
- F. Handling shall be in accordance with ASTM F402.
- G. Storage facilities shall be classified and marked in accordance with NFPA 704:
 - 1. Materials shall be stored with protection from puncture, dirt, grease, moisture, mechanical abrasions, excessive heat, ultraviolet (UV) radiation damage or other damage.
 - 2. Pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendation.
- H. Plastic pipe shall be packed, packaged and marked in accordance with ASTM D3892.
- I. Upon delivery of piping, fitting, components, and equipment to the site, inspect items for damage and verify items meet project requirements.

1.07 PROJECT/SITE CONDITIONS:

- A. Verification of Dimensions:
 - 1. The Contractor shall become familiar with all details of the work, verify all dimensions indicated in the field and advise the Contracting Officer of any discrepancy before performing any work.
- B. Drawings:
 - 1. Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required.
 - 2. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and shall arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.
- C. Accessibility:
 - 1. Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible.

SECTION 232114 - OUTDOOR GEOTHERMAL PIPING: continued

2. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 - PRODUCTS

2.01 GROUND HEAT EXCHANGER PIPING SYSTEM:

- A. Provide high density polyethylene pipe (HDPE), fittings, and piping components for the underground portions of the ground heat exchanger:
 1. Use of polyvinyl chloride (PVC) or polybutylene pipe and fittings is not permitted.
 2. Vertical well piping and u-bends shall be completely factory assembled and tested. No field joints are allowed except at connections from vertical well piping to horizontal header piping.
- B. High Density Polyethylene Pipe (HDPE):
 1. Pipe shall be manufactured from virgin high density polyethylene extrusion material in accordance with ASTM D2513 with PE345434C or PE355434C cell classification and UV stabilizer of C, D, or E as specified in ASTM D3350.
 2. Provide ASTM D3035 pipe with a standard dimension ratio (SDR) of 11.0.
- C. Fittings:
 1. Provide ASTM D3261 butt and saddle fusion fittings and ASTM D2683 socket fusion fittings manufactured in accordance with ASTM D2513.
 - a. Barbed fittings, compression type fittings, mechanical joint fittings, grove fittings, and hose clamps are not permitted in polyethylene pipe systems.
 - b. All pipe fittings underground shall be fusion type joints.
 - c. Flange joints and fittings shall not be provided on underground piping.
 - d. There shall be no joints in either leg of each vertical loop except for the factory assembled and tested connections to the U-Bend.
 2. Threaded Transition Fittings:
 - a. Provide ASTM D2513 reinforced threaded steel-to-polyethylene fittings.
 - b. Fittings shall have a factory applied external epoxy coating.

2.02 PIPING ACCESSORIES:

- A. Tracer Wire for Nonmetallic Piping:
 1. Provide bare copper or aluminum wire not less than 0.10 inch in diameter in sufficient length to be continuous over each separate run of nonmetallic pipe.
- B. U-Bend Assemblies:
 1. Provide factory-assembled and fused injection-molded 180-degree U-bend assemblies.
 - a. U-bend assemblies shall be used for the vertical well field vertical loop heat exchangers.
 - b. Each assembly shall be factory pressure tested to 200 psig.
 - c. Each assembly shall be provided with a factory pressure test report.
 - d. Each U-bend assembly shall be temporarily capped to prevent the entry of dirt during storage and installation.
- C. Building Surface Penetrations:
 1. Except as indicated otherwise, provide pipe sleeves as specified in this Section.
 - a. Provide where piping passes entirely through floors.
 - b. Secure sleeves in position and location during construction.
 - c. Provide sleeves of sufficient length to pass through entire thickness of floors.
 - d. Provide 3/8-inch minimum clearance between exterior or piping or pipe insulation, and interior of sleeve.

SECTION 232114 - OUTDOOR GEOTHERMAL PIPING: continued

- e. The annular space between pipe and sleeve shall be sealed in accordance with SECTION 079200 - JOINT SEALANTS.
 - 2. Sleeves in Masonry and Concrete:
 - a. Provide steel standard weight or PVC standard weight pipe sleeves.
 - b. Pipes passing through concrete floors shall be provided with pipe sleeves fitted into place at the time of construction.
- 2.03 BENTONITE GROUT:
- A. Provide bentonite grout mixture for pressure grouting and sealing the bore hole of the vertical well.
 - 1. Provide grouting of wells in accordance with IGSHPA 21015.
 - 2. The grout selected shall meet ANSI/NSF Standard 60.
 - 3. The grout shall meet all local and state rules and regulations.
 - 4. The bentonite will be a slurry that will be tremie grouted from the bottom of the boring to the surface in accordance with the IGSHPA installation manual.
 - 5. The contractor will work quickly to assure that there are no air voids forming as a result of the bentonite placing.
 - B. Cementitious Thermally Enhanced Grout:
 - 1. Provide cementitious thermally enhanced grout mixture:
 - a. The cementitious thermally enhanced grout mixture shall be a high solids sodium bentonite grout with Portland cement, potable water, silica sand compound, and a super plasticizer compound.
 - b. The grout shall be mixed per the manufacturer instructions.
 - c. Potable water shall be used for mixing the grout.
 - d. The thermal conductivity of the grout mixture compound shall be a minimum of 1.4 Btu/hr-ft-F or greater.
 - e. The target grout weight shall be 16 pounds/gallon.

PART 3 - EXECUTION

- 3.01 INSTALLATION:
- A. As-Built Drawings:
 - 1. As-Built Drawings of the installed systems: As-Built Drawings shall also show and document the as-constructed locations of the well field with dimensions, including all wells and loop fields.
- 3.02 ABOVEGROUND PIPING:
- A. Provide above ground piping as specified in SECTION 232113 - HYDRONIC PIPING.
- 3.03 EARTHWORK:
- A. Earthwork shall be performed in accordance with applicable provisions of SECTION 312000 - EARTHMOVING, except that bentonite and thermally enhanced grouts shall be used where indicated.
- 3.04 GROUND HEAT EXCHANGER PIPING:
- A. Examine areas and conditions under which ground heat exchanger systems will be installed:
 - 1. Prior to excavation, trenching, or drilling, locate and mark buried utilities.
 - 2. Do not proceed with work until approved by the Contracting Officer.
 - 3. Sharp bends and mitered joints shall not be used in piping.

SECTION 232114 - OUTDOOR GEOTHERMAL PIPING: continued

4. Provide fittings for changes in direction when minimum bend radius, as recommended by the pipe manufacturer, is exceeded.
 5. All pipe bends shall be radius type elbows.
 6. Make changes in piping sizes through tapered concentric fittings.
 7. Leaks shall be "cut-out" and repaired in accordance with the pipe manufacturer's recommendations.
 8. Direct buried threaded or flanged connections are not permitted.
 9. Prior to installation of the ground heat exchanger systems, verify that the installers are certified ground heat exchanger installers.
 10. Inspect all piping for damage prior to installation.
 11. Installation shall follow IGSHPA guidelines as well as local, state, and Federal guidelines and regulations.
 12. Upon delivery of piping, inspect the pipe for damage and verify that the pipe meets the project specifications.
 13. Prior to installation of pipe, carefully inspect pipe for damage.
 14. Do not use the pipe if it has a cut or a gouge that is more than 10% of the minimum wall thickness of the pipe.
 15. Provide reels and pipe coil.
 16. Reels shall be used to securely hold the pipe coil while being pressure tested.
 17. When inserting the pipe into the bore hole, spool off pipe from the reel into the hole.
- B. Vertical Well Fields:
1. Each vertical well and ground heat exchanger loop shall have a Well Construction Permit as required by local and state regulations.
 - a. The contractor shall maintain these permits during the construction contract period.
 - b. A copy of the permits shall be submitted with the As-Built documentation:
 - (1) Construction and installation of each well shall be in accordance to these permits.
 - c. Each well shall be performed by a state certified well driller:
 - (1) Certifications shall be in the state where the work occurs.
 - d. Prior to installation of wells, verify the well drillers and pump installers are certified.
 - e. For any well that is abandoned, abandonment shall be performed in accordance to local and state regulations:
 - (1) Provide abandonment records with certification to the Contracting Officer for review and submittal to the state.
 - f. For any well that is closed, closing shall be performed in accordance to local and state regulations:
 - (1) Provide closing records with certification to the Contracting Officer for review and submittal to the state.
 - g. All well submittals and records shall have the names of the well drillers and copies of their certifications.
 2. Each U-bend loop shall be assembled, laid out straight, taped to reduce springback and water pressure tested at 200 psi for leaks and flow by IGSHPA 21020 recommended procedures before the hole is bored.
 - a. Comply with all local and state codes, regulations and requirements during the construction of the vertical wells or bore holes.
 - b. Submit for each vertical well a Well Construction Log Record.

SECTION 232114 - OUTDOOR GEOTHERMAL PIPING: continued

- c. The borehole shall be constructed as indicated:
 - (1) Where any discrepancy exists between local and state codes, regulations and requirements and this specification, the more stringent requirement applies.
 - (2) When inserting the U-bend assembly into the bore hole, use the depth graduations as another means of verification of depth of the bore hole.
 - (3) There shall be no joint in either leg of each vertical loop except for the factory assembled connection at the U-bend.
- d. Vertical bores shall be 5 feet deeper than the length of the U-bend assembly loop and shall be clean (no casing) and of sufficient diameter to facilitate the installation of the U-bend assembly and a third pipe for pressure grouting:
 - (1) Fill the loop with water and pressurize to 40 psi to prevent the pipe from being crushed by backfill material.
 - (2) Temporarily cap the ends of the U-bend assemblies until the actual testing begins.
 - (3) The cap shall be fused to the pipe end in order to hold the pressure.
 - (4) Pressure testing can be performed while the bore hole is being drilled.
- e. Backfill the bores from the bottom up with a bentonite grout material and grouting process in conformance with IGSHA 21010 to ensure pipe contact and compliance with local and State requirements for sealing:
 - (1) Bentonite grout shall be prepared and mix in accordance with manufacturer's recommendations for water-to-mix ratio.
 - (2) Grouting materials shall be placed using a pressure pump with a tremie pipe system:
 - (a) Install the grouting material from the bottom to the top of the vertical borehole.
 - (b) If any settling occurs during the initial 24-hour period after installation, additional material shall be added to insure the grouting material remains at the desired surface level.
 - (3) The bores shall not contain large, sharp, or jagged rocks or debris.
 - (4) Take reasonable and prudent care during installation and backfilling to not crush, cut or kink the pipe.
- f. In the event that a geological formation is encountered, that prevents the grouting material from forming a solid seal, either a 3/8-inch or 3/4-inch cementitious bentonite grout material may be used to seal the specific formation zone:
 - (1) Notify the Contracting Officer of any problems encountered.
 - (2) Upon completion of the specific zone, resume grouting until the desired surface of the vertical well or bore hole is reached.
- g. During installation of the vertical well, maintain a water and soils log:
 - (1) The log shall indicate depth of water encountered, materials encountered, depth intervals of materials and physical description.
 - (2) If water is encountered, indicate in the log the depths at which it was encountered, and the static water level.
 - (3) Include in the log the type of drill rig used, the actual drilling time to complete the bore hole.
- h. In absence of other requirements or as indicated, provide U-bend assemblies having the following pipe diameters for the U-bend assembly length as follows:
 - (1) 1-1/4-inch diameter for 250- to 500-foot loop length.

SECTION 232114 - OUTDOOR GEOTHERMAL PIPING: continued

- i. Each well location shall be shown and identified on As-Built Drawings.
 - (1) Provide a tracer wire system:
 - (a) The tracer wire system shall include a locator device to identify the well field.
 - (b) The locator device shall be located in the mechanical room.
 - j. Minimum vertical well distance:
 - (1) In absence of other requirements or as indicated, provide a minimum well separation distance between wells of 20 feet.
 - (2) Provide a minimum separation distance between wells and building foundation walls of 20 feet.
- C. Horizontal Header Piping:
 - 1. Horizontal trenches for ground heat exchanger piping may be dug with a chain type trenching machine or a backhoe.
 - a. The piping shall be buried a minimum of 6 feet deep or as indicated.
 - b. Make joints while pipe is laying beside the trench.
 - c. If the soil contains rocks, dig the trench 6 inches deeper than required and install a base of 6 inches of fines or sand before placing the pipe.
 - d. After the piping is installed, tested, and flushed, purged, inspected, and approved while still under pressure, backfill 6 inches above with fines or sand.
 - e. Complete backfill in accordance with IGSHPA 21020 recommended procedures.
 - f. When laying pipe in trench, insure the bottom of the trench is smooth, free from rocks and debris.
 - g. When laying pipe, use a fine to medium backfill to fill trench.
 - h. If there are multiple pipes in the trench, insure each pipe is completely surrounded and supported with backfill before the next pipe is installed.
 - 2. Piping at Building Entries:
 - a. Install a concrete duct bank for polyethylene piping installed below building footings.
 - b. The duct bank should extend 12 inches beyond the footings.
 - c. The conduit should end 6 inches above the floor.
 - d. The ends of the conduit where the pipe is located, fill the annular space with insulation and a silicone seal.
- D. Polyethylene Piping:
 - 1. Install piping in accordance with manufacturer's written instructions.
 - 2. Polybutylene piping shall not be used.
 - 3. Piping components shall be joined by a heat fusion method that conforms the piping manufacturer's recommendation for this application.
 - 4. During installation, keep trash, soil, and foreign objects out of the pipe.
 - 5. Tape or cap ends of the pipe until the pipe is joined to the circuit.
 - 6. The vertical loop take-off tee fittings may be made using tee fittings or the saddle fusion process on header piping 1.25-inch diameter and above.
 - 7. Completely remove the cutout on the saddle tees.
 - 8. Use bell reductions at pipe reductions.
 - 9. Use reducing socket tees when fabricating socket type reducing headers.
 - 10. Avoid sharp bends and mitered elbows and bends in piping.
 - 11. Consult pipe manufacturer for minimum bend radius.
 - 12. Install elbow fittings at changes in pipe direction that are tighter than the minimum recommended bend radius.
 - 13. Use only continuous pipe in vertical U-bend loops.

SECTION 232114 - OUTDOOR GEOTHERMAL PIPING: continued

- E. Heat Fusion Process:
 - 1. Joining shall be either by butt, socket or saddle (for sidewall applications only) fusion in accordance with the manufacturer's Heat Fusion Qualification Guide.
 - 2. Use socket fusion joints for pipe 3/4-inch diameter and less.
 - 3. Use butt fusion joints for pipe greater than 3/4-inch diameter.
 - 4. Different plastics or grades of plastic shall not be fused together.
 - 5. When fusing pipe, perform heat fusion tests to verify the quality of the joints.
 - 6. Notify the Contracting Officer of the results of the heat fusion tests.
- F. Pressurizing:
 - 1. After assembly of the entire ground loop system, fill the system with water and pressure test to 100 psi.
 - 2. Visually inspect welds prior to backfill of the trenches.
- G. Pipe Identification:
 - 1. Install metalized (detectable) warning and identification tape above each horizontal pipe run. Install tape a minimum of 6 inches below finish grade.
 - 2. Install mechanical identification of vertical bore holes and connecting headers.
- H. Tracer Wire:
 - 1. Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe.
 - 2. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.
- I. Threaded Fittings:
 - 1. Threaded joints shall be sealed with a sealant compatible with the circulating fluid; use of lubricating tape for sealing is not permitted.
 - 2. Do not thread metal pipe into plastic pipe or vice versa.
 - 3. Direct buried threaded joints are not permitted.
 - 4. Threaded joints may be used only above grade, within mechanical spaces or within valve pits.

3.05 FLUSHING AND PURGING GROUND HEAT EXCHANGER:

- A. Before connection of the plastic ground heat exchanger loops to the header, flush and purge each loop thoroughly in accordance with IGSHPA 21020 recommendations and leave filled with clean water:
 - 1. If the loop is not immediately joined to the header, it shall be taped or capped.
 - 2. Purge and vent the ground heat exchanger system piping of all air.

3.06 FIELD QUALITY CONTROL:

- A. Provide a QC Specialist to perform duties for this system in accordance with SECTION 014500 - QUALITY CONTROL.
- B. Upon completion and before final acceptance of work, test each system in service to demonstrate compliance with the contract requirements:
 - 1. Adjust controls and balance systems prior to final acceptance of completed systems.
 - 2. Test controls through every cycle of operation.
 - 3. Test safety controls to demonstrate performance of required function.
 - 4. Correct defects in work provided by Contractor and repeat tests.
 - 5. Furnish fuel, water, electricity, instruments, connecting devices and personnel for tests.
 - 6. Flush and clean piping before placing in operation.
 - 7. Clean equipment, piping, strainers, ducts and filters.

SECTION 232114 - OUTDOOR GEOTHERMAL PIPING: continued

- C. Flow Test of Ground Heat Exchanger Piping:
 - 1. Before backfilling the trenches, flush, purge and vent systems of air and flow test to ensure all portions of the heat exchanger are properly flowing using the procedures recommended by IGSHPA 21020.
 - 2. Perform the flushing and purging operation with the water source heat pumps isolated by shutoff valves from the ground heat exchanger system:
 - a. Allow pump to run 15 minutes after the last air bubbles have been removed.
 - b. After the ground heat exchanger is completely flushed of air and debris, open the isolation valves and permit circulation through the heat pumps until the entire system is flushed and purged.
 - 3. Utilizing the procedures recommended by IGSHPA 21020, conduct a pressure and flow test on the ground heat exchanger to ensure the system is free of blockage:
 - a. If the flow test indicates blockage, locate the blockage using the manufacturer's recommendation, remove the blockage, then repeat the purge procedure and conduct the pressure and flow test again until all portions of the system are free flowing.
 - b. The flow test shall be observed and approved by the Contracting Officer.
 - 4. Form 1, "Ground Heat Exchanger Inspection and Test Report", located following, shall be completed for each system by the Contractor after completion of the flow test before the systems can be backfilled.

SECTION 232114 - OUTDOOR GEOTHERMAL PIPING: continued

FORM 1

GROUND HEAT EXCHANGER (GHX) INSPECTION AND TEST REPORT

NOTE: Use separate form for each GHX loop system.

Building: _____ Inspection Date: _____

Ground Heat Exchanger No. or Description: _____

Does the ground heat exchanger have a Well Construction Permit? Permit No.?

Does the ground heat exchanger have an approved well permit? Permit No.?

List the WSHP Unit No.'s served by this GHX: _____

Ground Heat Exchanger Design Water Flow - _____ gpm

Calculated purging flow and press to achieve 2 feet/sec

Purging: Flow _____ gpm Head _____ psi Duration of test _____ min.

Hydrostatic test pressure _____ psi Duration _____ min.

Did the system pass the pressure test? _____

Is antifreeze required in system? _____ If yes, was antifreeze measured? _____

Has a dimensioned drawing been prepared, completely and accurately showing the layout of the ground heat exchanger? _____

Does the layout differ substantially from the contract documents? _____

If so is the deviation approved? _____

Depth of installed vertical loops is _____ feet. (Design is _____ feet.)

Depth of horizontal piping is _____ feet. (Design is _____ feet.)

Are the trenches clear of sharp bends, rocks, or other sharp objects that could restrict flow? _____

Are all joints heat fused (butt-, socket-, or saddle-fusion)? _____

Do the joints have the proper amount of roll-out? _____

Has the piping material been cut-out and properly removed from saddle-fusion tees? _____

Grout Manufacturer? _____ Percent of solids used in grout? _____

SECTION 232114 - OUTDOOR GEOTHERMAL PIPING: continued

Grout Type? _____ Grout Thermal conductivity, k (give units)? _____

Was the system backfilled properly with good clean backfill material? _____

Attach the soil boring and water well log sheet for the bore hole? _____

For each well submit a Well Construction Log Record

Comments: _____

Inspected and approved this _____ date by _____

Title: _____

D. Pressure Test of Ground Heat Exchanger Piping:

1. Prior to any cover or backfill of bore holes or trenches and after flow testing, flushing, and purging, the ground heat exchanger piping and headers shall be pressure tested by hydrostatic test:
 - a. The system shall be isolated from all connections to piping.
 - b. Ensure that the piping system has been flushed of all dirt and debris.
 - c. The piping shall then be plugged or capped as necessary in preparation for the hydrostatic test(s).
2. Hydrostatic Test:
 - a. Test report shall document dates and results of system flushes and hydrostatic tests.
 - b. The piping shall be hydrostatically pressurized to 150% of system pressure 150 psi and monitor piping.
 - c. If there is any pressure loss or visible leakage during the testing, the leak shall be identified and repaired in accordance with the piping components manufacturer's recommendations.
 - d. Test shall be repeated until there is no loss in pressure during the test period.
 - e. Provide results of test in test report.
 - f. During testing, do not exceed the pipe/pipe fitting manufacturer test pressure rating or 150% of the pipe pressure rating.
 - g. Do not pneumatic test the pipe.
 - h. Prior to testing, remove all air from the system.
 - i. Provide test in accordance to IGSHPA standards.

END OF SECTION 232114

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following:
 - 1. Close-coupled, in-line centrifugal pumps.

1.02 REFERENCES:

- A. Applicable Standards (Latest Edition):
 - 1. ASTM International (ASTM):
 - a. B584 - Copper Alloy Sand Castings for General Applications.
 - 2. Hydraulic Institute (HI):
 - a. 1.1-1.5 - Centrifugal Pumps for Nomenclature, Definitions, Application and Operation (ANSI).
 - 3. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code.
 - 4. Underwriters Laboratories Inc. (UL):
 - a. 778 - Motor-Operated Water Pumps.

1.03 DEFINITIONS:

- A. Buna-N: Nitrile rubber.
- B. EPT: Ethylene propylene terpolymer.

1.04 SUBMITTALS:

- A. General: Submit the following in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
- C. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- D. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE:

- A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of hydronic pumps and are based on the specific system indicated. Refer to DIVISION 01.
- C. 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.
- D. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
- B. Store pumps in dry location.
- C. Retain protective covers for flanges and protective coatings during storage.

SECTION 232123 - HYDRONIC PUMPS: continued

- D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
- E. Comply with pump manufacturer's written rigging instructions.

1.07 EXTRA MATERIALS:

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Mechanical Seals: One mechanical seal for each pump.

PART 2 - PRODUCTS

2.01 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 or an approved equal.

2.02 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS:

- A. Manufacturers:
 - 1. Bell & Gossett; Div. of ITT Industries.
 - 2. Grundfos Pumps Corporation.
 - 3. PACO Pumps.
 - 4. Taco, Inc.
- B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 225°F.
- C. Pump Construction:
 - 1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, and threaded companion-flange connections.
 - 2. Impeller: ASTM B584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
 - 3. Pump Shaft: Stainless steel.
 - 4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket. Include water slinger on shaft between motor and seal.
 - 5. Pump Bearings: Oil lubricated; bronze-journal or thrust type.
- D. Motor: Variable speed, with permanently lubricated ball bearings, unless otherwise indicated; and rigidly mounted to pump casing. Comply with requirements in SECTION 230513 - MOTORS.
- E. Variable Frequency Controllers: Shall be provided by DIVISION 26.
- F. Capacities and Characteristics:
 - 1. Capacity: As scheduled on the Drawings.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.

SECTION 232123 - HYDRONIC PUMPS: continued

- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PUMP INSTALLATION:

- A. Comply with HI 1.4.
- B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Install continuous-thread hanger rods and spring hangers of sufficient size to support pump weight. Vibration isolation devices are specified in SECTION 230548 - MECHANICAL VIBRATION AND SEISMIC CONTROLS. Fabricate brackets or supports as required. Hanger and support materials are specified in SECTION 230529 - HANGERS AND SUPPORTS.
- E. Suspend vertically mounted, in-line centrifugal pumps independent of piping. Install pumps with motor and pump shafts vertical. Use continuous-thread hanger rods and spring hangers of sufficient size to support pump weight. Vibration isolation devices are specified in SECTION 230548 - MECHANICAL VIBRATION AND SEISMIC CONTROLS. Hanger and support materials are specified in SECTION 230529 - HANGERS AND SUPPORTS.

3.03 ALIGNMENT:

- A. Align pump and motor shafts and piping connections after setting and piping connections have been made.
- B. Comply with pump and coupling manufacturers' written instructions.
- C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5.
- D. After alignment is correct, tighten bolts evenly but not too firmly.

3.04 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 machine to allow service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Install check valve and throttling valve on discharge side of pumps.
- F. Install Y-type strainer and shutoff valve on suction side of pumps.
- G. Install pressure gauges on pump suction and discharge, at integral pressure-gauge tapping, or install single gauge with multiple input selector valve.
- H. Ground equipment according to DIVISION 26.
- I. Connect wiring according to DIVISION 26.

3.05 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. Check piping connections for tightness.
 - 3. Clean strainers on suction piping.
 - 4. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.

SECTION 232123 - HYDRONIC PUMPS: continued

- b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
 - 5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
 - 6. Start motor.
 - 7. Open discharge valve slowly.
- 3.06 DEMONSTRATION:
- A. Engage a factory-authorized service representative to train Contracting Officer's maintenance personnel to adjust, operate, and maintain hydronic pumps. Refer to requirements in SECTION 017900 - DEMONSTRATION AND TRAINING.

END OF SECTION 232123

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes refrigerant piping used for air-conditioning applications.

1.02 REFERENCES:

- A. Applicable Standards (Latest Edition):
 - 1. Air-Conditioning & Refrigeration Institute (ARI):
 - a. 495 - Refrigerant Liquid Receivers.
 - b. 730 - Flow-Capacity Rating and application of Suction-Line Filters and Filter-Driers.
 - c. 750 - Thermostatic Refrigerant Expansion Valves.
 - d. 760 - Solenoid Valves for Use with Volatile Refrigerants.
 - 2. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - a. 15 - Safety Code for Refrigeration Systems (ANSI).
 - b. 34 - Designation and Safety Classification of Refrigerants (ANSI).
 - 3. American Welding Society (AWS):
 - a. A5.8 - Filler Metals for Brazing and Braze Welding.
 - b. Brazing Handbook (Chapter "Pipe and Tube").
 - 4. ASME International (ASME):
 - a. B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - b. B31.5 - Refrigeration Piping and Heat Transfer Components.
 - c. ASME Boiler and Pressure Vessel Code: Section II, Part C, "Welding Rods, Electrodes, and Filler Metals;" Section VIII, "Pressure Vessels;" Section IX, "Welding and Brazing Qualifications."
 - 5. ASTM International (ASTM):
 - a. B32 - Solder Metal.
 - b. B88 - Seamless Copper Water Tube.
 - c. B88M - Seamless Copper Water Tube [Metric].
 - d. B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 - e. B828 - Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
 - 6. Copper Development Association Inc. (CDA):
 - a. Copper Tube Handbook.
 - 7. Manufacturer's Standardization Society of the Valve and Fittings Industry Inc. (MSS):
 - a. SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 - 8. National Electrical Manufacturers Association (NEMA):
 - a. 250 - Enclosures for Electrical Equipment (1,000V Maximum).
 - 9. Underwriters Laboratories Inc. (UL):
 - a. 207 - Refrigerant-Containing Components and Accessories, Nonelectrical.
 - b. 429 - Electrically Operated Valves.

1.03 PERFORMANCE REQUIREMENTS:

- A. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig (2,068 kPa).
 - 2. Suction Lines for Heat-Pump Applications: 535 psig (3,689 kPa).
 - 3. Hot-Gas and Liquid Lines: 535 psig (3,689 kPa).

SECTION 232300 - REFRIGERANT PIPING: continued

1.04 SUBMITTALS:

- A. General: Submit each item in the Article in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:
 - 1. Thermostatic expansion valves.
 - 2. Solenoid valves.
 - 3. Hot-gas bypass valves.
 - 4. Filter dryers.
 - 5. Strainers.
 - 6. Pressure-regulating valves.
- C. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 - 1. Shop Drawing Scale: 1/4 inch equals 1 foot (1:50).
 - 2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.05 QUALITY ASSURANCE:

- A. Comply with ASHRAE 15.
- B. Comply with ASME B31.5.

1.06 PRODUCT STORAGE AND HANDLING:

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.01 COPPER TUBE AND FITTINGS:

- A. Copper Tube: ASTM B88, Type L (ASTM B88M, Type B) or ASTM B280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch (180-mm) long assembly.
 - 4. Pressure Rating: Factory test at minimum 500 psig (3,450 kPa).

SECTION 232300 - REFRIGERANT PIPING: continued

5. Maximum Operating Temperature: 250°F (121°C).

2.02 VALVES AND SPECIALTIES:

A. Packed-Angle Valves:

1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig (3,450 kPa).
8. Maximum Operating Temperature: 275°F (135°C).

B. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. End Connections: Socket, union, threaded, or flanged.
6. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
7. Working Pressure Rating: 500 psig (3,450 kPa).
8. Maximum Operating Temperature: 275°F (135°C).

C. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig (3,450 kPa).

D. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and 115Vac coil.
6. Working Pressure Rating: 400 psig (2,760 kPa).
7. Maximum Operating Temperature: 240°F (116°C).
8. Manual operator.

E. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig (2,760 kPa).
6. Maximum Operating Temperature: 240°F (116°C).

F. Thermostatic Expansion Valves: Comply with ARI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.

SECTION 232300 - REFRIGERANT PIPING: continued

4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
 5. Suction Temperature: As required by application.
 6. Superheat: Nonadjustable.
 7. Reverse-flow option (for heat-pump applications).
 8. End Connections: Socket, flare, or threaded union.
 9. Working Pressure Rating: 450 psig (3,100 kPa).
- G. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
 2. Screen: 100-mesh stainless steel.
 3. End Connections: Socket or flare.
 4. Working Pressure Rating: 500 psig (3,450 kPa).
 5. Maximum Operating Temperature: 275°F (135°C).
- H. Angle-Type Strainers:
1. Body: Forged brass or cast bronze.
 2. Drain Plug: Brass hex plug.
 3. Screen: 100-mesh monel.
 4. End Connections: Socket or flare.
 5. Working Pressure Rating: 500 psig (3,450 kPa).
 6. Maximum Operating Temperature: 275°F (135°C).
- I. Moisture/Liquid Indicators:
1. Body: Forged brass.
 2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
 3. Indicator: Color coded to show moisture content in ppm.
 4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
 5. End Connections: Socket or flare.
 6. Working Pressure Rating: 500 psig (3,450 kPa).
 7. Maximum Operating Temperature: 240°F (116°C).
- J. Replaceable-Core Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
 2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
 3. Desiccant Media: Activated alumina or charcoal.
 4. End Connections: Socket.
 5. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
 6. Maximum Pressure Loss: 2 psig (14 kPa).
 7. Working Pressure Rating: 500 psig (3,450 kPa).
 8. Maximum Operating Temperature: 240°F (116°C).
- K. Permanent Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell.
 2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
 3. Desiccant Media: Activated alumina or charcoal.
 4. End Connections: Socket.
 5. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
 6. Maximum Pressure Loss: 2 psig (14 kPa).
 7. Working Pressure Rating: 500 psig (3,450 kPa).
 8. Maximum Operating Temperature: 240°F (116°C).

SECTION 232300 - REFRIGERANT PIPING: continued

2.03 REFRIGERANTS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 - 1. Atofina Chemicals, Inc.
 - 2. DuPont Company; Fluorochemicals Div.
 - 3. Honeywell, Inc.; Genetron Refrigerants.
 - 4. INEOS Fluor Americas LLC.
- B. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS FOR REFRIGERANT R-410A:

- A. Hot-Gas and Liquid Lines, and Suction Lines:
 - 1. NPS 1-1/4 (DN 32) and Smaller: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.
 - 2. NPS 1-1/2 (DN 40) and Larger: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.
- B. Safety-Relief-Valve Discharge Piping: Copper, Type L (B), annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

3.02 VALVE AND SPECIALTY APPLICATIONS:

- A. Install packed-angle valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install packed-angle valves on inlet and outlet side of filter dryers.
- E. Install a full-sized, three-valve bypass around filter dryers.
- F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - 1. Install valve so diaphragm case is warmer than bulb.
 - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
 - 1. Solenoid valves.
 - 2. Thermostatic expansion valves.
 - 3. Hot-gas bypass valves.
 - 4. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

SECTION 232300 - REFRIGERANT PIPING: continued

- L. Install receivers sized to accommodate pump-down charge.
- M. Install flexible connectors at compressors.

3.03 PIPING INSTALLATION:

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. 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 adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in DIVISION 08 if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. Install refrigerant piping in protective conduit where installed belowground.
- M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- N. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- P. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
- Q. Seal penetrations through fire and smoke barriers in accordance with DIVISION 07.
- R. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- S. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- T. Seal pipe penetrations through exterior walls in accordance with DIVISION 07.
- U. Identify refrigerant piping and valves in accordance with SECTION 230553 - MECHANICAL IDENTIFICATION.

SECTION 232300 - REFRIGERANT PIPING: continued

3.04 PIPE 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 pipe and fittings before assembly.
- C. Soldered Joints: Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook."
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.05 HANGERS AND SUPPORTS:

- A. Hanger, support, and anchor products are specified in SECTION 230529 - HANGERS AND SUPPORTS.
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1/2 (DN 15): Maximum span, 60 inches (1,500 mm); minimum rod size, 1/4 inch (6.4 mm).
 - 2. NPS 5/8 (DN 18): Maximum span, 60 inches (1,500 mm); minimum rod size, 1/4 inch (6.4 mm).
 - 3. NPS 1 (DN 25): Maximum span, 72 inches (1,800 mm); minimum rod size, 1/4 inch (6.4 mm).
 - 4. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2,400 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 5. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2,400 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 6. NPS 2 (DN 50): Maximum span, 96 inches (2,400 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 7. NPS 2-1/2 (DN 65): Maximum span, 108 inches (2,700 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 8. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (9.5 mm).
 - 9. NPS 4 (DN 100): Maximum span, 12 feet (3.7 m); minimum rod size, 1/2 inch (13 mm).
- D. Support multifloor vertical runs at least at each floor.

3.06 FIELD QUALITY CONTROL:

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Comply with ASME B31.5, Chapter VI.
 - 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.

SECTION 232300 - REFRIGERANT PIPING: continued

3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.07 SYSTEM CHARGING:

- A. Charge system using the following procedures:
 1. Install core in filter dryers after leak test but before evacuation.
 2. Evacuate system for time as indicated in table:

Table 1 - System Evacuation Time								
Outside Temperature (°F)	90	80	75	70	65	60	55	50
Hours of System Evacuation	1	2	3	4	8	36	50	72

3. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
4. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
5. Charge system with a new filter-dryer core in charging line.

3.08 ADJUSTING:

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 1. Open shutoff valves in condenser water circuit.
 2. Verify that compressor oil level is correct.
 3. Open compressor suction and discharge valves.
 4. Open refrigerant valves except bypass valves that are used for other purposes.
 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from -2- to +10-inch wg. Metal ducts include the following:
 - 1. Rectangular ducts and fittings.
 - 2. Single-wall, round spiral-seam ducts and formed fittings.
- B. Related Work Specified Elsewhere:
 - 1. Dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts: SECTION 233300 - DUCT ACCESSORIES.
 - 2. For mastics, joint and seam sealant: SECTION 018113 - SUSTAINABLE DESIGN REQUIREMENTS.

1.02 REFERENCES:

- A. Applicable Standards.
 - 1. American Society for Testing and Materials (ASTM):
 - a. A36A - Carbon Structural Steel.
 - b. A653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - c. C920 - Elastomeric Joint Sealants.
 - 2. National Air Duct Cleaners Association (1518 K St., NW, Suite 503, Washington, DC 20005; 202-737-2926; www.nadca.com) (NADCA):
 - a. 1992-01 - Mechanical Cleaning of Nonporous Air Conveyance System Components.
 - 3. National Fire Protection Association (NFPA):
 - a. 90A - Installation of Air Conditioning and Ventilating Systems (ANSI).
 - b. 90B - Installation of Warm Air Heating and Air Conditioning Systems (ANSI).
 - 4. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - a. Duct Cleanliness for New Construction.
 - b. HVAC Air Duct Leakage Test Manual.
 - c. HVAC Duct Construction Standards - Metal and Flexible.
 - d. Seismic Restraint Manual: Guidelines for Mechanical Systems.
 - 5. Underwriters Laboratories Inc. (UL):
 - a. 723 - Test for Surface Burning Characteristics of Building Materials.

1.03 SYSTEM DESCRIPTION:

- A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Contracting Officer. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.04 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.

SECTION 233113 - METAL DUCTS: continued

- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity 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 62.1-2004.

1.05 SUBMITTALS:

- A. General: Submit each item in this Article in accordance with SECTION 230500 - COMMON WORK RESULTS FOR HVAC.
- B. Product Data: For each type of the following products:
 - 1. Sealants and gaskets.
- C. LEED® Submittals:
 - 1. Product Data for Prerequisite EQ 1: Documentation indicating that duct systems comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."
 - 2. Product Data for Prerequisite EA 2: Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."
 - 3. Leakage Test Report for Prerequisite EA 2: Documentation of work performed for compliance with ASHRAE/IESNA 90.1-2004, Section 6.4.4.2.2 - "Duct Leakage Tests."
 - 4. Duct-Cleaning Test Report for Prerequisite EQ 1: Documentation of work performed for compliance with ASHRAE 62.1-2004, Section 7.2.4 - "Ventilation System Start-Up."
- D. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory- and shop-fabricated ducts and fittings.
 - 3. Duct layout indicating sizes, configuration, and static-pressure classes.
 - 4. Elevation of top of ducts.
 - 5. Dimensions of main duct runs from building grid lines.
 - 6. Fittings.
 - 7. Reinforcement and spacing.
 - 8. Seam and joint construction.
 - 9. Penetrations through fire-rated and other partitions.
 - 10. Equipment installation based on equipment being used on Project.
 - 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 - 12. Hangers and supports, including methods for duct and building attachment, and vibration isolation.
- E. Delegated-Design Submittal:
 - 1. Sheet metal thicknesses.
 - 2. Joint and seam construction and sealing.
 - 3. Reinforcement details and spacing.
 - 4. Materials, fabrication, assembly, and spacing of hangers and supports.
- F. Welding certificates.
- G. Field quality-control reports.

1.06 QUALITY ASSURANCE:

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

SECTION 233113 - METAL DUCTS: continued

- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.01 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.

2.02 SHEET METAL MATERIALS:

- A. 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: Lock-forming quality; complying with ASTM A653 and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.03 SEALANT MATERIALS:

- A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
- B. For indoor applications, use sealants that have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Joint and Seam Tape: 2 inches wide; glass-fiber-reinforced fabric.
- D. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
- E. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.
- F. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use O.
- G. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.04 HANGERS AND SUPPORTS:

- A. Building Attachments: Concrete inserts, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Do not use powder-actuated concrete fasteners.
- B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
 - 1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

SECTION 233113 - METAL DUCTS: continued

2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
 3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.
 - C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
 - D. Trapeze and Riser Supports: Steel shapes complying with ASTM A36.
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
- 2.05 RECTANGULAR DUCT FABRICATION:
- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
 2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
 - C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.
 1. Duct Size: Maximum 30 inches wide and up to 2-inch wg pressure class.
 2. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.
 - D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.
- 2.06 ROUND DUCT AND FITTING FABRICATION:
- A. Round, Longitudinal- and Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - B. Duct Joints:
 1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
 2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
 3. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
 - C. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.
 - D. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

SECTION 233113 - METAL DUCTS: continued

- E. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
 - 1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," unless otherwise indicated.
 - 2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from -2- to +2-inch wg:
 - a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.
 - b. Ducts 37 to 50 Inches in Diameter: 0.040 inch.
 - 3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:
 - a. Ducts 3 to 26 Inches in Diameter: 0.034 inch.
 - b. Ducts 27 to 50 Inches in Diameter: 0.040 inch.
 - 4. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
 - 5. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 - 6. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 - 7. Round Elbows Larger Than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
 - 8. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures: 0.040 inch thick with 2-piece welded construction.
 - 9. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
 - 10. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch.

PART 3 - EXECUTION

3.01 DUCT APPLICATIONS:

- A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:
 - 1. Supply Ducts (before Air Terminal Units): 3-inch wg.
 - 2. Supply Ducts (after Air Terminal Units): 1-inch wg.
 - 3. Supply Ducts (in Mechanical Equipment Rooms): 3-inch wg.
 - 4. Return Ducts (Negative Pressure): 2-inch wg.
 - 5. Exhaust Ducts (Negative Pressure): 2-inch wg.
- B. All ducts shall be galvanized steel.

3.02 DUCT INSTALLATION:

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," unless otherwise indicated.
- B. Install round and flat-oval ducts in lengths not less than 12 feet, unless interrupted by fittings.

SECTION 233113 - METAL DUCTS: continued

- C. Install ducts with fewest possible joints.
- D. Install fabricated fittings for changes in directions, size, and shape and for connections.
- E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.
- F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
- 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. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- J. Coordinate layout with suspended ceiling, fire-dampers, lighting layouts, and similar finished work.
- K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.
- N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire dampers are specified in SECTION 233300 - DUCT ACCESSORIES. Firestopping materials and installation methods are specified in DIVISION 07.
- O. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."
- P. Paint interiors of metal ducts that do not have duct liner, for 24 inches upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer. Paint materials and application requirements are specified in DIVISION 09.

3.03 SEAM AND JOINT SEALING:

- A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for duct seal level indicated.
 - 1. Supply Ducts (Pressure Class greater than 2-inch wg): Seal Class A for unconditioned spaces and Seal Class B for conditioned spaces.
 - 2. Supply Ducts (Pressure Class less than or equal to 2-inch wg): Seal Class B for unconditioned spaces and Seal Class C for conditioned spaces.
 - 3. Return Ducts: Seal Class B for unconditioned spaces and Seal Class C for conditioned spaces.
 - 4. Exhaust Ducts: Seal Class C for unconditioned spaces and Seal Class B for conditioned spaces.
- B. Seal ducts before external insulation is applied.

3.04 HANGING AND SUPPORTING:

- A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.
- B. Support vertical ducts at maximum intervals of 16 feet and at each floor.

SECTION 233113 - METAL DUCTS: continued

- C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
 - D. Install concrete inserts before placing concrete.
- 3.05 CONNECTIONS:
- A. Make connections to equipment with flexible connectors according to SECTION 233300 - DUCT ACCESSORIES.
 - B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.
- 3.06 FIELD QUALITY CONTROL:
- A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
 - 1. Provide leakage tests on supply air duct larger than 20 inches in diameter.
 - 2. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 3. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
 - 4. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round and flat-oval ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2-inch wg (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg.
 - 5. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.
- 3.07 CLEANING NEW SYSTEMS:
- A. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.
 - B. Use service openings, as required, for physical and mechanical entry and for inspection.
 - 1. Create other openings to comply with duct standards.
 - 2. Disconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling sections to gain access during the cleaning process.
 - C. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.
 - D. Clean the following metal duct systems by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Coils and related components.
 - 5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.

SECTION 233113 - METAL DUCTS: continued

- E. Mechanical Cleaning Methodology:
 - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet.
 - 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
- F. Cleanliness Verification:
 - 1. Visually inspect metal ducts for contaminants.
 - 2. Where contaminants are discovered, re-clean and reinspect ducts.

END OF SECTION 233113

SECTION 233300 - DUCT ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following:
 - 1. Volume dampers.
 - 2. Motorized control dampers.
 - 3. Fire dampers.
 - 4. Turning vanes.
 - 5. Duct-mounting access doors.
 - 6. Flexible connectors.
 - 7. Flexible ducts.
 - 8. Duct accessory hardware.
- B. Related Work Specified Elsewhere:
 - 1. Duct-mounting smoke detectors: SECTION 283100 - FIRE ALARM SYSTEMS.
 - 2. Electric damper actuators: SECTION 230900 - HVAC INSTRUMENTATION AND CONTROLS.
 - 3. Adhesives and sealants: SECTION 018113 - SUSTAINABLE DESIGN REQUIREMENTS.

1.02 REFERENCES:

- A. Applicable Standards (Latest Edition):
 - 1. American Society for Testing and Materials (ASTM):
 - a. A480 - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
 - b. A653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - c. B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
 - d. B221 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 2. National Fire Protection Association (NFPA):
 - a. 90A - Installation of Air Conditioning and Ventilating Systems (ANSI).
 - b. 90B - Installation of Warm Air Heating and Air Conditioning System (ANSI).
 - 3. The North American Insulation Manufacturers Association (NAIMA):
 - a. AH116 - Fibrous Glass Duct Construction Standards.
 - 4. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
 - a. HVAC Duct Construction Standards - Metal and Flexible.
 - 5. Underwriters Laboratories Inc. (UL):
 - a. 181 - Factory-Made Air Ducts and Air Connectors.
 - b. 555 - Fire Dampers.
 - c. Fire Resistance Directory.

1.03 SUBMITTALS:

- A. General: Submit each item in this Article in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Product Data: For the following:
 - 1. Backdraft dampers.

SECTION 233300 - DUCT ACCESSORIES: continued

2. Volume dampers.
 3. Motorized control dampers.
 4. Fire dampers.
 5. Turning vanes.
 6. Duct-mounting access doors.
 7. Flexible connectors.
 8. Flexible ducts.
- C. LEED[®] Submittal:
1. Product Data for Prerequisite EQ1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."
 2. Product Data for Credit IEQc4.1: For adhesives, sealants, mastics, grouts and solvent cements installed inside the weatherproofing barrier of the building, submit documentation including manufacturer's printed statement (MSDS Sheet) of VOC content of each product.
- D. 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.
1. Special fittings.
 2. Manual-volume damper installations.
 3. Motorized-control damper installations.
 4. Fire-damper installations, including sleeves and duct-mounting access doors.
- 1.04 QUALITY ASSURANCE:
- A. Comply with NFPA 90A and NFPA 90B.
- 1.05 EXTRA MATERIALS:
- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fusible Links: Furnish quantity equal to 10% of amount installed.

PART 2 - PRODUCTS

- 2.01 MANUFACTURERS:
- A. Manufacturers: Subject to compliance with requirements, provide products by one of those listed below or an approved equal.
- 2.02 SHEET METAL MATERIALS:
- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A653 and having G90 (Z275) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Stainless Steel: ASTM A480.
- D. Aluminum Sheets: ASTM B209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: ASTM B221, alloy 6063, temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

SECTION 233300 - DUCT ACCESSORIES: continued

- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.03 VOLUME DAMPERS:

- A. Manufacturers:
 - 1. McGill AirFlow Corporation.
 - 2. Penn Ventilation Company, Inc.
 - 3. Ruskin Company.
- B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
 - 1. Pressure Classes of 3-Inch wg or Higher: End bearings or other seals for ducts with axle's full length of damper blades and bearings at both ends of operating shaft.
- C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
 - 1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 - 2. Roll-Formed Steel Blades: 0.064-inch thick, galvanized sheet steel.
 - 3. Roll-Formed Aluminum Blades: 0.10-inch thick aluminum sheet.
 - 4. Extruded-Aluminum Blades: 0.050-inch thick extruded aluminum.
 - 5. Blade Axles: Galvanized steel.
 - 6. Bearings: Molded synthetic.
 - 7. Tie Bars and Brackets: Galvanized steel.
- D. Jackshaft: 1-inch diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
- E. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.04 MOTORIZED CONTROL DAMPERS:

- A. Manufacturers:
 - 1. Greenheck.
 - 2. Penn Ventilation Company, Inc.
 - 3. Ruskin Company.
- B. General Description: AMCA-rated, parallel or opposed-blade design; minimum of 0.1084-inch thick, galvanized-steel frames with holes for duct mounting; minimum of 0.0635-inch thick, galvanized-steel damper blades with maximum blade width of 8 inches.
 - 1. Secure blades to 1/2-inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
 - 2. Operating Temperature Range: From -40 to +200°F.
 - 3. Provide closed-cell neoprene edging.

SECTION 233300 - DUCT ACCESSORIES: continued

2.05 FIRE DAMPERS:

- A. Manufacturers:
 - 1. Greenheck.
 - 2. Penn Ventilation Company, Inc.
 - 3. Ruskin Company.
- B. Fire dampers shall be labeled according to UL 555.
- C. Fire Rating: 1-1/2 or 3 hours as required for application.
- D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, minimum 0.034-inch thick galvanized steel; with mitered and interlocking corners.
- E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 - 1. Minimum Thickness: 0.052 or 0.138 inch thick as indicated and of length to suit application.
 - 2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.
- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. Blades: Roll-formed, interlocking, minimum 0.034-inch thick, galvanized sheet steel. In place of interlocking blades, use full-length, minimum 0.034-inch thick, galvanized-steel blade connectors.
- H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- I. Fusible Links: Replaceable, 165°F rated.

2.06 TURNING VANES:

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
- B. Manufactured Turning Vanes: Fabricate 1-1/2-inch wide, single-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.07 DUCT-MOUNTING ACCESS DOORS:

- A. General Description: Fabricate doors airtight and suitable for duct pressure class.
- B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1- by 1-inch butt or piano hinge and cam latches.
 - 1. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 2. Provide number of hinges and locks as follows:
 - a. Less than 12 Inches Square: Secure with two sash locks.
 - b. Up to 18 Inches Square: Two hinges and two sash locks.
 - c. Up to 24 by 48 Inches: Three hinges and two compression latches.
 - d. Sizes 24 by 48 Inches and Larger: One additional hinge.
- C. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- D. Insulation: 1-inch thick, fibrous-glass or polystyrene-foam board.

2.08 FLEXIBLE CONNECTORS:

- A. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

SECTION 233300 - DUCT ACCESSORIES: continued

- B. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Select metal compatible with ducts.
- C. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd.
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: -40 to +200°F.
- D. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd.
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: -50 to +250°F.

2.09 FLEXIBLE DUCTS:

- A. Insulated-Duct Connectors: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor barrier film.
 - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 - 2. Maximum Air Velocity: 4,000 fpm.
 - 3. Temperature Range: -10 to +160°F.
- B. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches to suit duct size.

2.10 DUCT ACCESSORY HARDWARE:

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease. VOC Content of Adhesives shall not exceed the VOC content listed in SECTION 018113 for that application.

PART 3 - EXECUTION

3.01 APPLICATION AND INSTALLATION:

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.
- B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel.
- C. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.
- D. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.
- E. Provide test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install fire dampers, with fusible links, according to manufacturer's UL-approved written instructions.
- G. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
 - 1. On both sides of duct coils.
 - 2. Downstream from volume dampers and equipment.

SECTION 233300 - DUCT ACCESSORIES: continued

3. Adjacent to fire dampers, providing access to reset or reinstall fusible links.
 4. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot spacing.
 5. On sides of ducts where adequate clearance is available.
 - H. Install the following sizes for duct-mounting, rectangular access doors:
 1. One-Hand or Inspection Access: 8 by 5 inches.
 2. Two-Hand Access: 12 by 6 inches.
 3. Head and Hand Access: 18 by 10 inches.
 4. Head and Shoulders Access: 21 by 14 inches.
 5. Body Access: 25 by 14 inches.
 6. Body Plus Ladder Access: 25 by 17 inches.
 - I. Install the following sizes for duct-mounting, round access doors:
 1. One-Hand or Inspection Access: 8 inches in diameter.
 2. Two-Hand Access: 10 inches in diameter.
 3. Head and Hand Access: 12 inches in diameter.
 4. Head and Shoulders Access: 18 inches in diameter.
 5. Body Access: 24 inches in diameter.
 - J. Label access doors according to SECTION 230553 - MECHANICAL IDENTIFICATION.
 - K. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
 - L. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
 - M. Connect diffusers or light troffer boots to low pressure ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
 - N. Connect flexible ducts to metal ducts with liquid adhesive plus tape.
 - O. Install duct test holes where indicated and required for testing and balancing purposes.
- 3.02 ADJUSTING:
- A. Adjust duct accessories for proper settings.
 - B. Adjust fire dampers for proper action.
 - C. Final positioning of manual-volume dampers is specified in SECTION 230593 - TESTING, ADJUSTING, AND BALANCING.

END OF SECTION 233300

SECTION 233423 - POWER VENTILATORS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following:
 - 1. In-line centrifugal fans.

1.02 REFERENCES:

- A. Applicable Standards (Latest Edition):
 - 1. American Bearing Manufacturers Association (ABMA):
 - a. 9 - Load Ratings and Fatigue Life for Ball Bearings.
 - 2. Air Movement and Control Association International, Inc. (AMCA):
 - a. 99 - Standards Handbook.
 - b. 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating (ANSI).
 - c. 300 - Reverberant Room Method for Sound Testing of Fans.
 - d. 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
 - 3. NFPA:
 - a. 70 - National Electrical Code.
 - 4. Underwriters Laboratories Inc. (UL):
 - a. 705 - Power Ventilators.

1.03 PERFORMANCE REQUIREMENTS:

- A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
- B. Operating Limits: Classify according to AMCA 99.

1.04 SUBMITTALS:

- A. General: Submit each item in this Article in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Fan speed controllers.
- C. 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.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
 - 2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

SECTION 233423 - POWER VENTILATORS: continued

1.05 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. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standard: Power ventilators shall comply with UL 705.

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.07 COORDINATION:

- A. Coordinate size and location of structural-steel support members.

1.08 EXTRA MATERIALS:

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.01 IN-LINE CENTRIFUGAL FANS:

- 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 or an approved equal:
 - 1. Greenheck.
 - 2. Hartzell Fan, Inc.
 - 3. Loren Cook Company.
 - 4. Penn Ventilation.
- B. Description: In-line, direct or belt-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.
- C. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- F. Accessories:
 - 1. Companion Flanges: For inlet and outlet duct connections.
 - 2. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
- G. Capacities and Characteristics: As scheduled on the drawings.

2.02 MOTORS:

- A. Comply with requirements in SECTION 230513 - MOTORS.

SECTION 233423 POWER VENTILATORS: continued

- B. Motors shall be premium efficiency.

2.03 SOURCE QUALITY CONTROL:

- A. Sound-Power Level Ratings: Comply with AMCA 301. Factory test fans according to AMCA 300. Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Install power ventilators level and plumb.
- B. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- C. Support suspended units from structure using threaded steel rods and spring hangers with vertical-limit stops having a static deflection of 1 inch. Vibration-control and seismic-control devices are specified in SECTION 230548 - MECHANICAL VIBRATION AND SEISMIC CONTROLS. Provide seismic restraints on all fans weighing over 31 pounds.
- D. Install units with clearances for service and maintenance.
- E. Label units according to requirements specified in SECTION 230553 - MECHANICAL IDENTIFICATION.

3.02 CONNECTIONS:

- A. Duct installation and connection requirements are specified in other DIVISION 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in SECTION 233300 - DUCT ACCESSORIES.
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment in accordance with DIVISION 26.
- D. Connect wiring in accordance with DIVISION 26.

3.03 FIELD QUALITY CONTROL:

- A. Perform the following field tests and inspections and prepare test reports:
 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.

SECTION 233423 - POWER VENTILATORS: continued

- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.04 ADJUSTING:

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Refer to SECTION 230593 - TESTING, ADJUSTING, AND BALANCING for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

END OF SECTION 233423

SECTION 233700 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following:
 - 1. Single-duct air terminal units.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. Air-Conditioning and Refrigeration Institute (ARI):
 - a. 880 - Air Terminals.
 - 2. American Society for Testing and Materials (ASTM):
 - a. C1071 - Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).
 - 3. National Electrical Manufacturers Association (NEMA):
 - a. 250 - Enclosures for Electrical Equipment (1,000V Maximum).
 - 4. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code.
 - b. 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
 - 5. Underwriters Laboratories Inc. (UL):
 - a. 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 - b. 486B - Wire Connectors for Use with Aluminum Conductors.

1.03 SUBMITTALS:

- A. General: Submit the following in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Product Data: For each type of product indicated, include rated capacities, furnished specialties, sound-power ratings, and accessories.
- C. LEED® Submittal:
 - 1. Product Data for Prerequisite EQ1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."
- D. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Include a schedule showing unique model designation, room location, model number, size, and accessories furnished.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
 - 3. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
- E. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to requirements of SECTION 230500, include the following:
 - 1. Instructions for resetting minimum and maximum air volumes.
 - 2. Instructions for adjusting software set points.

1.04 QUALITY ASSURANCE:

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air terminal units and are based on the specific system indicated. Refer to DIVISION 01.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. NFPA Compliance: Install air terminal units according to NFPA 90A.

SECTION 233700 - AIR TERMINAL UNITS: continued

1.05 COORDINATION:

- A. Coordinate layout and installation of air terminal units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.01 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 or an approved equal.

2.02 SHUTOFF SINGLE-DUCT AIR TERMINAL UNITS:

- A. Manufacturers:
 - 1. Krueger.
 - 2. Price Industries.
 - 3. Titus.
 - 4. Trane Co. (The); Worldwide Applied Systems Group.
 - 5. Tuttle & Bailey.
- B. Configuration: Pressure independent volume-damper assembly inside unit casing with control components located inside a protective metal shroud.
- C. Casing: 0.034-inch steel.
 - 1. Casing Lining: 1/2-inch thick, coated, fibrous-glass duct liner complying with ASTM C1071; secured with adhesive. Cover liner with nonporous foil.
 - 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
 - 3. Air Outlet: S-slip and drive connections.
 - 4. Access: Removable panels for access to dampers and other parts requiring service, adjustment, or maintenance; with airtight gasket.
- D. Regulator Assembly: Extruded-aluminum or galvanized-steel components; key damper blades onto shaft with nylon-fitted pivot points located inside unit casing.
 - 1. Automatic Flow-Control Assembly: Combined spring rates shall be matched for each volume-regulator size with machined dashpot for stable operation.
 - 2. Factory-calibrated and field-adjustable assembly with shaft extension for connection to externally mounted control actuator.
- E. Airflow Sensing Device: Factory installed, multi-point velocity averaging sensor.
- F. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
 - 1. Maximum Damper Leakage: ARI 880 rated, 2% of nominal airflow at 3-inch wg inlet static pressure.
 - 2. Damper Position: Normally open.
- G. DDC Controls: Single-package unitary controller and actuator specified in SECTION 230900 - HVAC INSTRUMENTATION AND CONTROLS.

2.03 SOURCE QUALITY CONTROL:

- A. Identification: Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.
- B. Verification of Performance: Rate air terminal units according to ARI 880.

SECTION 233700 - AIR TERMINAL UNITS: continued

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- B. Provide seismic restraints for all units weighing more than 31 pounds. Refer to SECTION 230548 - MECHANICAL VIBRATION AND SEISMIC CONTROLS.

3.02 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 air terminal units to allow service and maintenance.
- C. Connect ducts to air terminal units according to SECTION 233113 - METAL DUCTS.
- D. Connect terminal units (except integral-diffuser air terminal units) to supply ducts using sheet metal ducts. Do not use flexible ducts.
- E. Ground units with electric heating coils according to DIVISION 26.
- F. Connect wiring according to DIVISION 26.
- G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.03 FIELD QUALITY CONTROL:

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

3.04 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 and do the following:
 - a. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 - b. Verify that controls and control enclosure are accessible.
 - c. Verify that control connections are complete.
 - d. Verify that nameplate and identification tag are visible.
 - e. Verify that controls respond to inputs as specified.

3.05 DEMONSTRATION:

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units. Refer to DIVISION 01.

END OF SECTION 233700

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section Includes:
 - 1. Rectangular and square ceiling diffusers.
 - 2. Adjustable grilles.
- B. Related Work Specified Elsewhere:
 - 1. Fixed and adjustable louvers and wall vents, whether or not they are connected to ducts DIVISION 08.
 - 2. Fire dampers and volume-control dampers not integral to diffusers, registers, and grilles: SECTION 233300 - DUCT ACCESSORIES.

1.02 REFERENCES:

- A. Applicable Standards (latest edition):
 - 1. American Society of Heating, Refrigerating and air-Conditions engineers (ASHRAE):
 - a. 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets (ANSI).

1.03 SUBMITTALS:

- A. General: Submit the following in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- C. Source quality-control reports.

PART 2 - PRODUCTS

2.01 CEILING DIFFUSERS:

- A. Rectangular and Square Ceiling Diffusers Type A:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 - a. Krueger.
 - b. Price Industries.
 - c. Titus.
 - d. Tuttle & Bailey.
 - 2. Devices shall be specifically designed for variable-air-volume flows.
 - 3. Material: Steel.
 - 4. Finish: Baked enamel, match color of ceiling T-bar.
 - 5. Face Size: 24 by 24 inches.
 - 6. Face Style: Three or Four cone.
 - 7. Mounting: Surface or T-bar.
 - 8. Pattern: Fixed.
 - 9. Dampers: Not required.
 - 10. Accessories:
 - a. Molded insulation blanket.

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES: continued

B. Perforated Ceiling Diffusers Type B:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 - a. Krueger.
 - b. Price Industries.
 - c. Titus.
 - d. Tuttle & Bailey.
2. Material: Steel.
3. Finish: Baked enamel, match color of ceiling T-bar.
4. Face Size: As indicated on the Drawings.
5. Face Style: Perforated.
6. Mounting: Surface or T-bar.
7. Pattern: Fixed.
8. Dampers: Not required.

2.02 REGISTERS AND GRILLES:

A. Exhaust Grille Type D:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 - a. Krueger.
 - b. Price Industries.
 - c. Titus.
 - d. Tuttle & Bailey.
2. Material: Steel or Aluminum.
3. Finish: Baked enamel, match ceiling color.
4. Face Arrangement: Double deflection blades, front blades shall be long dimension. Blade spacing shall be 3/4 inch.
5. Damper: Provide with optional opposed blade control damper.
6. Frame: 1 inch wide minimum.
7. Mounting: Surface.

B. Supply Grille Type C:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 - a. Krueger.
 - b. Price Industries.
 - c. Titus.
 - d. Tuttle & Bailey.
2. Material: Steel or Aluminum.
3. Finish: Baked enamel, white.
4. Face Arrangement: Double deflection blades, front blades shall be long dimension. Blade spacing shall be 3/4 inch.
5. Damper: Provide with optional opposed blade control damper.
6. Frame: 1 inch wide minimum.
7. Mounting: Duct mounted.

2.03 SOURCE QUALITY CONTROL:

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES: continued

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Engineer for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING:

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 237314 - INDOOR DEDICATED OUTSIDE AIR UNITS

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section Includes:
 - 1. Variable-air-volume, water-source heat pump designed for 100% outside air.

1.02 REFERENCES:

- A. Applicable Standards (Latest Edition):
 - 1. Air-Conditioning and Refrigeration Institute (ARI):
 - a. 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
 - b. 430 - Central-Station Air-Handling Units.
 - 2. Air Movement and Control Association International, Inc. (AMCA):
 - a. 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating (ANSI).
 - b. 300 - Reverberant Room Method for Sound Testing of Fans.
 - c. 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
 - d. 500-D - Laboratory Methods for Testing Dampers for Rating.
 - 3. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - a. 33 - Methods of Testing Forced Circulation Air Cooling and Air Heating Coils.
 - b. 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particles Size (ANSI).
 - c. 62.1 - Ventilation for Acceptable Indoor Air Quality (ANSI)
 - 4. ASTM International (ASTM):
 - a. B88 - Seamless Copper Water Tube.
 - 5. National Electrical Manufacturers Association (NEMA):
 - a. ICS 2 - Industrial Control and Systems: Controllers, Contractors, and Overload Relays, Rated not more than 2,000Vac or 750Vdc.
 - b. MG 1 - Motors and Generators.
 - 6. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code.
 - b. 90A - Installation of Air Conditioning and Ventilating Systems.
 - 7. Sheet Metal and air Conditioning Contractor's National Association (SMACNA).
 - a. HVAC Duct Construction Standards.
 - 8. Structural Engineering Institute/American Society of Civil Engineers (SEI/ASCE):
 - a. 7 - Minimum Design Loads for Buildings and Other Structures.

1.03 PERFORMANCE REQUIREMENTS:

- A. Structural Performance: Casing panels shall be self-supporting and capable of withstanding 133% of internal static pressures indicated, without panel joints exceeding a deflection of L/200 where "L" is the unsupported span length within completed casings.

1.04 SUBMITTALS:

- A. General:
 - 1. Submit each item in this Article in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Product Data: For each air-handling unit indicated.
 - 1. Unit dimensions and weight.
 - 2. Cabinet material, metal thickness, finishes, insulation, and accessories.

SECTION 237314 - INDOOR DEDICATED OUTSIDE AIR UNITS: continued

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.
- C. Delegated-Design Submittal: For vibration isolation restraints indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 1. Design Calculations: Calculate requirements for selecting vibration isolators.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.
- G. LEED[®] Submittal:
 1. Product Data for Prerequisite EQ1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."

1.05 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. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, and shall be listed and labeled by ARI.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- E. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- F. Comply with NFPA 70.

1.06 COORDINATION:

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.07 EXTRA MATERIALS:

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Filters: One set for each air-handling unit.
 2. Fan Belts: One set for each air-handling unit fan.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide Aaon model M2-H-011-R8AAOCX or a comparable product by one of the following or an approved equal:
 1. Addison Products Company.
 2. Aaon.

SECTION 237314 - INDOOR DEDICATED OUTSIDE AIR UNITS: continued

3. Climate Master.
4. Valent Air Management Systems.

2.02 UNIT CASINGS:

- A. General Fabrication Requirements for Casings:
 1. Forming: Form walls, roofs, and floors with at least two breaks at each joint.
 2. Casing Joints: Sheet metal screws or pop rivets.
 3. Sealing: Seal all joints with water-resistant sealant.
 4. Factory Finish for Steel Casings: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on enamel finish, consisting of prime coat and thermosetting topcoat.
 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- B. Casing Insulation and Adhesive:
 1. Materials: ASTM C1071, Type I or Type II.
 2. Location and Application: Encased between outside and inside casing.
- C. Inspection and Access Panels and Access Doors:
 1. Panel and Door Fabrication: Formed and reinforced, single- or double-wall and insulated panels of same materials and thicknesses as casing.
 2. Inspection and Access Panels:
 - a. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against air-pressure differential.
 - b. Gasket: Neoprene, applied around entire perimeters of panel frames.
 - c. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.
 3. Access Doors:
 - a. Hinges: A minimum of two ball-bearing hinges or stainless-steel piano hinge and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against air-pressure differential.
 - b. Gasket: Neoprene, applied around entire perimeters of panel frames.
 4. Locations and Applications:
 - a. Fan Section: Doors.
 - b. Access Section: Doors.
 - c. Coil Section: Inspection and access panel.
 - d. Filter Section: Doors large enough to allow periodic removal and installation of filters.
- D. Condensate Drain Pans:
 1. Fabricated with 2% slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.
 - a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
 - b. Depth: A minimum of 2 inches.
 2. Formed sections.
 3. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
 4. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
 - a. Minimum Connection Size: NPS 1.

SECTION 237314 - INDOOR DEDICATED OUTSIDE AIR UNITS: continued

5. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.
 - E. Air-Handling-Unit Mounting Frame: Formed galvanized-steel channel or structural channel supports, designed for low deflection, welded with integral lifting lugs.
- 2.03 FAN, DRIVE, AND MOTOR SECTION:
- A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
 1. Shafts: Designed for continuous operation at maximum-rated fan speed and motor horsepower, and with field-adjustable alignment.
 - a. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
 - b. Designed to operate at no more than 70% of first critical speed at top of fan's speed range.
 - B. Centrifugal Fan Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.
 1. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 2. Horizontal-Flanged, Split Housing: Bolted construction.
 3. Housing for Supply Fan: Attach housing to fan-section casing with metal-edged flexible duct connector.
 4. Flexible Connector: Factory fabricated with a fabric strip 5-3/4 inches wide attached to 2 strips of 2-3/4-inch wide, 0.028-inch thick, galvanized-steel sheet or 0.032-inch thick aluminum sheets; select metal compatible with casing.
 - a. Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives shall comply with UL 181, Class 1.
 - (1) Fabric Minimum Weight: 26 oz./sq. yd.
 - (2) Fabric Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - (3) Fabric Service Temperature: -40 to +200°F.
 - C. Airfoil, Centrifugal Fan Wheels: Smooth-curved inlet flange, backplate, and hollow die-formed airfoil-shaped blades continuously welded at tip flange and backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.
 - D. Fan Shaft Bearings:
 1. Grease-Lubricated Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing. Provide bearings with minimum L-10 life of 100,000 hours.
 - E. Belt Drives: Factory mounted, with adjustable alignment and belt tensioning, and with 1.5 service factor based on fan motor.
 1. Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
 2. Motor Pulleys: Adjustable pitch for use with 5-hp motors and smaller; fixed pitch for use with motors larger than 5 hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.
 3. Belts: Oil resistant, nonsparking, and nonstatic; in matched sets for multiple-belt drives.
 4. Belt Guards: Comply with requirements specified by OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards"; 0.1046-inch thick, 3/4-inch diamond-mesh wire screen, welded to steel angle frame; prime coated.

SECTION 237314 - INDOOR DEDICATED OUTSIDE AIR UNITS: continued

- F. Internal Vibration Isolation: Fans shall be factory mounted with manufacturer's standard restrained vibration isolation mounting devices having a minimum static deflection of 2 inches.
- G. Motor: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in SECTION 230513 - MOTORS.
 - 1. Enclosure Type: Totally enclosed, fan cooled.
 - 2. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
 - 3. 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.
 - 4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in DIVISION 26.
 - 5. Mount unit-mounted disconnect switches on exterior of unit.
- H. Variable Frequency Controllers: Shall be provided by DIVISION 26.

2.04 COIL SECTION:

- A. General Requirements for Coil Section:
 - 1. Comply with ARI 410.
 - 2. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
 - 3. Coils shall not act as structural component of unit.
- B. Refrigerant Coils: Coil designed for use with R-410A refrigerant, fabricated according to ARI 410, connected with soldered fittings.
 - 1. Capacity Reduction: Circuit for face control. Front to back split interlace.
 - 2. Tubes: Copper.
 - 3. Fins: Aluminum.
 - 4. Fin and Tube Joint: Mechanical bond a silver brazed.
 - 5. Coil Coating: Polymer e-coated cooling coil.
 - 6. Suction and Distributor: Seamless copper tube with brazed joints.
 - 7. Frames: Galvanized-steel channel frame, 0.052 inch.
 - 8. Ratings: Design tested and rated according to ASHRAE 33 and ARI 410.
 - a. Working-Pressure Rating: 300 psig.
 - 9. Source Quality Control: Test to 450 psig and 300 psig underwater.

2.05 WATER-SOURCE HEAT PUMP SECTION:

- A. Refrigerant-to-Water Heat Exchanger:
 - 1. Coaxial heat exchanger with copper water tube with enhanced heat-transfer surfaces inside a steel shell; both shell and tube leak tested to 450 psig on refrigerant side and 400 psig on water side. Factory mount heat exchanger in unit on resilient rubber vibration isolators.
 - 2. Refrigerant Circuit Components:
 - a. Sealed Refrigerant Circuit: Charge with R-410A refrigerant. Minimum of 2 circuits required. Intertwine circuits in refrigerant to air coil.
 - b. Charging Connections: Service fittings on suction and liquid for charging and testing on each circuit.
 - c. Reversing Valve: Pilot-operated sliding-type valve designed to be fail-safe in heating position with replaceable magnetic coil.
 - d. Compressor: Hermetic scroll compressors installed on vibration isolators housed in an acoustically treated enclosure with factory-installed safeties as follows:
 - (1) Antirecycle timer.

SECTION 237314 - INDOOR DEDICATED OUTSIDE AIR UNITS: continued

- (2) High-pressure cutout.
 - (3) Low-pressure cutout or loss of charge switch.
 - (4) Internal thermal-overload protection.
 - (5) Freezestat to stop compressor if water-loop temperature in refrigerant-to-water heat exchanger falls below 35°F.
- e. Refrigerant Piping Materials: ASTM B743 copper tube with wrought-copper fittings and brazed joints.
 - f. Pipe Insulation: Refrigerant minimum 3/8-inch thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-development indexes per ASTM E84.
 - g. Refrigerant Metering Device: Thermal expansion valve to allow specified operation with entering-water temperatures from 25 to 125°F.
 - h. Hot-Gas Reheat Valve: Pilot-operated sliding-type valve with replaceable magnetic coil.
 - i. Hot-Gas Reheat: Reheat valve diverts refrigerant hot gas to reheat coil when remote humidistat calls for dehumidification.
 - j. Provide unit with digital scroll compressor to maintain continuous refrigeration system operation at 10% of full load on lead compressor.

2.06 AIR FILTRATION SECTION:

- A. General Requirements for Air Filtration Section:
 1. Comply with NFPA 90A.
 2. Provide minimum arrestance according to ASHRAE 52.1, and a Minimum Efficiency Reporting Value (MERV) according to ASHRAE 52.2.
 3. Provide filter holding frames arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
- B. Extended-Surface, Disposable Panel Filters:
 1. Factory-fabricated, dry, extended-surface type.
 2. Thickness: 2 inches.
 3. Arrestance (ASHRAE 52.1): 90.
 4. MERV (ASHRAE 52.2): 8.
 5. Media: Fibrous material formed into deep-V-shaped pleats and held by self-supporting wire grid.
 6. Media-Grid Frame: Nonflammable cardboard.
 7. Mounting Frames: Welded, galvanized steel, with gaskets and fasteners, suitable for bolting together into built-up filter banks.
- C. Extended-Surface, Cartridge-Media Filters:
 1. Factory-fabricated, dry, extended-surface, self-supporting type.
 2. Arrestance (ASHRAE 52.1): 95.
 3. MERV (ASHRAE 52.2): 13.
 4. Media: Fibrous material with antimicrobial agent constructed so individual pleats are maintained in tapered form by flexible internal supports under rated-airflow conditions.
 5. Filter-Media Frame: Galvanized steel.
 6. Mounting Frames: Welded, galvanized steel, with gaskets and fasteners, suitable for bolting together into built-up filter banks.

SECTION 237314 - INDOOR DEDICATED OUTSIDE AIR UNITS: continued

2.07 DAMPERS:

- A. General Requirements for Dampers: Leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating," shall not exceed 2% of air quantity at 2,000-fpm face velocity through damper and 4-inch wg pressure differential.
- B. Damper Operators: Comply with requirements in SECTION 230900 - HVAC INSTRUMENTATION AND CONTROLS.
- C. Outdoor-Air Dampers: Low-leakage, double-skin, airfoil-blade, galvanized-steel dampers with compressible jamb seals and extruded-vinyl blade edge seals in opposed or parallel-blade arrangement with steel operating rods rotating in stainless-steel sleeve bearings mounted in a single galvanized-steel frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 5 cfm/sq. ft. at 1-inch wg and 9 cfm/sq. ft. at 4-inch wg.

2.08 CAPACITIES AND CHARACTERISTICS:

- A. As scheduled on the Drawings.

2.09 SOURCE QUALITY CONTROL:

- A. Fan Sound-Power Level Ratings: Comply with AMCA 301. Test fans according to AMCA 300. Fans shall bear AMCA-certified sound ratings seal.
- B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210.
- C. Refrigerant Coils: Factory tested to 450 psig according to ARI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. Equipment Mounting: Install air-handling units on concrete bases using elastomeric pads. Secure units to anchor bolts installed in concrete bases. Comply with requirements for concrete bases specified in DIVISION 03. Comply with requirements for vibration isolation devices specified in SECTION 230548 - MECHANICAL VIBRATION AND SEISMIC CONTROLS.
- 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. If air handlers are used during construction, filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 shall be used at each return grille. Remove temporary filters immediately prior to final test and balancing.
- E. Install filter-gauge, static-pressure taps upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum in accessible position. Provide filter

SECTION 237314 - INDOOR DEDICATED OUTSIDE AIR UNITS: continued

gauges on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

3.03 CONNECTIONS:

- A. Comply with requirements for piping specified in other DIVISIONS 22 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to air-handling unit to allow service and maintenance.
- C. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.
- D. Connect condensate drain pans using, ASTM B88, 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.
- E. Geothermal Water Piping: Comply with applicable requirements in SECTION 232113 - 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.
- F. Connect duct to air-handling units with flexible connections. Comply with requirements in SECTION 233300 - DUCT ACCESSORIES.

3.04 FIELD QUALITY CONTROL:

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. 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. Leak Test: After installation, fill water coils with water, and test coils and connections for leaks.
 - 2. Charge refrigerant coils with refrigerant and test for leaks.
 - 3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.05 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 shipping, blocking, and bracing are removed.
 - 3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
 - 4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
 - 5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory recommended lubricants.
 - 6. Verify that outdoor-dampers open and close, and maintain minimum outdoor-air setting.
 - 7. Comb coil fins for parallel orientation.

SECTION 237314 - INDOOR DEDICATED OUTSIDE AIR UNITS: continued

8. Verify that water source heat pump components are operating correctly.
 9. Install new, clean filters.
 10. Verify that manual and automatic volume control and fire dampers in connected duct systems are in fully open position.
- B. Starting procedures for air-handling units include the following:
1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
 2. Measure and record motor electrical values for voltage and amperage.
 3. Manually operate dampers from fully closed to fully open position and record fan performance.
- 3.06 ADJUSTING:
- A. Adjust damper linkages for proper damper operation.
 - B. Comply with requirements in SECTION 230900 - TESTING, ADJUSTING, AND BALANCING for air-handling system testing, adjusting, and balancing.
- 3.07 CLEANING:
- A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.
- 3.08 DEMONSTRATION:
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-handling units. Comply with requirements in SECTION 017900 - DEMONSTRATION AND TRAINING.

END OF SECTION 237314

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONING UNITS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

1.02 REFERENCES:

- A. Applicable Standards (Latest Edition):
 - 1. Air-Conditioning and Refrigeration Institute (ARI):
 - a. 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
 - 2. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code.

1.03 SUBMITTALS:

- A. General: Submit each item in this Article in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- C. Shop Drawings: Diagram power, signal, and control wiring.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.
- F. Warranty: Special warranty specified in this Section.
- G. LEED[®] Submittals:
 - 1. Credit EA 4: Manufacturers' product data for refrigerants, including printed statement that refrigerants are free of HCFCs.

1.04 QUALITY ASSURANCE:

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to DIVISION 01.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1.
- D. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1.
- E. Units shall be designed to operate with HCFC-free refrigerants.

1.05 COORDINATION:

- A. Coordinate size and location of concrete bases for units. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in DIVISION 03.

1.06 WARRANTY:

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from Date of Substantial Completion.

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONING UNITS: continued

1.07 EXTRA MATERIALS:

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set of filters for each unit.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of those listed below or an approved equal.
 - 1. Friedrich Air Conditioning Company.
 - 2. Fujitsu General America.
 - 3. Mitsubishi Electronics America, Inc.; HVAC Division.
 - 4. Sanyo Fisher (U.S.A.) Corp.

2.02 WALL-MOUNTING, EVAPORATOR-FAN COMPONENTS:

- A. Cabinet: Enameled steel with removable panels on front and ends in color selected by Engineer, and discharge drain pans with drain connection.
- B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.
- C. Fan: Direct drive, centrifugal fan.
- D. Fan Motors: Comply with requirements in SECTION 230513 - MOTORS.
 - 1. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.
- E. Filters: Permanent, cleanable.

2.03 CEILING-MOUNTING CASSETTE, EVAPORATOR-FAN COMPONENTS:

- A. Cabinet: Ceiling cassette fan coil unit, 2 feet by 2 feet. Cabinet shall have adjustable four-way air distribution grilles. Return air shall be through the distribution panel. Cabinet shall be insulated. Integral temperature sensor.
- B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with electronic-expansion valve.
- C. Condensate Pan: Provide condensate pan with connection to drain.
- D. Outside Air Intake: Unit shall provide for connection of outside air duct.
- E. Fan: Direct drive, centrifugal fan and integral condensate pump.
- F. Fan Motors: Comply with requirements in SECTION 230513 - MOTORS.
 - 1. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.
- G. Filters: High Efficiency MERV 8 minimum.

2.04 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS:

- A. Casing: Steel, finished with baked enamel in color selected by Engineer, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gauge ports on exterior of casing.
- B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - 1. Compressor Type: Inverter controlled scroll.
 - 2. Refrigerant Type: R-410A.

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONING UNITS: continued

- C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler. Provide with manufacturer's optional coil coating for coastal areas.
- D. Fan: Aluminum-propeller type, directly connected to motor.
- E. Motor: Permanently lubricated, with integral thermal-overload protection.
- F. Low Ambient Kit.
- G. Mounting Base: Polyethylene.

2.05 ACCESSORIES:

- A. Control equipment is specified in SECTION 230900 - HVAC INSTRUMENTATION AND CONTROLS.
- B. Provide wall mounted controller for each evaporator unit to control compressor and evaporator fan. Provide with Bacnet compatible system gateway for connection to the building DDC System. DDC system shall receive alarms, temperature and on/off status; and shall control on/off operation and temperature setpoints.
- C. Automatic-reset timer to prevent rapid cycling of compressor.
- D. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

2.06 FAN COIL UNIT CONDENSATE PUMP:

- A. Basis of Design: Little Giant Model #VCMA-15 ULS or approved equal.
- B. 1/2 gallon, ABS plastic condensate pump unit shall include vertical-type pump with stainless steel motor shaft, galvanized steel tank cover and integral float/switch assembly. Thermally protected motor shall be UL-listed. Pump shall feature a safety switch that can be wired to a DDC alarm to warn of possible tank overflow. Provide with check valve on pump outlet. Shut off head shall be minimum 15 feet.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install ground-mounting, compressor-condenser components on polyethylene mounting base.
- D. Install seismic restraints. Refer to SECTION 230548 - MECHANICAL VIBRATION AND SEISMIC CONTROL.
- E. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 1 inch. Refer to SECTION 230548 - MECHANICAL VIBRATION AND SEISMIC CONTROL.
- F. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.02 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 unit to allow service and maintenance.
- C. Ground equipment according to DIVISION 26.
- D. Electrical Connections: Comply with requirements in DIVISION 26 for power wiring, switches, and motor controls.

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONING UNITS: continued

3.03 FIELD QUALITY CONTROL:

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

3.04 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.

3.05 DEMONSTRATION:

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to DIVISION 01.

END OF SECTION 238126

SECTION 238146 - WATER-SOURCE HEAT PUMPS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes the following types of water-source heat pumps:
 - 1. Concealed horizontal or vertical units, 6 tons and smaller.
 - 2. Accessories.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American Refrigeration Institute (ARI):
 - a. Guideline B - Roof Mounted Outdoor air-conditioning Installations.
 - b. ISO-13256-1 - Water-Source Heat Pumps - Testing and Rating for Performance.
 - 2. American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE):
 - a. 15 - Safety Standard for Refrigeration Systems.
 - b. 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Use in General Ventilation for Removing Particulate Matter (ANSI).
 - c. 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size (ANSI).
 - d. 62 - Ventilation for Acceptable Indoor Air Quality.
 - 3. American Society of Heating, Refrigerating and Air-Conditioning Engineers/Illuminating Engineering Society of North America (ASHRAE/IESNA):
 - a. 90.1 - Energy Standard for Buildings except Low-Rise Residential Buildings.
 - 4. ASTM International (ASTM):
 - a. B88 - Seamless Copper Water Tube.
 - b. B88M - Seamless Copper Water Tube (Metric).
 - c. B743 - Seamless Copper Tube in Coils.
 - d. E84 - Test Method for Surface Burning Characteristics of Building Materials.
 - 5. National Roofing Contractors Association (NRCA):
 - a. Low-Slope Membrane Roofing Construction Details Manual, Vol. 1 (1996).
 - 6. NFPA International (NFPA):
 - a. 70 - National Electrical Code.
 - 7. Underwriters Laboratories Inc. (UL):
 - a. 181 - Factory-Made Air Ducts and Air Connectors.
 - b. 1995 - Heating and Cooling Equipment.

1.03 SUBMITTALS:

- A. General: Submit the following as specified in SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Product Data: Include rated capacities, furnished specialties, and accessories for each model.
- C. 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.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- D. Product Certificates: For each type of water-source heat pump, signed by product manufacturer.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For water-source heat pumps to include in emergency, operation, and maintenance manuals.
- G. Warranty: Special warranty specified in this Section.

SECTION 238146 - WATER-SOURCE HEAT PUMPS: continued

1.04 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 ASHRAE 15.
- C. Comply with minimum COP/efficiency levels according to ASHRAE/IESNA 90.1.
- D. Comply with NFPA 70.
- E. Comply with safety requirements in UL 1995 for duct-system connections.

1.05 COORDINATION:

- A. Coordinate layout and installation of water-source heat pumps and suspension components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components, and partition assemblies.

1.06 WARRANTY:

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water-source heat pumps that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, refrigeration components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

1.07 EXTRA MATERIALS:

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. One set of filters for each unit.

PART 2 - PRODUCTS

2.01 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 or an approved equal.

2.02 CONCEALED WATER-SOURCE HEAT PUMPS, 6 TONS AND SMALLER:

- A. Manufacturers:
 - 1. Carrier Corporation.
 - 2. ClimateMaster, Inc.
 - 3. McQuay International.
 - 4. Trane.
- B. Description: Packaged water-source heat pump with temperature controls; factory assembled, tested, and rated according to ARI-ISO-13256-1.
- C. Cabinet and Chassis: Galvanized-steel casing with the following features:
 - 1. Minimum of 2 access panels for access and maintenance of internal components. One for blower section and one for compressor.
 - 2. Knockouts for electrical and piping connections.
 - 3. Flanged duct connections.
 - 4. Cabinet Insulation: Glass-fiber liner, minimum 1/2 inch thick, complying with UL 181.

SECTION 238146 - WATER-SOURCE HEAT PUMPS: continued

5. Condensate Drainage: Stainless-steel drain pan pitched as required in ASHRAE 62 with condensate drain piping projecting through unit cabinet.
- D. Fan: Direct driven, centrifugal, with multispeed motor resiliently mounted in fan inlet.
 1. General requirements for motors are specified in SECTION 230513 - MOTORS.
 2. Motor: Multispeed, permanently lubricated. Permanent split capacitor or ECM motor as indicated on the Drawings.
- E. Water Circuit:
 1. Refrigerant-to-Water Heat Exchangers:
 - a. Coaxial heat exchangers with copper or cupronickel water tube with enhanced heat-transfer surfaces inside a steel shell; both shell and tube leak tested to 450 psig on refrigerant side and 400 psig on water side. Factory mount heat exchanger in unit on resilient rubber vibration isolators.
 2. Motorized Water Valve: Stop water flow through the unit when compressor is off.
- F. Refrigerant-to-Air Coils: Copper tubes with aluminum fins, leak tested to 450 psig. Provide with optional e-coating.
- G. Refrigerant Circuit Components:
 1. Sealed Refrigerant Circuit: Charge with R-410A refrigerant.
 2. Charging Connections: Service fittings on suction and liquid for charging and testing.
 3. Reversing Valve: Pilot-operated sliding-type valve designed to be fail-safe in heating position with replaceable magnetic coil.
 4. Compressor: Compressors shall be rotary or reciprocating for units 2 tons or less and scroll for larger sizes. Hermetic compressor installed on vibration isolators and housed in an acoustically treated enclosure with factory-installed safeties as follows:
 - a. Anti-recycle timer.
 - b. High-pressure cutout.
 - c. Low-pressure cutout or loss of charge switch.
 - d. Internal thermal-overload protection.
 - e. Freezestat to stop compressor if water-loop temperature in refrigerant-to-water heat exchanger falls below 35°F.
 - f. Condensate overflow switch to stop compressor with high condensate level in condensate drain pan.
 5. Refrigerant Piping Materials: ASTM B743 copper tube with wrought-copper fittings and brazed joints.
 6. Pipe Insulation: Refrigerant minimum 3/8 inch thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-development indexes according to ASTM E84.
 7. Refrigerant Metering Device: Thermal expansion valve to allow specified operation with entering-water temperatures from 30 to 110°F.
- H. Filters: Disposable, pleated type, 2 inches thick and with a minimum efficiency reporting value of 13 according to ASHRAE 52.2.
- I. Controls:
 1. Basic Unit Controls:
 - a. Low- and high-voltage protection.
 - b. Overcurrent protection for compressor and fan motor.
 - c. Random time delay, three to ten seconds, start on power up.
 - d. Time delay override for servicing.
 - e. Control voltage transformer.
 2. Thermostat:
 - a. Wall-mounted temperature sensor with ± 3 degree setpoint adjustment.

SECTION 238146 - WATER-SOURCE HEAT PUMPS: continued

- b. Unoccupied period override push button.
- c. LED to indicate fault condition at heat pump.
- 3. DDC interface requirements as further described in SECTION 230900 - HVAC INSTRUMENTATION AND CONTROLS.
 - a. Interface relay for scheduled operation.
 - b. Interface relay to provide indication of fault at central workstation.
 - c. Provide Johnson Controls Metasys compatible interface for the following functions:
 - (1) Set-point adjustment for set points identified in this Section.
 - (2) Start/stop and operating status of heat-pump unit.
 - (3) Data inquiry to include supply air, room air temperature and humidity, and entering and leaving-water temperatures.
 - (4) Occupied and unoccupied schedules.
- J. Electrical Connection: Single electrical connection.
- K. Capacities and Characteristics: As Scheduled on the Drawings.

2.03 HOSE KITS:

- A. General: Hose kits shall be designed for minimum 400 psig working pressure, and operating temperatures from 30 to 211°F. Tag hose kits to equipment designations.
- B. Hose: Length 24 inches. Minimum diameter, equal to water-source heat-pump connection size.
- C. Isolation Valves: Two-piece full port bronze-body ball valves with stainless-steel ball and stem and galvanized-steel lever handle. Provide valve for supply and return. If balancing device is combination shutoff type with memory stop, the isolation valve may be omitted on the return.
- D. Strainer: Y-type with blowdown valve in supply connection.
- E. Balancing Device: Mount in return connection. Include meter ports to allow flow measurement with differential pressure gauge.
 - 1. Manual, calibrated-orifice balancing valve.

2.04 FAN COIL UNIT CONDENSATE PUMP:

- A. Basis of Design: Little Giant Model #VCMA-15 ULS or approved equal.
- B. 1/2 gallon, ABS plastic condensate pump unit shall include vertical-type pump with stainless steel motor shaft, galvanized steel tank cover and integral float/switch assembly. Thermally protected motor shall be UL-listed. Pump shall feature a safety switch that can be wired to a DDC alarm to warn of possible tank overflow. Provide with check valve on pump outlet. Shut off head shall be minimum 15 feet.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of water-source heat pumps.
- B. Examine roughing-in for piping and electric installations for water-source heat pumps to verify actual locations of piping connections and electrical conduit before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. Suspend water-source heat pumps from structure with threaded steel rods and minimum 0.5-inch static deflection rubber-in-shear vibration isolators. Provide seismic restraints.

SECTION 238146 - WATER-SOURCE HEAT PUMPS: continued

Vibration isolators and seismic restraints are specified in SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT.

- B. Install wall-mounting thermostats, humidistats, and switch controls in electrical outlet boxes at heights to match lighting controls.

3.03 CONNECTIONS:

- A. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
 - 1. Connect supply and return hydronic piping to heat pump with unions and shutoff valves or hose kits.
 - 2. Connect heat-pump condensate drain pan to indirect waste connection with condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.
- B. Duct installation requirements are specified in other DIVISION 23 Sections. Drawings indicate general arrangement of ducts. Specific connection requirements are as follows:
 - 1. Connect supply and return ducts to water-source heat pumps with flexible duct connectors specified in SECTION 233300 - DUCT ACCESSORIES.
- C. Install electrical devices furnished by manufacturer but not specified to be factory mounted.
- D. Install piping adjacent to machine to allow service and maintenance.
- E. Ground equipment according to DIVISION 26.
- F. Connect wiring according to DIVISION 26.

3.04 FIELD QUALITY CONTROL:

- A. Provide a QC Specialist to perform duties for this equipment in accordance with SECTION 014500 - QUALITY CONTROL.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.
- C. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing water-source heat pumps and after electrical circuitry has been energized, test units for compliance with requirements.
 - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.

3.05 STARTUP SERVICE:

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
 - 1. Inspect for visible damage to unit casing.
 - 2. Inspect for visible damage to compressor, coils, and fans.
 - 3. Inspect internal insulation.
 - 4. Verify that labels are clearly visible.
 - 5. Verify that clearances have been provided for servicing.
 - 6. Verify that controls are connected and operable.
 - 7. Verify that filters are installed.

SECTION 238146 - WATER-SOURCE HEAT PUMPS: continued

8. Adjust vibration isolators.
 9. Inspect operation of barometric dampers.
 10. Verify bearing lubrication on fan.
 11. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 12. Adjust fan belts to proper alignment and tension.
 13. Start unit according to manufacturer's written instructions.
 14. Complete startup sheets and attach copy with Contractor's startup report.
 15. Inspect and record performance of interlocks and protective devices; verify sequences.
 16. Operate unit for an initial period as recommended or required by manufacturer, but no less than 24 hours.
 17. Verify thermostat and humidistat calibration.
 18. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
 19. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
- 3.06 ADJUSTING:
- A. Adjust initial temperature and humidity set points.
 - B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
 - C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions.
- 3.07 CLEANING:
- A. Replace filters used during construction prior to air balance or substantial completion.
 - B. After completing installation of exposed, factory-finished water-source heat pumps, inspect exposed finishes and repair damaged finishes.
- 3.08 DEMONSTRATION:
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water-source heat pumps. Refer to requirements in SECTION 017900 - DEMONSTRATION AND TRAINING.

END OF SECTION 238146

SECTION 238240 - PROPELLER UNIT HEATERS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes propeller unit heaters with electric-resistance coils.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. American Society of Heating, Refrigerating and air-Conditioning Engineers (ASHRAE):
 - a. 33 - Method of Testing Forced Circulation Air Cooling and Heating Coils (ANSI).
 - 2. NFPA International (NFPA):
 - a. 70 - National Electrical Code.
 - b. 90A - Installation of Air Conditioning and Ventilating Systems.
 - 3. Underwriters Laboratories Inc. (UL):
 - a. 823 - Electric Heaters for Use in Hazardous (Classified) Locations.
 - b. 2021 - Fixed and Location-Dedicated Electric Room Heaters.

1.03 SUBMITTALS:

- A. General: Submit as specified in SECTION 230500 - COMMON WORK RESULTS FOR HVAC.
- B. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each unit type and configuration.
- C. Shop Drawings: Submit the following for each unit type and configuration:
 - 1. Plans, elevations, sections, and details.
 - 2. Details of anchorages and attachments to structure and to supported equipment.
 - 3. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 - 4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
- D. Operation and Maintenance Data: For propeller unit heaters to include in operation and maintenance manuals.

1.04 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.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 - 1. Brasch Manufacturing Co., Inc.
 - 2. Carrier Corp.
 - 3. Chromalox.

2.02 UNIT HEATERS:

- A. Description: An assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.
- B. Comply with UL 2021.

SECTION 238240 - PROPELLER UNIT HEATERS: continued

2.03 CASING:

- A. Cabinet: Removable panels for maintenance access to controls.
- B. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.
- C. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

2.04 ELECTRIC-RESISTANCE HEATING ELEMENTS:

- A. Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550°F at any point during normal operation.
 - 1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
 - 2. Wiring Terminations: Stainless-steel or corrosion-resistant material.

2.05 FAN:

- A. Propeller type, aluminum wheel directly mounted on motor shaft in the fan venturi.

2.06 FAN MOTORS:

- A. Comply with requirements in SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT.
- B. Motor Type: Permanently lubricated.

2.07 CONTROLS:

- A. Control Devices:
 - 1. Unit-mounted thermostat.

2.08 CAPACITIES AND CHARACTERISTICS:

- A. As scheduled on the Drawings.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for electrical connections to verify actual locations before propeller unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. Install propeller unit heaters level and plumb.
- B. Install propeller unit heaters to comply with NFPA 90A.
- C. Provide seismic restraints for all units weighing more than 31 lbs. Refer to SECTION 230548 - MECHANICAL VIBRATION AND SEISMIC CONTROLS.

3.03 CONNECTIONS:

- A. Ground equipment according to DIVISION 26.
- B. Connect wiring according to DIVISION 26.

SECTION 238240 - PROPELLER UNIT HEATERS: continued

3.04 FIELD QUALITY CONTROL:

- A. Testing: Perform the following field quality-control testing and report results in writing:
 - 1. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 - 3. Test and adjust controls and safeties.
- B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 238240

SECTION 238241 - WALL AND CEILING HEATERS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes wall and ceiling heaters with propeller fans and electric heating elements.

1.02 REFERENCES:

- A. Applicable Standards (Latest Edition):
 - 1. NFPA:
 - a. 70 - National Electrical Code.
 - b. 90A - Installation of Air Conditioning and Ventilating Systems.
 - 2. Underwriters Laboratories Inc. (UL):
 - a. 2021 - Fixed and Location-Dedicated Electric Room Heaters.

1.03 SUBMITTALS:

- A. General: Submit each item in this Article in accordance with SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS.
- B. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.
- C. 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.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- D. Samples for Color Selection: Finish colors for units with factory-applied color finishes.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For wall and ceiling heaters to include in emergency, operation, and maintenance manuals.

1.04 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.

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS:

- A. Basis of Design Product: Subject to compliance with requirements, provide Berko FRC Series or a comparable product by one of the following or an approved equal:
 - 1. Berko Electric Heating; a division of Marley Engineered Products.
 - 2. Chromalox, Inc.; a division of Emerson Electric Company.
 - 3. Indeeco.
 - 4. Markel Products; a division of TPI Corporation.
 - 5. Marley Electric Heating; a division of Marley Engineered Products.
 - 6. QMark Electric Heating; a division of Marley Engineered Products.
 - 7. Trane.
- B. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021. Wall heater shall be recessed in wall cavity.

SECTION 238241 - WALL AND CEILING HEATERS: continued

- C. Cabinet:
 - 1. Front Panel: Stamped-steel louver, minimum 16 gage, with removable panels fastened with tamperproof fasteners.
 - 2. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Contracting Officer, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
- D. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high temperature protection.
- E. Fan: Aluminum propeller directly connected to motor.
 - 1. Motor: Permanently lubricated. Comply with requirements in SECTION 230513 - MOTORS.
- F. Controls: Unit-mounted thermostat.
- G. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.
- H. Capacities and Characteristics: As indicated on the Drawings.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas to receive wall heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for electrical connections to verify actual locations before wall and ceiling heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. Install wall boxes in finished wall assembly.
- B. Install wall heaters to comply with NFPA 90A.

3.03 CONNECTIONS:

- A. Ground equipment in accordance with DIVISION 26.
- B. Connect wiring in accordance with DIVISION 26.

3.04 FIELD QUALITY CONTROL:

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Operate electric heating elements to verify proper operation and electrical connections.
 - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

3.05 ADJUSTING:

- A. Adjust initial temperature set points.

END OF SECTION 238241

DIVISION 26 - ELECTRICAL

SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section specifies general administrative and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in DIVISION 01:
 - 1. Submittals.
 - 2. Coordination drawings.
 - 3. Record documents.
 - 4. Maintenance manuals.
 - 5. Rough-ins.
 - 6. Electrical installations.
 - 7. Cutting and patching.
- B. Related Work Specified Elsewhere: The following Sections contain requirements that relate to this Section.
 - 1. Excavation for electrical installations within the building boundaries and from building to utility connections: DIVISION 31.
 - 2. Factory-installed motors, controllers, accessories, and connections: DIVISIONS 22 and 23.
 - 3. DIVISION 27 - Communication.
 - 4. DIVISION 28 - Fire Alarm.
 - 5. DIVISION 48 - Photovoltaic.
- C. Site Conditions:
 - 1. Altitude = 16 feet above mean sea level.
 - 2. Maximum Outdoor Ambient Temperature = +91°F.
 - 3. Minimum Outdoor Ambient Temperature = +57°F.
 - 4. Maximum Outdoor Relative Humidity = 74%.
 - 5. Seismic Zone D.
- D. This Contract includes, but is not limited to, the following work components:
 - 1. Provide and install (including supports) the following Equipment as per the Drawings and Specifications:

1.02 SUBMITTALS:

- A. Submit as specified in DIVISION 01.
- B. LEED® Submittals:
 - 1. Product Data for EQ Credit 4.1: For site-applied interior adhesives, sealants and sealant primers, documentation indicating VOC content of product and VOC limit per LEED-NC requirements.
 - a. Include in the LEED Documentation Notebook.
- C. Refer to each section in this Division for specific Submittal requirements.
- D. Provide "As-Built" schematic diagrams and wiring diagrams.

1.03 COORDINATION DRAWINGS:

- A. Prepare coordination drawings in accordance with DIVISION 01, for equipment rooms, and other congested areas to a scale of 1/4 inches = 1 foot-0 inches or larger if required. Detail major elements, components, and systems of electrical equipment and materials in relationship

SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS: continued

with other systems, installations, and building components. Drawings shall be prepared on 30- by 42-inch paper. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of major raceway systems, equipment, and materials.
2. Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.
3. Exterior wall and foundation penetrations.
4. Fire-rated wall and floor penetrations.
5. Equipment connections and support details.
6. Sizes and location of required concrete pads and bases.
7. Support details.
8. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
9. Prepare floor plans, elevations, and appropriate details to indicate penetrations in floors, walls, and ceilings, and their relationship to other penetrations and installations.
10. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets, air inlets, light fixtures, communications systems' components, sprinklers, speakers, heat detectors, smoke detectors, and other ceiling-mounted devices.

1.04 RECORD DOCUMENTS:

- A. Prepare record documents in accordance with the requirements in SECTION 017800 - CONTRACT CLOSEOUT. In addition to the requirements specified in DIVISION 01, indicate installed conditions for:
 1. Major raceway systems, size and location for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; fuse sizes and circuit breaker sizes and arrangements.
 2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 3. Approved substitutions, Contract Modifications, and actual Equipment and Materials installed.
- B. Engage the services of a licensed Land Surveyor or licensed Professional Engineer registered in the state in which the Project is located to record the locations and invert elevations of underground installations.

1.05 MAINTENANCE MANUALS:

- A. Prepare maintenance manuals in accordance with SECTION 017800 - CONTRACT CLOSEOUT. In addition to the requirements specified in DIVISION 01, include the following information for Equipment items:
 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
 3. Maintenance procedures for routine preventive maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 4. Servicing instructions and lubrication charts and schedules.
 5. "As-Built" schematic and wiring diagrams.

SECTION 260000 - BASIC ELECTRICAL REQUIREMENT: continued

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver products to the Project Site properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.07 WARRANTY:

- A. Provide a minimum 1-year warranty on all electrical Equipment. Warranty period shall begin when Equipment is permanently energized or started unless specified otherwise. Contractor shall provide written notification to Contracting Officer's Representative prior to this warranty start date.
- B. Warranty on lamps and fixture shall start at building occupancy.

1.08 INSTRUCTIONS, TRAINING, AND MANUFACTURER'S SERVICE REPRESENTATIVE:

- A. Provide instructions and training of Contracting Officer's personnel as specified.
- B. Provide services of a manufacturer's authorized service representative as specified.

PART 2 - PRODUCTS

2.01 Unless indicated otherwise, all Equipment and Material shall be new, undamaged and meet the requirements of Underwriters Laboratories, Inc. (UL). Where UL requirements are not applicable, equipment and material shall be identified as such by Contractor and approved by Contracting Officer before purchase and installation.

2.02 LEED REQUIREMENTS:

- A. See SECTION 018113 - SUSTAINABLE DESIGN REQUIREMENTS for LEED requirements pertaining to VOC limits for site-applied interior adhesives, sealants, paints and coatings.

2.03 ELECTRONIC EQUIPMENT COMPLIANCE:

- A. Contractor warrants that all equipment, devices, items, systems, software, hardware, or firmware provided shall properly, appropriately, and consistently function and accurately process date and time data (including without limitation: calculating, comparing, and sequencing). This warranty supersedes anything in the Specifications or other Contract Documents which might be construed inconsistently. This warranty is applicable whether the equipment, device, item, system, software, hardware, or firmware is specified with or without reference to a manufacturer's name, make, or model number.

PART 3 - EXECUTION

3.01 ROUGH-IN:

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual Equipment to be connected.
- B. Refer to Equipment Specifications in DIVISIONS 01 through 48 and the Equipment Submittals for rough-in requirements.

SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS: continued

3.02 ELECTRICAL INSTALLATIONS:

- A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. All electrical work and material shall comply with the National Electrical Code (NEC) 2011 Edition and ANG ETL 01-1-1. Comply with the following requirements:
1. Coordinate electrical systems, equipment, and materials installation with other building components. Equipment motor horsepower sizes and kilowatt sizes shown are approximate. If Equipment of a different size is furnished by Contractor, Contractor shall furnish and install the proper support equipment, motor starter, switchgear, feeders, fuses, circuit breaker, disconnect switch, wire, and conduit required for the Equipment furnished, at no additional cost to Contracting Officer.
 2. Verify all existing dimensions by field measurements.
 3. Arrange for chases, slots, and openings in other building components during progress of construction to allow for electrical installations.
 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components as they are constructed.
 5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large Equipment requiring positioning prior to closing in the building. Coordinate concrete pads, bases, roof curbs, and related items.
 6. Coordinate with all other building trades.
 7. Where mounting heights are not specifically detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 8. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
 9. Install systems, materials, and equipment to conform with approved Submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Should coordination requirements conflict with individual system requirements, refer conflict to Contracting Officer's Representative in writing.
 10. Install systems, Materials, and Equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
 11. Install electrical Equipment to facilitate servicing, maintenance, and repair or replacement of Equipment components. As much as practical, connect Equipment for ease of disconnecting with minimum of interference with other installations.
 12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
 13. All equipment and materials shall be installed in accordance with the National Electrical Code (NEC) and ANG ETL 01-1-1.
 14. All equipment conductor termination provisions shall be UL-listed for 75°C conductors.
 15. All electrical equipment and installations shall be of adequate strength to withstand, without failure, forces encountered in defined Seismic Zone 2A.
 16. For underground duct provide magnetic tape 12 inches below grade for entire length of duct bank.

SECTION 260000 - BASIC ELECTRICAL REQUIREMENT: continued

3.03 CUTTING AND PATCHING:

- A. General: Perform all required cutting and patching. In addition to the requirements specified in DIVISION 01, the following requirements apply:
 - 1. Perform cutting and patching for electrical Equipment and Materials required to:
 - a. Uncover work to provide for installation of ill-timed Work.
 - b. Remove and replace defective Work.
 - c. Remove and replace work not conforming to requirements of the Contract Documents.
 - d. Remove Samples of installed Work as specified for testing.
 - e. Install Equipment and Materials in existing structures.
 - f. Upon written instructions from Contracting Officer, uncover and restore Work to provide for Contracting Officer's observation of concealed Work if installed without using the proper specified procedures.
 - B. For work in existing installations, the Contractor shall cut, remove, and legally dispose of selected electrical equipment, components, and materials as indicated, including, but not limited to, removal of electrical items indicated to be removed and items made obsolete by the new Work.
 - C. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
 - D. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
 - E. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
 - F. All penetrations through fire-rated walls, ceilings and floors shall be sealed with a UL-listed and Factory Mutual approved sealant system that matches the fire rating of the surface penetrated.
 - G. Patch existing finished surfaces and building components that must be cut for the electrical installation or are damaged by Contractor using new materials matching existing materials.
 - H. Patch finished surfaces and building components using new materials specified for the original installation.
 - I. All cutting, patching, and repairing shall be subject to the supervision and the approval of Contracting Officer's Representative.

3.04 SPECIFIC REQUIREMENTS:

- A. Refer to each Section this Division for specific performance requirements.

END OF SECTION 260000

SECTION 260516 - WIRES AND CABLES

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section specifies wires, cables, and connectors for power, lighting, signal, control, and related systems.
- B. Related Work Specified Elsewhere:
 - 1. Earthwork for trenching and backfilling for direct buried cable: DIVISION 31.
 - 2. SECTION 260534 - ELECTRICAL BOXES AND FITTINGS for connectors for terminating cables in boxes and other electrical enclosures.
 - 3. SECTION 262730 - ELECTRICAL CONNECTIONS.
 - 4. SECTION 260553 - ELECTRICAL IDENTIFICATION.
 - 5. SECTION 260526 - GROUNDING.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. Institute of Electrical and Electronic Engineers (IEEE): Provide components which comply with the following standards:
 - a. 82-83 - Test Procedures for Impulse Voltage Tests on Insulated Conductors.
 - b. 400 - Guide for Making High-Direct-Voltage Tests on Power Cable Systems in the Field.
 - 2. National Electrical Manufacturers Association (NEMA) and Insulated Cable Engineers Association (ICEA): Provide components which comply with the following standards:
 - a. NEMA WC-5 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (ICEA S-61-402).
 - b. NEMA WC-7 - Cross Linked Thermosetting Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (ICEA S-66-524).
 - c. NEMA WC-8 - Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (ICEA S-68-516).
 - d. ICEA S-68-516 - Voltage Tests after Installation.
 - 3. National Fire Protection Association (NFPA): Comply with the following standards:
 - a. 70 - National Electrical Code (NEC).
 - 4. Underwriters Laboratories (UL): Provide components which are listed and labeled by UL under the following standards:
 - a. 44 - Rubber-Insulated Wires and Cables.
 - b. 83 - Thermoplastic-Insulated Wires and Cables.
 - c. 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 - d. 493 - Thermoplastic Insulated Underground Feeder and Branch Circuit Cables.
 - e. 854 - Service Entrance Cable.
 - f. 1277 - Tray TC Power and Control Cables.
 - 5. Conform to applicable codes and regulations regarding toxicity of combustion products of insulating materials.

1.03 SUBMITTALS:

- A. Refer to DIVISION 01 and SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS for administrative and procedural requirements for Submittals.
- B. Includes, but not limited to, the following:
 - 1. Product Data Sheets for electrical wires, cables, and connectors:
 - a. Wire and cable data sheet.
 - b. Wire and cable weight.

SECTION 260516 - WIRES AND CABLES: continued

- c. Recommended maximum pulling tension and minimum bending radius of wire and cable.
- d. Recommended wire and cable pulling lubricants.
- e. All field test data.

PART 2 - PRODUCTS

2.01 WIRE AND CABLES:

- A. General: Provide wire and cable suitable for the location where installed.
- B. Conductors: Minimum conductor size shall be #12 AWG. Except #14 AWG stranded can be used for controls unless indicated or specified otherwise. Provide solid conductors for power and lighting circuits No. 10 AWG and smaller unless indicated or specified otherwise. Provide stranded conductors for sizes No. 8 AWG and larger unless indicated or specified otherwise.
- C. Conductor Material: Use copper for all sizes.
- D. Provide wire and cable numbers that match electrical schematics.
- E. Provide stranded hookup wire with appropriate voltage rating and ampere rating inside of all control enclosures.

2.02 CONNECTORS FOR CONDUCTORS:

- A. Provide UL-listed factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperature ratings to or greater than those of the wires upon which used. Connectors shall be identified for the conductor material.
 - 1. Lighting and receptacle circuit connectors for No. 10 AWG and smaller shall be twist-on spring solderless connectors. Provide silicone filled twist-on watertight/raintight connectors for all lighting circuits and receptacles circuits routed outdoors or indoors in wet locations.
 - 2. Nonlighting and nonreceptacle circuit connectors for No. 12, No. 10 AWG, and connectors for No. 8 AWG and larger shall be solderless connectors.
 - 3. All uninsulated joints shall be taped to provide an insulation value equal to that of the wire.

PART 3 - EXECUTION

3.01 WIRING METHOD:

- A. Use the following wiring methods as indicated:
 - 1. Wire and Cable: Install all wire in raceway (except if indicated or specified otherwise).
 - 2. 600V Feeder and Branch Circuit Cable:
 - a. 480V, 277V, 240V, 208V, 120V and Control Cables for 120V Circuits (and Lower Voltage): Type THHN/THWN rated 600Vac.
 - 3. 600V Service Entrance Cable Type USE: For underground service to buildings where indicated. Rated 600Vac.
 - 4. Medium voltage cable where indicated. Medium cable shall be 15 kV, 133% EPR. The 15 kV cable shall be concentric-lay-strand, Class B conductor. Provided soft drawn copper cable complying with ASTM B3.
 - a. All medium voltage splices and cable terminations shall be made by a certified medium voltage cable splicer.

SECTION 260516 - WIRES AND CABLES: continued

3.02 INSTALLATION OF WIRES AND CABLES:

- A. General: Install electrical cables, wires, and connectors in compliance with NEC.
- B. Coordinate cable installation with other Work.
- C. Do not pull wire and cable until raceway system is complete. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL-listed pulling compound or lubricant that is compatible with wire outer covering, cable outer covering, raceway, and wire/cable manufacturer's recommendations.
- D. Use pulling means including fish tape, cable, and basket weave wire/cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.
- E. Keep conductor splices to a minimum. All splices shall be made in junction boxes.
- F. Install splice and tap connectors which possess equivalent or better mechanical strength and insulation rating than conductors being spliced.
- G. Use splice and tap connectors which are compatible with conductor material.
- H. Provide adequate length of conductors within electrical enclosures and neatly train the conductors to terminal points. Circuits with conductors larger than No. 10 AWG shall be bundled together inside of enclosures. Make terminations so there are no bare conductors visible at the terminal.
- I. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A.

J. Table 1:

- 1. Insulation Color Coding for Phase Identification:
- 2. Color code 600V insulated, service entrance, feeder, and branch circuit conductors with factory-applied colored insulation for No. 8 AWG and smaller (except No. 6 AWG and smaller for green ground wire); 1-inch band of colored tape at all splices and terminations for No. 6 AWG and larger (except No. 4 AWG and larger for green ground wire) as follows:

<u>208Y/120V 60 hertz</u>	<u>Phase</u>	<u>480Y/277V 60 Hertz</u>	<u>Vdc</u>
Black	A	Brown	
Red	B	Orange	
Blue	C	Yellow	
White	Neutral	Gray	
Green	Ground	Green	
	Positive		Red
	Negative		Black

- 3. Identification tape shall be with 4 inches of termination.
- K. Group circuits in conduit such that no conduit contains more than a total of three phase conductors, three neutral conductors, and one ground conductor (unless indicated or specified otherwise).
- L. Install wire and cable numbers on all field wiring that matches electrical schematics.
- M. Leave 12 inches of each wire in each receptacle and wall switch device box.

3.03 FIELD QUALITY CONTROL:

- A. Prior to energizing, test wires and cables for electrical continuity and for short circuits.

SECTION 260516 - WIRES AND CABLES: continued

- B. Prior to energizing, check all installed feeders and building service wires and cables with insulation megohm meter to determine insulation resistance levels to assure requirements are fulfilled. Record and submit all field test data. Megger 300V cables with 500Vdc megohm meter between each conductor and ground. Megger 600V cables with 1,000Vdc megger between each conductor and ground. Also, megger between adjacent conductors. Megger cables after installation (not on cable reel) with cables disconnected at both ends. The values must be approximately as follows:

<u>Conductor Size (AWG or MCM)</u>	<u>Resistance (Megohms-1,000 ft)</u>
14-8	200
6-2/0	100
3/0-500	50

- C. Do not test wires or cables with an AC test set.

END OF SECTION 260516

SECTION 260526 - GROUNDING

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section specifies electrical grounding and bonding as indicated on Drawings and schedules and as specified herein. Grounding and bonding work is defined to encompass systems, circuits, and equipment.
- B. Type of electrical grounding and bonding work specified in this Section includes the following:
 - 1. Solidly grounded. Grounded through a ground connection in which no impedance has been intentionally inserted.
- C. Applications of electrical grounding and bonding work in this Section include the following:
 - 1. Underground metal piping.
 - 2. Underground metal water piping.
 - 3. Underground metal structures.
 - 4. Metal building frames.
 - 5. Electrical power systems.
 - 6. Grounding electrodes.
 - 7. Counterpoise grounding loops.
 - 8. Separately derived systems.
 - 9. Raceways.
 - 10. Service equipment.
 - 11. Boxes and Enclosures.
 - 12. Equipment.
 - 13. Lightning protection systems.
 - 14. Chain link fences and gates.
 - 15. Cable tray.
 - 16. Aircraft static ground receptacles.
- D. Refer to other DIVISION 26 Sections for wires/cables, electrical raceways, boxes and fittings, and wiring devices which are required in conjunction with electrical grounding and bonding work; not work of this Section.
- E. Related Work Specified Elsewhere:
 - 1. SECTION 264100 - LIGHTNING PROTECTION.

1.02 REFERENCES:

- A. Applicable Standards:
 - 1. Institute of Electrical and Electronic Engineers (IEEE): Comply with applicable requirements and recommended installation practices of the following IEEE Standards pertaining to grounding and bonding of systems, circuits, and equipment:
 - a. 81 - Guide for Measuring Ground Resistance, and Potential Gradient in the Earth.
 - b. 141 - Recommended Practice for Electric Power Distribution for Industrial Plants.
 - c. 142 - Recommended Practice for Grounding Industrial and Commercial Power Systems.
 - 2. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code (NEC): Comply with applicable local electrical code requirements of the authority having jurisdiction, and NEC as applicable to electrical grounding and bonding, pertaining to systems, circuits, and equipment.
 - b. 780 - Lightning Protection Code.

SECTION 260526 - GROUNDING: continued

3. Underwriters Laboratories (UL): Comply with applicable requirements of the following standards. Provide grounding and bonding products which are UL-listed and labeled for their intended usage.
 - a. 467 - Electrical Grounding and Bonding Equipment.
 - b. 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 - c. 869 - Electrical Service Equipment.
 4. Telecommunication Industry Association (TIA):
 - a. J-STD-607-A - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
- 1.03 SUBMITTALS:
- A. Refer to DIVISION 01 and SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS for administrative and procedural requirements for Submittals.
 - B. Includes, but not limited to, the following:
 1. Product Data: Submit manufacturer's data on grounding and bonding products and associated accessories.
 2. All field test reports.

PART 2 - PRODUCTS

2.01 GROUNDING AND BONDING:

- A. Materials and Components:
 1. General: Except as otherwise indicated, provide electrical grounding and bonding systems indicated; with assembly of materials, including, but not limited to, cables/wires, connectors, solderless lug terminals, grounding electrodes, bonding jumper braid, surge arresters, and additional accessories needed for a complete installation. Where more than one type component product meets indicated requirements, selection is Contractor's code-compliance option. Where materials or components are not indicated, provide products which comply with NEC, UL, and IEEE requirements and with established industry standards for those applications.
 2. Conductors: Unless otherwise indicated, provide insulated electrical grounding conductors for equipment grounding conductor connections that match power supply wiring materials and as a minimum are sized according to the NEC. Provide uninsulated, stranded, tinned, copper cable for ground electrode conductors.
 3. Bonding Plates, Connectors, Terminals, and Clamps: Provide electrical bonding plates, connectors, terminals, lugs, and clamps as recommended by bonding plate, connector, terminal, and clamp manufacturers for indicated applications.
 4. Ground Rods or Ground Electrodes:
 - a. Ground Rods or Grounding Electrodes: Copper Clad, 3/4-inch diameter by 10 feet.
 - b. Provide with threaded end to receive Aircraft Static Ground receptacle.
 5. Electrical Grounding Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, bonding straps, as recommended by accessories manufacturers for type service required or indicated.
 6. Field Welding: Provide exothermic welded connections where grounding conductors connect to underground grounding conductors and underground grounding electrodes.
 7. Aircraft Static Ground Receptacle: Provide Cast Bronze threaded to receive 3/4-inch sectional ground rod.

SECTION 260526 - GROUNDING: continued

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas and conditions under which electrical grounding and bonding connections are to be made. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF ELECTRICAL GROUNDING AND BONDING SYSTEMS:

- A. Install electrical grounding and bonding systems as indicated, in accordance with manufacturer's instructions and applicable portions of NEC, NECA's "Standard of Installation," and in accordance with recognized industry practices to ensure that products comply with requirements.
- B. Weld grounding conductors to underground grounding conductors and underground electrodes. Ground electrode conductor shall not contain splices between the ground electrode and the service entrance equipment.
- C. Ground electrical service system neutral at service entrance equipment to grounding electrodes and concrete foundation footing reinforcing bars in the bottom of the footing.
- D. Ground each separately derived system neutral to:
 - 1. Effectively grounded metallic water pipe.
 - 2. Effectively grounded structural steel member.
 - 3. Main building ground system.
- E. Bond the system neutral to service entrance equipment enclosures.
- F. Ground all exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductors in raceways and cables, receptacle ground conductors, and metallic plumbing systems.
- G. Ground Rods:
 - 1. Provide rods where indicated by driving and not by drilling or jetting.
 - 2. Drive rods into unexcavated portion of earth where possible. If rods must be driven into excavated areas, drive rods after compaction of backfill is completed.
 - 3. Drive rod to a depth such that the top of rod is 18 inches below final grade. Attach ground grid cable.
 - 4. At grounding receptacles, drive rods to a depth such that the top of the receptacle is flush with the finished surface.
- H. Install ground counterpoise which encircles the building and is connected to perimeter structural steel columns indicated and to each driven grounding electrode.
- I. Terminate feeder and branch circuit insulated equipment grounding conductors with grounding lug on substation, switchgear, switchboard, motor control center, or panelboard ground bus. When conduit enters from below and is not connected to the enclosure, ground equipment grounding conductor on conduit grounding bushing and then bond to ground bus (or grounded enclosure if there is no ground bus).
- J. Connect grounding electrode conductors to 1-inch diameter or greater metallic cold water pipe using a suitably sized ground clamp. Provide connections to flanged piping at street side of flange.
- K. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with tightening torque values specified in UL 486A to assure permanent and effective grounding.
- L. Install braided type code-sized ground cable bonding jumpers with ground clamps on water meter piping to electrically bypass water meters.

SECTION 260526 - GROUNDING: continued

- M. Route grounding connections and conductors to ground and protective devices in shortest and straightest paths as possible to minimize transient voltage rises.
- N. Apply corrosion-resistant finish to field connections, buried metallic grounding and bonding products, and places where factory applied protective coatings have been destroyed, which are subjected to corrosive action.
- O. Ground all wireway at least once and at 10-foot intervals.
- P. Install insulated equipment ground conductor in all nonmetallic (and metallic) conduit.
- Q. Bond non-isolated equipment ground conductors to each pull box, device box and junction box through which they are routed.
- R. Clean metal contact surfaces of clamp-on connectors to ensure electrical conductivity and circuit integrity.
- S. Ground all manhole hardware to manhole ground rods and connect to the underground duct system ground conductors.
- T. Provide each communication room backboard with a "Green" insulated ground wire that is connected to the grounding electrode system, per J-STD-607-A. See Drawings for sizes.
- U. All flexible power cords shall contain a green insulated equipment grounding wire.
- V. Install isolated grounds where indicated.

3.03 FIELD QUALITY CONTROL:

- A. Test ground resistance at each rod (before interconnection to other rods), the entire ground rod-ground cable counterpoise system before it is bonded to building steel and the equipment listed below. Test shall be witnessed by the Contracting Officer's Representative. Test with a DC three-point earth ground resistance tester in accordance with IEEE 81. Measure ground resistance without the soil being moistened by any means other than natural precipitation. Where tests show resistance-to-ground is over values in Table 1 below, take appropriate action to reduce resistance to the values in Table 1 by driving additional ground rods and extending ground cables to the new rods; then retest to demonstrate compliance. Record and submit results. The Contractor shall provide the following information at minimum to the Contracting Officer. Method used, temperature humidity and general weather condition at time of test.

Table 1

<u>Equipment</u>	<u>Equipment to Earth Ground Resistance (Ohms)</u>
Equipment operating at 1,000V and higher	1
Transformers and substations less than 500 kVA	5
Transformers and substations 500 - 1,000 kVA	5
Transformers and substations greater than 1,000 kVA	3
Pad mounted transformers	5
Manhole grounds	5
Other secondary neutrals and other grounds	5
Lightning protection grounds	1
Aircraft static ground receptacle	5

END OF SECTION 260526

SECTION 260529 - SUPPORTING DEVICES AND SEALS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section specifies supports, anchors, sleeves, and seals as indicated by Drawings and schedules and/or specified in other DIVISION 26 Sections.
- B. Types of supports, anchors, sleeves, and seals specified in this Section include the following:
 - 1. Clevis hangers.
 - 2. Riser clamps.
 - 3. Steel rod coupling.
 - 4. C-clamps.
 - 5. I-beam clamps.
 - 6. One-hole conduit straps.
 - 7. Two-hole conduit straps.
 - 8. Hexagonal nuts.
 - 9. Round threaded steel rods.
 - 10. Conduit clamps.
 - 11. U-bolts.
 - 12. Lead expansion anchors.
 - 13. Toggle bolts.
 - 14. Wall, ceiling, roof and floor seals.
 - 15. Conduit cable supports.
 - 16. U-channel strut system.
- C. Related Work Specified Elsewhere:
 - 1. Supports, anchors, sleeves, and seals furnished as part of factory-fabricated equipment, are specified as part of that equipment assembly in other DIVISION 26 Sections.

1.02 REFERENCES:

- A. Applicable Standards: Comply with the following standards.
 - 1. American Society for Testing and Materials (ASTM):
 - a. E814 - Fire Tests of Through-Penetration Fire Stops, pertaining to fire stop components.
 - 2. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code (NEC).
 - 3. National Electrical Contractors Association (NECA):
 - a. Standard of Installation - Pertaining to anchors, fasteners, hangers, supports, and equipment mounting.
 - 4. Underwriters Laboratories (UL):
 - a. Provide electrical devices, components, and fire stops which are UL-listed and labeled.

1.03 SUBMITTALS:

- A. Refer to DIVISION 01 and SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS for administrative and procedural requirements for submittals.
- B. Includes, but not limited to, the following:
 - 1. Product Data: Submit manufacture's data on supporting devices including catalog cuts, specifications, and installation instructions for each type of support, anchor, sleeve, and seal.

SECTION 260529 - SUPPORTING DEVICES AND SEALS: continued

- C. LEED® Submittals:
 - 1. Product Data for EQ Credit 4.1: For site-applied interior adhesives, sealants and sealant primers, documentation indicating VOC content of product and VOC limit per LEED-NC v2.2 requirements.
 - a. Include in the LEED Documentation Notebook.
- D. Shop Drawings: Submit dimensioned drawings of fabricated products, indicating weights, strength, details of fabrication, and details of materials.

PART 2 - PRODUCTS

2.01 LEED REQUIREMENTS:

- A. See SECTION 018113 - SUSTAINABLE DESIGN REQUIREMENTS for LEED requirements pertaining to VOC limits for site-applied interior adhesives, sealants, paints and coatings.

2.02 MATERIALS AND COMPONENTS:

- A. General: Provide supporting devices which comply with manufacturer's standard materials, design, and construction in accordance with published product information as required for complete installation and as herein specified. All supports shall be designed for the support of the maximum number of conduits and their maximum conductor weights for maximum conduit loading. Where more than one type of supporting device meets indicated requirements, selection is Contractor's option. Do not use perforated metal straps for supports.
- B. Supports: Supporting devices of types, sizes, materials indicated, and having the following construction features.
 - 1. Clevis Conduit Hangers: For supporting conduit; galvanized steel; with 3/8-, 1/2-, 5/8- or 3/4-inch rod; size of clevis and rod as required.
 - 2. Riser Clamps: For supporting conduit, galvanized steel, with two bolts and nuts.
 - 3. Steel Rod Couplings: Provide 3/8, 1/2-, 5/8- or 3/4-inch straight rod couplings; size as required.
 - 4. C-Beam Clamps: Malleable iron, 3/8, 1/2-, 5/8-, or 3/4-inch rod; size as required.
 - 5. I-Beam Clamps: Galvanized steel, with 3/8, 1/2-, 5/8-, or 3/4-inch rod; size as required; 3/8-inch horizontal "J" hook safety rod that bolts across the flange, flange width as required.
 - 6. One-Hole Conduit Straps: For supporting conduit; stamped plated steel, size as required.
 - 7. Two-Hole Conduit Straps: For supporting conduit, stamped plated steel, size as required.
 - 8. Hexagonal Nuts, Flat Washers and Lock Washers: For 3/8-, 1/2-, 5/8-, 3/4-inch rod; size as required; shall be galvanized steel.
 - 9. Round Threaded Steel Rod: Galvanized steel, 3/8, 1/2-, 5/8-, or 3/4-inch diameter, size as required. Minimum size is 3/8-inch diameter.
 - 10. Conduit Clamps: For supporting conduit; galvanized stamped steel; size as required.
 - 11. U-Bolts: For supporting conduit; galvanized; size as required.
- C. Anchors: Anchors of types, sizes, and materials indicated, with the following construction features:
 - 1. Lead Expansion Anchors: 1/2-, 5/8-, or 3/4-inch; as required.
 - 2. Toggle Bolts: Springhead, 3/16-inch x 4-inch or larger size as required.

SECTION 260529 - SUPPORTING DEVICES AND SEALS: continued

- D. Sleeves and Seals: Sleeves and seals of types, sizes, and materials indicated, with the following construction features:
 - 1. Pipe Sleeves: When penetrating a wall, ceiling roof or floor, provide pipe sleeves of one of the following:
 - a. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from the following gauge metal: 3-inch and smaller, 20-gauge; 4-inch to 6-inch, 16-gauge; over 6 inches, 14-gauge.
 - b. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.
 - c. Iron Pipe: Fabricate from cast iron or ductile-iron pipe; remove burrs.
 - d. Plastic Pipe: Fabricate from Schedule 80 PVC plastic pipe; remove burrs.
 - 2. Wall, Roof and Floor Seals: Provide sleeves for conduit which penetrate foundation walls below grade, floors, ceilings, or exterior walls. Caulk between sleeve and conduit with nontoxic, UL-classified caulking material to ensure watertight seal.
 - 3. Provide a fire-rated sleeve and seal equal to or exceeding the fire rating of the ceiling, floor, or wall being penetrated.
- E. Conduit Cable Supports: Cable supports with insulating wedging plug for nonarmored type electrical cables in risers; construct for rigid metal conduit (size as required) number of wires as required, type wire as specified; construct body of malleable-iron casting with hot-dip galvanized finish.
- F. U-Channel Strut Systems: Unless indicated otherwise, U-channel strut system for supporting electrical equipment, 12-gauge steel hot-dip galvanized after fabrication for wet and outdoor locations, 12-gauge standard green paint finish for dry and indoor locations, of types and sizes indicated; construct with 9/16-inch diameter holes, 8-inch o.c. on top surface, and with the fittings as required which mate and match with U-channel.
- G. Fire and Smoke Stop Compounds: Provide one of the following:
 - 1. Dow Corning 2000.
 - 2. 3M Fire Barrier 2000.

PART 3 - EXECUTION

3.01 INSTALLATION OF SUPPORTING DEVICES:

- A. Install hangers, anchors, sleeves, and seals as specified, required, and indicated, in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NECA and NEC for installation of supporting devices.
- B. Install hangers, supports, clamps, and attachments to support conduit properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. Install supports with spacings indicated and as required by the NEC or as indicated when less than NEC required spacing.
- C. Torque sleeve seal nuts, complying with manufacturers recommended values. Ensure that sealing grommets expand to form watertight seal.
- D. Design trapeze type supports, including fasteners to the structure to carry the following loads:
 - 1. The greater of the following:
 - a. The total calculated load multiplied by a factor of 4.
 - b. The total calculated load plus 200 pounds.
- E. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
- F. Repair damage to painted finishes with paint recommended by manufacturer.

SECTION 260529 - SUPPORTING DEVICES AND SEALS: continued

- G. Install fire and smoke stop compounds at all penetrations of fire rated walls, floors, ceilings and roofs. Install fire and smoke stop compounds in accordance with manufacturer's instructions to provide a fire seal rating equal to or greater than that of the surface penetrated.
- H. Provide seismic support and bracing for all multiple conduit support trapezes plus individually supported conduit 2-1/2 inches and larger such that the supports shall resist the forces of a Seismic Zone 2A event without collapse.
- I. Provide seismic support and bracing for all cable tray such that the support shall resist the forces of a Seismic Zone 2A event without collapse.
- J. Provide mounting on all overhead utilities and other fixtures weighing 31 pounds or more to minimize the likelihood that they will fall. Design all equipment to resist forces of 0.5 times the equipment weight on any direction and 1.5 times the equipment weight in the downward direction.

END OF SECTION 260529

SECTION 260533 - RACEWAYS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section specifies all conduit, wireway, surface metal raceways, fittings, and accessories.

1.02 RELATED WORK SPECIFIED ELSEWHERE:

- A. SECTION 312333 - TRENCHING AND BACKFILLING.
- B. SECTION 260534 - ELECTRICAL BOXES AND FITTINGS.
- C. SECTION 260529 - SUPPORTING DEVICES AND SEALS.
- D. SECTION 260553 - ELECTRICAL IDENTIFICATION.
- E. SECTION 260526 - GROUNDING.

1.03 REFERENCES:

- A. Applicable Standards: Comply with applicable requirements of the following standards.
 - 1. Joint Industrial Council (JIC):
 - a. Comply with standards for Oil and Dust Tight Lay-In Wireway.
 - 2. National Electrical Manufacturers Association (NEMA):
 - a. RN-1 - Poly Vinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - b. TC-2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
 - c. TC-3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
 - 3. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code, (NEC). Comply with applicable requirements of NEC pertaining to construction and installation of raceway systems.
 - 4. Underwriters Laboratories (UL):
 - a. Provide all raceways which are UL-listed and labeled.
 - b. 1 - Flexible Metal Electrical Conduit.
 - c. 5 - Surface Metal Electrical Raceways and Fittings.
 - d. 6 - Rigid Metal Electrical Conduit.
 - e. 360 - Liquidtight Flexible Steel Conduit.
 - f. 514B - Fittings for Conduit and Outlet Boxes.
 - g. 651 - Schedule 40 and 80 Rigid PVC Conduit.
 - h. 797 - Electrical Metallic Tubing.
 - i. 870 - Electrical Wireways, Auxiliary Gutters, and Associated Fittings.
 - j. 1242 - Intermediate Metal Conduit.

1.04 SUBMITTALS:

- A. Refer to DIVISION 01 and SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS for administrative and procedural requirements for submittals.
- B. Submittals shall include, but not be limited to, the following:
 - 1. Product Data: Submit manufacturer's technical product data, including specifications and installation instructions, for each type of raceway system required. Include data substantiating that materials comply with requirements.
 - 2. Samples: Submit 6-inch length of exposed type surface metal raceways with required finish, in accordance with requirements of DIVISION 01.

SECTION 260533 - RACEWAYS: continued

PART 2 - PRODUCTS

2.01 METAL CONDUIT AND TUBING:

- A. General: Provide metal conduit, tubing, and fittings of types, grades, sizes, and weights (wall thicknesses) for each service indicated. Where sizes, types, and grades are not specified or indicated, provide proper selection to fulfill specified requirements, and comply with applicable portions of NEC for raceways. Minimum size shall be 3/4 inch, unless indicated or specified otherwise.
- B. Rigid Steel Conduit: Rigid steel, zinc coated, threaded type conforming to UL 6.
 - 1. Zinc coating fused to inside and outside walls.
- C. PVC Externally Coated Rigid Steel Conduit and Fittings: Rigid Steel Zinc coated with additional external 40 mil coating of PVC conforming to NEMA RN 1. Coating shall be bonded to conduit (extruded coating shall not be accepted).
- D. Intermediate Steel Conduit: Rigid intermediate grade (IMC) hot-dip galvanized conforming to UL 1242.
- E. Electrical Metallic Tubing (EMT): UL797.
- F. Flexible Metal Conduit: UL 1. Formed from continuous length of spirally-wound, interlocked zinc-coated strip steel. Minimum size shall be 1/2 inch unless indicated or specified otherwise. Approved as a grounding path for circuits rated 20 amperes or less and in lengths of 6 feet and less.
- G. Liquid-Tight, Flexible Metal Conduit: Liquid-tight flexible steel conduit; construct of single strip, flexible, continuous, interlocked, and double-wrapped steel; galvanized inside and outside; coat with (oil-resistant,) liquid-tight thermoplastic jacket. Approved as a grounding path in conduit sizes 1-1/4 inches and smaller and in lengths 6 feet or less when protected as follows:
 - 1. 3/8 inch and 1/2 inch protected at 20 amperes or less.
 - 2. 3/4 inch, 1 inch and 1-1/4 inch protected at 60 amperes or less.
- H. Rigid Metal Conduit Fittings: Threaded cast-malleable iron, galvanized or cadmium plated, conforming to UL 514B.
 - 1. Provide steel fittings for steel conduit.
 - 2. Provide aluminum fittings for aluminum conduit.
- I. Flexible Metal Conduit Fittings: Threadless hinged clamp type. Provide conduit fittings for use with flexible steel conduit. Fittings shall be approved for grounding per NEC 350-5.
 - 1. Straight Terminal Connectors: One-piece body, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provide with locknut.
 - 2. 45- or 90-degree Terminal Angle Connectors: Two-piece body construction with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.
- J. Liquid-Tight Flexible Metal Conduit Fittings: Provide cadmium plated, malleable-iron fittings with compression type steel ferrule and neoprene gasket sealing rings, with insulated or noninsulated throat. Fittings shall be approved for grounding in conduit sizes 1-1/4 inches and smaller per NEC.
- K. EMT Fittings: Steel compression type.
- L. Conduit Bodies: Galvanized cast-metal conduit bodies of types, shapes, and sizes as required to fulfill job requirements and NEC requirements. Construct conduit bodies with threaded conduit entrance ends, removable covers, either cast or of galvanized steel and corrosion-resistant screws.

SECTION 260533 - RACEWAYS: continued

- M. Conduit and Tubing Accessories: Provide conduit and tubing accessories of types, sizes, and materials, complying with manufacturer's published product information which mate and match conduit and tubing.
- N. Conduit Bushings: Provide insulated throat for all bushings. Grounding bushings shall have an integral copper set-screw type cable grounding lug.
- O. Explosion-proof flexible metal conduit rated for Class 1, Div. 2, and Group C&D.
- P. Explosion-proof conduit seal fittings sizes 3/4 inch through 3-1/2 inches shall have expanded fill sealing area such that they are UL-listed for use with 40% filled conduit. Conduit seal sealant shall be manufactured by the fitting manufacturer.

2.02 NONMETALLIC CONDUIT AND FITTINGS:

- A. General: Provide nonmetallic conduit, ducts, and fittings of types, sizes, and weights for each service indicated. Where types and grades are not indicated, provide proper selection determined by installer to fulfill wiring requirements which comply with provisions of NEC for raceways. Minimum size shall be 3/4 inch, unless indicated otherwise.
- B. Electrical Plastic Conduit:
 - 1. Heavy-Wall Conduit: Schedule 40, 90°C, UL-rated, constructed of polyvinyl chloride and conforming to NEMA TC-2, for direct burial or normal aboveground use, UL-listed, and in conformity with NEC Article 347.
- C. PVC Conduit Fittings: NEMA TC-3, mate and match to conduit or tubing type and material.
- D. Conduit and Tubing Accessories: Provide conduit, tubing, and duct accessories of types, sizes, and materials, complying with manufacturers published information which mate and match conduit and tubing.

2.03 WIREWAYS:

- A. General: Provide electrical wireways of types, grades, sizes, and number of channels for each type of service as indicated or required. Provide complete assembly of raceway including, but not limited to, couplings, offsets, elbows, expansion joints, adapters, holddown straps, end caps, and other components and accessories as required for complete system.
- B. Lay-in Wireways: NEMA 1 Enclosure. Provide 2.5- by 2.5-inch, 4- by 4-inch, 6- by 6-inch, 8- by 8-inch and 12- by 12-inch sizes as indicated or required. Construct lay-in wireways with hinged covers, in accordance with UL 870 and with components UL-listed, including lengths, connectors, and fittings. Wireways shall allow fastening hinged cover closed without use of parts other than standard lengths, fittings, and connectors. The 2-1/2-inch, 4-inch and 6-inch wireways shall be constructed with 16-gage steel. The 8-inch and 12-inch wireways shall be constructed with 14-gage steel. Wireway shall be painted with epoxy paint. Units shall be capable of sealing cover in closed position with screws. Provide NEMA 1 wireways in the 2-1/2-inch, 4-inch and 6-inch sizes with knockouts.
 - 1. Connectors: Provide wireway connectors suitable for lay-in conductors, with connector covers permanently attached such that removal is not necessary to utilize the lay-in feature.
 - 2. Finish: Protect sheet metal parts with rust inhibiting coating and baked enamel finish. Plate-finish hardware to prevent corrosion. Protect screws installed toward inside of wireway with spring nuts to prevent wire insulation damage.

SECTION 260533 - RACEWAYS: continued

PART 3 - EXECUTION

3.01 INSTALLATION OF RACEWAYS:

- A. General:
 - 1. Install raceways as indicated in accordance with manufacturer's written installation instructions and in compliance with NEC. Install raceways plumb and level, and maintain NEC recommended clearances. Provide raceway supports in accordance with the NEC and SECTION 260529.
- B. Coordinate with other work including wires/cables, boxes, and panel work as necessary to interface installation of electrical raceways and components with other work.
- C. Provide seismic bracing such that the raceways will not collapse during a Seismic Zone 2A event.

3.02 INSTALLATION OF CONDUITS:

- A. General: Install concealed conduits in new construction work - in walls, in slabs, or above suspended ceilings. Run conduits concealed in existing work where practicable. Where conduits cannot be concealed in finished areas, use surface metal raceways only where indicated. Provide holes for conduit in all boxes, panels and enclosures as required.
 - 1. All conduits installed above grade (including exposed and concealed above removable suspended ceilings) that contains emergency power and emergency lighting conductors shall be identified in accordance with SECTION 260553.
 - 2. Mechanically fasten together metal conduits, enclosures, and raceways to form continuous electrical conductor. Connect to electrical boxes, fittings, and cabinets to provide electrical continuity and firm mechanical assembly.
 - 3. Avoid use of dissimilar metals throughout system to eliminate possibility of galvanic corrosion. Where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.
 - 4. Install miscellaneous fittings such as reducers, close nipples, 3-piece unions, split couplings, and plugs that have been specifically designed and manufactured for their particular application. Install telescoping type linear expansion fittings in raceways every 200-foot linear run and wherever structural expansion joints are crossed.
 - 5. Use roughing-in dimensions of electrically powered units furnished by unit manufacturer. Set conduit and boxes for connection to units only after receiving dimensions and after checking location with other trades.
 - 6. Test conduits (witnessed by the Contracting Officer's representative) required to be installed but left empty with ball mandrel. Clear any conduit which rejects ball mandrel. Pay costs involved for restoration of conduit and surrounding surfaces to original condition. Provide 200-pound tensile strength nylon conduit fish line throughout the entire length of all empty conduits. Leave 12 inches of slack at each end.
 - 7. Do not install conduit in front of covers of new and existing electrical equipment, pull boxes, and junction boxes.
 - 8. Provide all openings in floors, walls, ceilings and roofs for passage of conduit. Fire ratings of walls, floors, ceiling and roofs shall be maintained when passing through them by providing fire seals in accordance with SECTION 260529.

SECTION 260533 - RACEWAYS: continued

9. Where different conduits contain circuits of different noise levels the horizontal and vertical spacing in inches between the outside surfaces of the conduits (or conduit to cable tray) shall not be less than indicated below (unless specified otherwise, indicated otherwise, or required otherwise by the equipment manufacturer):
 - a. Noise Level 1 Circuits: Analog circuits less than 50V, digital circuits less than 12V or telephone circuits.
 - b. Noise Level 2 Circuits: Analog circuits greater than 50V or digital circuits greater than 12V.
 - c. Noise Level 3 Circuits: 120Vac or DC circuits operating at less than 20 amperes.
 - d. Noise Level 4 Circuits: AC or DC circuits less than 800V operating with currents less than 800 amperes.
 - e. Noise Level 5 Circuits: Circuits over 800Vac or DC and/or over 800 amperes.
 - f. Additionally, route all conduit containing circuits with a capacity of between 2 kVA and 5 kVA a minimum of 6 inches from cable tray.
 - g. Additionally, route all conduit containing circuits with 5 kVA or greater capacity a minimum of 12 inches from cable tray.

MINIMUM HORIZONTAL AND VERTICAL SPACING BETWEEN
DIFFERENT CONDUIT OUTSIDE SURFACES
(OR CONDUIT TO CABLE TRAY) IN INCHES

Conduit Noise Level	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	Conduit to Cable Tray
1	*	1	3	12	12	*
2	1	*	3	9	12	*
3	3	3	*	*	6	6
4	12	9	*	*	*	12
5	12	12	6	*	*	12

* = Minimum separation required for installation of locknuts as if adjacent conduit were terminating in an enclosure.

10. Provide a weatherproof duct seal compound between the conductors and the inner walls of all conduit that are routed to NEMA 3, 3R, 3S, 4 and 4X enclosures to prohibit moisture and/or humid air from entering the raceway and condensing.
 11. Repair damage to galvanized finishes with a zinc-rich paint recommended by the manufacturer.
 12. Repair damage to PVC finishes with matching touch-up coating recommended by the manufacturer.
 13. Where metallic conduit leaves cast-in-place concrete (to air, to earth or to compacted fill) coat the conduit 2 inches on either side of the line formed by the finished concrete surface with a bitumastic asphalt coating.
- B. Conduit Installation: Provide threaded, rigid steel zinc-coated conduit where routed lower than 10 feet above the floor in the hangar aircraft bay, embedded in cast-in-place concrete, in hazardous locations, routed below floor slabs (unless indicated otherwise), when containing circuits over 600Vac, routed through cast-in-place masonry, or installed outdoors. Follow minimum requirements in other areas as follows:
1. Use rigid steel zinc-coated conduit in mechanical equipment rooms, shops, electrical equipment rooms, where exposed to physical damage, and in the aircraft hangar bay

SECTION 260533 - RACEWAYS: continued

- below 10 feet-0 inch height, and for 480V feeder circuits to switchboards, and panelboards.
2. Use steel zinc-coated EMT where routed higher than 10 feet above the floor in the hangar aircraft bay, for interior 480V branch circuits, interior concealed 120V power, lighting, alarms, controls, and communications in offices, corridors, toilets, break rooms, ceiling plenum areas, and in the aircraft hangar bay above 10 feet-0 inch height.
 3. Use flexible steel conduit only in movable partitions and from outlet boxes to interior recessed lighting fixtures (Maximum of 6 feet long and a minimum of 4 feet long) in nonenvironmental air plenums. Maximum length in environmental air plenums shall be 4 feet long), and final 24 inches of connection to motors, VFDs, transformers, and control items. Provide where subject to movement and vibration where connections are in dry, nonhazardous, interior locations. Provide in cells of precast concrete panels. Provide a "green" insulated equipment ground wire suitably sized per NEC 250.122 unless indicated otherwise in all flexible steel conduit. Except equipment ground wire is not required on control circuits rated 20 amperes or less where flexible steel conduit 6 feet or less in length is used only for vibration elimination purposes and not for purposes of providing flexibility for movement.
 4. Use liquid-tight flexible conduit in nonhazardous locations (length shall not exceed 6 feet, unless indicated otherwise) where subjected to movement and vibration where connections are subjected to one or more of the following conditions:
 - a. Exterior location.
 - b. Moist or humid atmosphere where condensation can be expected to accumulate.
 - c. Corrosive atmosphere.
 - d. Subjected to water spray or dripping oil, water or grease.
 - e. Connected to a motor driving a nonsubmerged pump.
 - f. Provide a "green" insulated equipment ground wire suitably sized per NEC 250.122 unless indicated otherwise in all liquid-tight flexible conduit. (Except equipment ground wire is not required on control circuits rated 20 amperes or less where liquid-tight flexible conduit 6 feet or less in length and conduit is sized 1-1/4 inches or less is used only for vibration elimination purposes and not for purposes of providing flexibility for movement.)
 5. Cut conduits straight, properly ream, and cut threads for threaded conduit deep and clean.
 6. Field-bend conduit with benders designed for purpose so as not to distort nor vary internal diameter.
 7. Size conduits as indicated, unless no size is indicated then size per NEC, except no conduit smaller than 3/4 inch shall be embedded in concrete or masonry.
 8. Fasten indoor, dry location threaded conduit terminations in sheet metal enclosures by 2 locknuts, and terminate with bushing. Install locknuts inside and outside enclosure.
 9. Conduits shall not cross pipe shafts, access openings or ductwork openings.
 10. Keep conduits a minimum distance of 6 inches from parallel runs of flues, hot water pipes or other sources of heat. Wherever possible, install horizontal raceway runs above water and steam piping.
 11. Support riser conduit at each floor level with clamp hangers.
 12. Use of running threads at conduit joints and terminations is prohibited. Where required, use 3-piece union or split coupling.
 13. Complete installation of electrical raceways before starting installation of cables/wires within raceways.
 14. Use externally PVC coated galvanized rigid steel conduit for all below grade conduit that is direct buried without concrete encasement.

SECTION 260533 - RACEWAYS: continued

15. Provide explosion-proof flexible metal conduit where indicated or required.
 16. Provide explosion-proof conduit seals where indicated or required. Fill conduit seals with sealant as recommended by the manufacturer.
 17. Conduit installed above suspended ceilings shall comply with the following:
 - a. Install exposed conduits and extensions from concealed conduit systems neatly and parallel with or at right angles to walls of building or structure.
 - b. Install exposed conduit work so as not to interfere with ceiling inserts, windows, doors, lights, ventilation ducts or outlets.
 - c. Support exposed conduits by use of hangers, clamps, or clips. Support conduits on each side of bends and on spacing not to exceed NEC requirements.
 18. For Branch circuits, route conduit above grade. Conduits may be routed in slab with approval of ANG.
- C. Concealed Conduits:
1. Metallic raceways in floors below grade or outside are to have conduit threads painted with corrosion inhibiting compound before couplings are assembled. Draw up coupling and conduit sufficiently tight to ensure watertightness.
 2. Install underground conduits a minimum of 36 inches below finished grade.
- D. Conduits in Concrete Slabs:
1. Place conduits between bottom reinforcing steel and top reinforcing steel.
 2. Place conduits either parallel or at 90 degrees to main reinforcing steel.
 3. Separate conduits by not less than the outside diameter of the largest conduit to ensure proper concrete bond.
 4. Conduits crossing in slab must be reviewed for proper cover by the Contracting Officer's Representative.
 5. Embedded conduit outside diameter shall not exceed 1/3 of slab thickness. Provide a minimum of 3/4 inch of concrete cover.
 6. Embedded conduit shall be PVC-coated rigid steel conduit.
- E. Install conduits so as not to damage or run through solid structural members. Avoid horizontal or cross runs in building partitions or interior walls. Conduits shall run vertically in all walls to above ceilings.
- F. Exposed Conduits:
1. Install exposed conduits and extensions from concealed conduit systems neatly and parallel with or at right angles to walls of building or structure.
 2. Install exposed conduit work so as not to interfere with ceiling inserts, windows, doors, lights, ventilation ducts or outlets.
 3. Support exposed conduits by use of hangers, clamps, or clips. Support conduits on each side of bends and on spacing not to exceed NEC requirements.
 4. Run conduit for outlets on waterproof walls exposed. Set anchors for supporting conduit on waterproof wall in waterproof cement.
 5. Above requirements for exposed conduits also apply to conduits installed in space above suspended ceilings and in crawl spaces.
- G. Nonmetallic Conduits:
1. Provide only where indicated. Do not install in hazardous locations (unless noted otherwise).
 2. Make solvent cemented joints in accordance with recommendations of manufacturer.
 3. Install PVC conduits in accordance with NEC and in compliance with local utility practices.

SECTION 260533 - RACEWAYS: continued

4. All duct banks shall be a minimum of 36 inches below grade. Conduit in duct banks shall have a minimum of 3 inches of concrete cover in all directions. There shall be a minimum of 3 inches of concrete separation between all conduit.
 5. All conduit horizontal bends and vertical risers of buried conduit or duct banks shall be made with PVC externally coated galvanized rigid steel conduit elbows.
- H. Conduit Fittings:
1. Provide locknuts for securing conduit to metal enclosures with a sharp edge for digging into metal and ridged outside circumference for proper fastening. Standard locknuts are not acceptable.
 2. Provide threaded, nylon insulated bushings for terminating conduits which have flared bottom and ribbed sides, with smooth upper edges to prevent injury to cable insulation.
 3. Provide threaded, grounding bushings of insulated type with copper set-screw clamp type lay-in grounding terminal where required by NEC, where indicated or specified.
 4. Provide miscellaneous fittings such as reducers, close nipples, 3-piece unions, split couplings, and plugs as required which are specifically designed for their particular application.
 5. Provide grounding in accordance with SECTION 260526.
 6. Provide rain tight hubs on all outdoor conduit that are terminated in a nonthreaded enclosure hole.
 7. Provide identification of all raceways as specified in SECTION 260553.
 8. EMT shall have galvanized compression type box connectors at all boxes.
 9. Provide raceway sealing fittings at suitable, approved, accessible locations and fill them with UL-listed explosion proof sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to adjacent wall plate or surfaces. Provide sealing fittings where:
 - a. Conduit enters or leaves hazardous locations.
 - b. Where conduit passes from warm locations to cold locations, such as boundaries of air-conditioned spaces.

3.03 INSTALLATION OF SURFACE METAL RACEWAYS AND WIREWAYS:

- A. General: Mechanically assemble metal enclosures and surface metal raceways for conductors to form continuous electrical conductor, and connect to electrical boxes, fittings, and cabinets to provide effective electrical continuity and rigid mechanical assembly.
1. Provide only where indicated. Avoid use of dissimilar metals throughout system to eliminate possibility of galvanic corrosion. Where dissimilar metals are in contact, coat all surfaces with corrosion inhibiting compound before assembling.
 2. Install expansion fittings in all raceways, surface metal raceways, and wireways wherever structural expansion joints are crossed.
 3. Make changes in direction of surface metal raceway and wireway with proper fittings supplied by raceway manufacturer. No field bends of surface metal raceway or wireway sections will be permitted.
 4. Properly support and anchor surface metal raceways for their entire length with structural materials. Surface metal raceways are not to span any space unsupported.
 5. Use boxes as supplied by surface metal raceway manufacturer wherever junction, pull or device boxes are required. Standard electrical "handy" boxes, etc., shall not be permitted for use with surface metal raceway installations.
 6. Provide identification of all raceways as specified in SECTION 260553.

SECTION 260533 - RACEWAYS: continued

7. Provide tap location nameplates for wireways when used as auxiliary gutters as specified in SECTION 260553.
8. Ground wire ways at 10-foot intervals per SECTION 260526.

END OF SECTION 260533

SECTION 260534 - ELECTRICAL BOXES AND FITTINGS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section specifies electrical boxes and fittings including:
 - 1. Outlet boxes.
 - 2. Device boxes.
 - 3. Weatherproof boxes.
 - 4. Junction boxes.
 - 5. Pull boxes.
 - 6. Floor boxes.
 - 7. Bushings and ground bushings.
 - 8. Locknuts.
 - 9. Knockout closures.
 - 10. Fittings.
- B. Related Work Specified Elsewhere:
 - 1. SECTION 260553 - IDENTIFICATION.
 - 2. SECTION 260526 - GROUNDING.
 - 3. SECTIONS 271300 and 271500 - COMMUNICATION.

1.02 REFERENCES:

- A. Applicable Standards: Comply with applicable requirements of the following standards.
 - 1. National Electrical Manufacturers Association (NEMA):
 - a. Comply with applicable requirements of the following NEMA standards pertaining to outlet and device boxes, covers, and box supports.
 - (1) OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - (2) OS 2 - Nonmetallic Outlet Boxes, Covers, and Box Supports.
 - (3) 250 - Enclosures for Electrical Equipment (1,000V Maximum).
 - 2. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code (NEC) as applicable to construction and installation of electrical boxes and fittings.
 - 3. Underwriters Laboratories (UL): Provide electrical boxes and fittings which are UL listed and labeled.
 - a. 50 - Electrical Cabinets and Boxes.
 - b. 514 Series - Outlet Boxes and Fittings.
 - c. 886 - Electrical Outlet Boxes and Fittings for Use in Hazardous Locations, Class I, Groups A, B, C, and D, and Class II, Groups E, F, and G.

1.03 SUBMITTALS:

- A. Refer to DIVISION 01 and SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS for administrative and procedural requirements for submittals.
- B. Includes, but not limited to, the following:
 - 1. Product Data: Submit manufacturer's data on electrical boxes and fittings.
 - 2. Shop Drawings: Submit layout drawings of electrical floor, junction and pull boxes showing accurately scaled box layouts and their spatial relationship to associated equipment.

SECTION 260534 - ELECTRICAL BOXES AND FITTINGS: continued

PART 2 - PRODUCTS

2.01 FABRICATED MATERIALS:

- A. Outlet Boxes: Galvanized, coated, flat rolled, sheet-steel outlet wiring boxes, of shapes, cubic inch capacities, and sizes, including box depths as required, indicated, and specified, suitable for installation at respective locations. Construct outlet boxes with mounting holes and with conduit knockout openings in bottom and sides. Provide boxes with threaded screw holes for grounding screws, fastening devices, box covers, and for equipment grounding. Minimum box size shall be 4 by 4 by 1.5 inches, provide larger box if required, specified or indicated otherwise.
- B. Device Boxes: Galvanized, coated, flat rolled, sheet-steel nongangable device boxes, of shapes, cubic inch capacities, and sizes, including box depths as required, indicated, and specified, suitable for installation at respective locations. Construct device boxes for flush mounting with mounting holes, with conduit knockout openings in bottom and sides, and with threaded screw holes for fastening devices and box covers. Provide corrosion-resistant screws for equipment grounding. Minimum box size shall be 4 by 4 by 1.5 inches, provide larger box if required, specified or indicated otherwise.
 - 1. Device Box Accessories: Provide as required for each installation, including mounting brackets, device box extensions, switch box supports, plaster ears, and plaster board expandable grip fasteners (use only in existing walls) which are compatible with device boxes being utilized to fulfill installation requirements for individual wiring situations. Choice of accessories is Contractor's code-compliance option.
- C. Weatherproof Boxes: Corrosion-resistant, cast-metal, weatherproof, outlet wiring boxes, of types, shapes, and sizes, including depth of boxes as required with threaded conduit hubs for fastening electrical conduit. Provide cast-metal face plates with spring-hinged, watertight caps suitably configured for each application, including face plate gaskets and corrosion-resistant fasteners.
- D. Junction and Pull Boxes: Galvanized, code-gage sheet steel junction and pull boxes, with screw-on covers; of types, shapes, and sizes, to suit each respective location and installation; with welded seams and equipped with manufacturer's standard corrosion resistant steel nuts, bolts, screws and washers.
- E. Floor Boxes in Slab: Cast-iron, raintight, adjustable floor boxes as indicated, with threaded-conduit-entrance ends and vertical adjusting rings, gaskets, brass floor plates with flush screw-on covers with ground flange and stainless steel cover screws.
 - 1. Floor Boxes Accessories: Flush type, duplex, 2-pole, 3-wire, grounding, 125V, 20 ampere, floor-type receptacles with flanges.
- F. Floor Boxes Raised Floor:
 - 1. The panel opening shall be 10 by 10 inches and have an overall module depth of 5 inches. The box must provide a total Device Wiring Chamber volume of at least 115 cubic inches. The total Box Volume capacity shall have a minimum of 358 cubic inches.
 - 2. The box lid shall be constructed of die-cast zinc materials, and shall also be removable and 180 degrees reversible. The lid shall provide a removable cable guard for egress of power and communication workstation cables. The cable guard, when in use, should extend above the surface of the lid for the purpose of added protection of the workstation cables.
 - 3. The trim flange shall be constructed of die-cast zinc material and have a minimum overall dimension of 11-1/2 by 11-1/2 inches.
 - 4. The wiring chamber shall provide two separate compartments to accommodate power wiring on one side of the box and communication wiring on the other side. The chamber

SECTION 260534 - ELECTRICAL BOXES AND FITTINGS: continued

shall also provide complete access to the communication wiring plate, which will allow for removal of the communication plate, without the need to disconnect the wiring of any communication device outlets. The box shall be supplied with a power plate which shall have four duplex receptacle knockouts.

5. The box shall be secured to the raised floor by the use of two locking toggles. The locking toggles shall be integral to the box and adjusted by use of their locking screws.
- G. Bushings: Provide threaded, nylon insulated metallic bushings. Provide steel bushings for conduit sizes 1.5 inches and smaller. Provide malleable iron bushings for conduit sizes 2 inches and larger.
- H. Grounding Bushings: Provided where indicated, specified and required by NEC. Provide threaded, insulated, malleable iron bushing with lay-in screw clamp lug.
- I. Locknuts: Provide steel locknuts for conduit sizes 2 inches and smaller. Provide malleable iron for conduit sizes 2.5 inches and larger.
- J. Sealing Hub: Provide watertight, threaded, insulated sealing hub connectors for all outdoor and indoor wet locations where conduit enters into enclosures. Sealing hub threaded lengths shall be adequate to allow installation of bushing.
- K. Knockout Closures: Provide steel, press-in knockout seals for all unused punched out knockouts 2 inches and smaller. Provide steel two-piece bolt on knockout seals for all unused punched out knockouts 2.5 inches and larger.
- L. Fittings: Provide all threaded nipples, insulated short elbows, offset nipples, offset connectors, enlargers, and reducers as required. Provide EMT compression type connectors with insulated throat. Provide EMT compression type insulated short elbows as required.

PART 3 - EXECUTION

3.01 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS:

- A. General: Install electrical boxes, bushings, locknuts, nipples, connectors, sealing hubs, and fittings as required, indicated, in accordance with applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.
- C. Provide weatherproof boxes for interior and exterior locations exposed to weather or moisture.
- D. All boxes containing emergency power and lighting circuits shall be identified as specified in SECTION 260553.
- E. Provide knockout closures to cap unused knockout holes where blanks have been removed.
- F. Install electrical boxes in only those locations which ensure ready accessibility to enclosed electrical wiring.
- G. Maximum box size in a fire-rated wall shall be 4- by 4-inch square. Do not install boxes back-to-back in walls. In nonfire-rated and nonacoustic- rated walls, provide not less than 6 inches horizontal separation between boxes installed in opposite sides of wall. Provide not less than 24 inches horizontal separation between boxes installed in opposite sides of fire-rated and acoustic-rated walls.
- H. Do not install aluminum products in concrete.
- I. Position recessed outlet boxes accurately to allow for surface finish thickness.
- J. Set floor boxes level and flush with finish flooring material.
- K. Fasten electrical boxes firmly and rigidly to the surfaces to which attached, structural surfaces to which attached, or solidly embed them in concrete or masonry.
- L. Provide electrical connections for installed boxes.
- M. Subsequent to installation of boxes, protect boxes from construction debris and damage.

SECTION 260534 - ELECTRICAL BOXES AND FITTINGS: continued

- N. Where conductors have been up-sized for voltage drop the Contractor shall provide a properly sized device box. Additionally, where required, the Contractor shall provide a box adjacent to the device box where the circuit conductor shall be "pig-tailed" down to a smaller wire size or insulated spade lugs shall be used to terminate on the device terminals.

3.02 GROUNDING:

- A. Properly ground electrical boxes and demonstrate compliance with requirements. Bond all nonisolated equipment grounding conductors to all electrical boxes.

END OF SECTION 260534

SECTION 260536 - CABLE TRAY

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section specifies cable tray.
- B. Types of cable tray specified in this Section include the following:
 - 1. Basket type.
 - 2. Tubular style cable runway.
- C. Related Work Specified Elsewhere:
 - 1. For Supporting Devices and Seals see SECTION 260529.
 - 2. For Electrical Identification see SECTION 260553.
 - 3. For grounding see SECTION 260526.

1.02 REFERENCES:

- A. Applicable Standards: Comply with applicable requirements of the following standards:
 - 1. American Society for Testing and Materials (ASTM):
 - a. 525 - Steel sheet, zinc-coated (galvanized) by the Hot-Dip Process, General Requirements, Specifications for.
 - 2. National Electrical Manufacturers Association (NEMA):
 - a. VE1 - Metallic Cable Tray Systems.
 - 3. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code (NEC).
 - 4. Underwriters Laboratories (UL): Require products which are UL-listed and labeled.

1.03 SUBMITTALS:

- A. Refer to DIVISION 01, SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS for administrative and procedural requirements for submittals.
- B. Includes, but not limited to, the following:
 - 1. Product Data: Manufacturer's data on cable tray including dimensions, features, strengths, and weights of all cable tray sections, fittings, and supports.

PART 2 - PRODUCTS

2.01 GENERAL:

- A. Cable tray interior shall be continuously smooth with no sharp corners or burrs. Where cable tray systems are used as the equipment grounding conductor, the cable tray sections and fittings shall be approved for the purpose, labeled with the minimum cross sectional area, and in compliance with NEC minimum cross sectional area requirements. Provide tray covers where tray runs under openings, stairs, and open grating. When covers are required outdoors, provide peaked covers for snow loading.
- B. Wire Basket Sections and Components:
 - 1. General: Provide wire basket of types and sizes indicated; with connector assemblies, tool less clips, connector plates, splice plates and splice bars. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features.

SECTION 260536 - CABLE TRAY: continued

2. Materials and Finishes: Material and finish specifications for each wire basket type are as follows:
 - a. Electroplated Zinc: Straight sections shall be made from steel meeting the minimum mechanical properties of ASTM A510 and shall be electroplated zinc in accordance with ASTM B633 SC2.
 - b. Stainless Steel: Straight sections and accessories shall be made from AISI Type 304 Stainless Steel.
- C. Tubular Style Cable Runway:
 1. Runway shall be ladder type with 1-1/2-inch stringer height with welded rungs.
 2. Runway shall be 12 inches wide and 10 feet long with rungs spaced 9 inches on center, or as shown on drawings.
 3. Cable runway shall be Flat Black powder coat.
- D. Fittings and Accessories:
 1. Provide horizontal elbows, vertical elbows, horizontal tees, vertical tees, horizontal cross, reducers, solid flanged covers, ventilated covers, peaked covers, cover clamps, metal barrier strips, end plates, connector plates, hinged splice plates, reducing splice plates, expansion joint plates, bonding jumpers, box connectors, cable dropouts, cable clamps, and supports required.
 2. Fittings and connector plates shall provide the same load capacity as the straight sections.
 3. All fittings and accessories shall be from the cable tray manufacturer.
 4. Provide warning signs with 1-1/2-inch high black letters on a yellow background that reads: "WARNING! Not to be used as a walkway, ladder, or support for ladders or personnel." Provide on the outside of each side of the cable tray at 10-foot intervals.
- E. Supports:
 1. Trapeze and center hung type supports shall utilize galvanized, manufactured framing channels, threaded rods, beam clamps, cable tray hold down clamps, etc. Supports shall support cable tray without noticeable deflection of support members.
 2. Provide galvanized rods, anchors, inserts, clamps, spacers, shims, bolts, nuts, and miscellaneous steel as required.
 3. Supports shall be adequate to support cable tray with cables indicated plus cables indicated for future installation (if any).
 4. Supports shall be designed for Seismic Category D.

PART 3 - EXECUTION

3.01 GENERAL:

- A. Install cable tray, fittings, and accessories level, plumb and as required, in accordance with manufacturer's written instructions, applicable requirements of NEMA and NEC, and with recognized industry standard practices to fulfill project requirements.
- B. Sufficient space shall encompass cable trays to permit access for cable installation.
- C. Where cable trays contain circuits of different noise levels, the horizontal and vertical spacing between outside surfaces of the cable trays shall not be less than indicated below (unless specified otherwise, indicated otherwise, or required otherwise by the equipment manufacturer):
 1. Noise Level 1 Circuits: Analog circuits less than 50V, digital signals less than 12V, or telephone circuits.
 2. Noise Level 2 Circuits: Analog circuits greater than 50V or digital circuits greater than 12V.
 3. Noise Level 3 Circuits: 120Vac or DC circuits operating at less than 20 amperes.

SECTION 260536 - CABLE TRAY: continued

4. Noise Level 4 Circuits: AC or DC circuits less than 800V with operating currents less than 800 amperes.
5. Noise Level 5 Circuits: Circuits over 800Vac or DC and/or operating with currents over 800 amperes.

Minimum Horizontal and Vertical Spacing
Between Different Cable Tray Outside Surfaces (in inches)

<u>Cable Noise Level</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
1	*	**	6	26	26
2	**	*	6	18	26
3	6	6	*	*	12
4	26	18	*	*	*
5	26	26	12	*	*

- * Provide space sufficient for installation of cables.
- ** Install cables in same tray, but separated by a grounded metallic barrier.

- D. Do not route cable tray within 12 inches of fluorescent light fixtures.
- E. Do not route cable tray within 40 inches of electric motors or transformers.
- F. Do not route cable tray within 12 inches of conduit containing circuits with a capacity between 2 kVA and 5 kVA.
- G. Do not route cable tray within 24 inches of conduit containing circuits with a capacity greater than 5 kVA.
- H. Do not route cable tray within 6 feet of lightning protection system roof or down conductors.
- I. Remove all burrs and sharp edges of cable trays where cables could be damaged.
- J. Provide additional bracing where required. Cable tray shall be braced to prevent movement in any direction.
- K. Provide tray-to-box fittings at all boxes and equipment.
- L. Metallic cable tray shall provide a continuous low resistance electrical ground.
- M. Provide all openings in floors and walls for passage of cable tray. Fire rating of walls and floors shall be maintained when passing through them by providing fire seals in accordance with SECTION 260529.
- N. Expansion plates with bonding jumpers are to be installed at all building expansion joints and every 150 feet.
- O. Cable tray installation shall be completed before installing cables.
- P. The cable tray shall not be used to support other items, conduit, cable tray, piping, or utilities.

3.02 SUPPORTS FOR CABLE TRAY:

- A. Install supports as indicated, specified, and required.
- B. All framing channel type inserts and rod inserts in concrete floors are to be installed as required for installation of supports.
- C. Locate cable tray supports such that:
 1. The supports for horizontal straight sections fall between the connector and the first quarter point of each piece of horizontal straight cable tray.
 2. The supports for horizontal elbows are within 2 feet of each fitting extremity and at the arc midpoint of 30-, 45-, 60- and 90-degree elbows.
 3. The supports for horizontal tees consist of one support under each side rail of the tee.

SECTION 260536 - CABLE TRAY: continued

4. The supports for reducers and expansion connectors are within 2 feet of each end of the fitting.
5. The supports for vertical elbows at the tops of runs are at each end of that fitting. Support vertical elbows at the bottom of runs at the top of the elbow and within 2 feet of the lower fitting extremity.
6. The supports for vertical tees are within 2 feet of each fitting extremity.
7. The supports for vertical straight sections do not exceed 10 feet on center.
8. A fitting, which is used as the end of a run, is supported at the end of the run.
9. Design supports, including fasteners, to the structure as follows:
 - a. Add seismic bracing for seismic zone 2A such that the cable tray will not collapse during a seismic event.
 - b. Carry the greater of the following:
 - (1) The total calculated load multiplied by a safety factor of 4.
 - (2) The total calculated load between supports plus 200 pounds.

3.03 METALLIC CABLE TRAY GROUNDING:

- A. Cable tray shall provide a continuous low resistance electrical ground. Provide grounding jumpers at all expansion plates. Provide cable tray grounding as indicated and as specified in SECTION 260526 - GROUNDING, and as required by the NEC.

3.04 PROTECTION:

- A. Repair damage to galvanized finishes with zinc-rich paint recommended by the manufacturer.

END OF SECTION 260536

SECTION 260553 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section specifies electrical identification work including the following:
 - 1. Buried cable and duct bank warnings.
 - 2. Electrical power, control, and communication conductors (and conduit).
 - 3. Operational instructions and warnings.
 - 4. Danger, caution, and warning signs.
 - 5. Equipment/system identification nameplates.

1.02 REFERENCES:

- A. Applicable Standards: Comply with the applicable requirements of the following standards.
 - 1. American National Standards Institute (ANSI):
 - a. A13.1 - Scheme for the Identification of Piping Systems.
 - b. Z53.1-1979 - Safety Color Code for Marking Physical Hazards.
 - 2. Federal Specifications (FS):
 - a. FS L-P-387 - Plastic Sheet, Laminated, Thermosetting (for designation plates).
 - 3. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code (NEC), as applicable to installation of identifying labels and markers for wiring and equipment.
 - 4. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR 1910.145 - Specifications for Accident Prevention Signs and Tags.
 - 5. Underwriters Laboratories (UL), pertaining to electrical identification systems:
 - a. 969-1991 - Marking and Labeling Systems.

1.03 SUBMITTALS:

- A. Refer to DIVISION 01 and SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS for administrative and procedural requirements for submittals.
- B. Includes, but not limited to, the following:
 - 1. Product Data: Submit manufacturer's data on electrical identification materials and products.
 - 2. Samples: Submit samples of each color, lettering style, and other graphic representation required for each identification material or system.

PART 2 - PRODUCTS

2.01 ELECTRICAL IDENTIFICATION MATERIALS:

- A. General: Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.
- B. Orange "Emergency" and "(____)-VOLT" Conduit, Equipment, Box, and Cable Tray Markers:
 - 1. General: Self-adhesive vinyl tape marker not less than 3 mils thick. Provide 1-1/8-inch wide by 4-1/2-inch long marker for 2-inch and smaller conduit. Provide 2-1/4-inch wide by 9-inch long marker for 2-1/2-inch and larger conduit and all cable tray. Except as otherwise indicated, provide black lettering which indicates highest voltage of cables(s) in conduit or cable tray. Provide black lettering that indicates "Emergency" power circuit is in conduit.

SECTION 260553 - ELECTRICAL IDENTIFICATION: continued

2. Colors: Unless otherwise indicated or required by governing regulations, provide orange background tape marker.
- C. Underground Type Plastic Line Marker:
 1. General: Permanent, bright-colored, continuous-printed plastic tape marker, intended for direct-burial service and not less than 6 inches wide by 4 mils thick. Provide tape marker with printing which most accurately indicates type of service of buried cable or duct bank. Provide embedded continuous metallic strip or core.
- D. Wire/Cable Identification Bands:
 1. General: Vinyl-cloth self-adhesive cable/conductor markers of wrap-around type, either prenumbered plastic coated type or write-on type, with clear plastic self-adhesive cover flap; numbered to show circuit identification number indicated on Drawings or Shop Drawings.
- E. Plasticized Tags:
 1. General: Preprinted or partially preprinted, accident-prevention and operational tags, on plasticized card stock with matt finish suitable for writing. Tags shall be approximately 3-1/4 by 5-5/8 inches, with brass grommets and wire fasteners, and with appropriate preprinted wording, including large-size primary wording, e.g., "DANGER, DO NOT OPERATE." Tags shall comply with OSHA requirements.
- F. Self-Adhesive Plastic Signs:
 1. General: Self-adhesive or pressure-sensitive, preprinted, flexible vinyl signs for operational instructions or warnings; of sizes suitable for application areas and adequate for visibility, with proper wording for each application, e.g., "EXHAUST FAN."
 - a. Colors: Unless otherwise indicated or required by governing regulations, provide white signs with black lettering.
- G. Baked Enamel "Danger" Signs:
 1. "DANGER" signs of baked enamel finish on 20-gage steel (unless specified otherwise); of standard safety red, safety black, and safety white as defined by ANSI Z53.1-1979; 14- by 10-inch size, except where 10 by 7 inches is the largest size which can be applied where needed, and except where larger size is needed for adequate vision; with recognized standard explanation wording, e.g., "____ VOLTS, KEEP AWAY." Sign shall conform to OSHA and ANSI Z53.1-1979.
- H. Baked Enamel "Caution" Signs:
 1. "CAUTION" signs of baked enamel finish on 20-gage steel (unless specified otherwise); of standard safety yellow with safety black letters; 14- by 10-inch size, except where 10 by 7 inches is the largest size which can be applied where needed, and except where larger size is needed for adequate vision; with recognized standard explanation wording, e.g., "Caution for Ear Protection Required in this Area."
- I. Based Enamel "WARNING" Signs:
 1. "WARNING" signs of baked enamel finish on 20-gage steel (unless specified otherwise); of standard safety orange with safety black letters; 14- by 10-inch size, except where 10 by 7 inches is largest size that can be applied where needed and except where larger size is needed for adequate vision; with recognized standard explanation wording. Sign shall conform to OSHA and ANSI Z53.1-1979.
- J. Engraved Plastic-Laminate Nameplates:
 1. General: Engraving stock melamine plastic laminate nameplates, in sizes (minimum height of characters shall be 1/8 inch) and thicknesses specified or indicated, engraved with engraver's standard letter style of sizes and wording indicated, white face and black core plies (letter color) except as otherwise indicated, specified, or required. Colors shall comply with OSHA and ANSI Z53.1. Nameplate shall be punched for mechanical

SECTION 260553 - ELECTRICAL IDENTIFICATION: continued

- fastening except where adhesive mounting is necessary because of surface it is mounted to.
- a. Thickness: 1/16 inch, for units up to 20 square inches or 8-inch length; 1/8 inch for larger units.
 - b. Fasteners: Self-tapping stainless steel screws. Utilize contact-type permanent adhesive where screws cannot or should not penetrate surface mounted to.
2. Lettering and Graphics:
- a. Coordinate names, abbreviations, and other designations used in electric identification work with corresponding designations shown, specified, or scheduled. Provide numbers, lettering, and wording as indicated, or if not otherwise indicated, as recommended by manufacturer or as required for proper identification and operation/maintenance of electrical systems and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters and numbers. Comply with OSHA requirements. Comply with color requirements of ANSI Z53.1.
- K. Panelboard branch circuit color coding shall be posted at each panelboard per NEC 200.6(D).
- L. Self-adhesive white strips with printed circuit numbers for all light switch wall plates and 120Vac, 60-hertz receptacle wall plates.

PART 3 - EXECUTION

3.01 APPLICATION AND INSTALLATION:

- A. General Installation Requirements:
1. Install electrical identification products as indicated, in accordance with manufacturer's written instructions and requirements of NEC.
 2. Coordination: Where identification is to be applied to surfaces which require finish painting, install identification after completion of painting.
 3. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.
- B. Conduit and Cable Tray Identification Markers:
1. General: Where electrical conduit is exposed, apply identification markers on electrical conduit at 20-foot intervals (visible from the floor) and within 3 feet of all panelboards, switchboards, switchgear, automatic transfer switches, substations, switches, devices, and circuit breakers (readily visible when standing in front of equipment). Identification on cable tray shall be on outside of both sidewalls at 20-foot intervals.
- C. Underground Cable, Conduit, and Duct Bank Identification Marker:
1. General: During back-filling/top-soiling of each exterior underground direct buried electrical, signal or communication cable, conduit and duct bank, install continuous underground-type plastic line marker, located directly over the direct buried cable, conduit or duct bank at 12 inches below finished grade. Where multiple small direct buried cables are buried in a common trench and do not exceed an overall width of 16 inches, install a single line marker.
 2. Install line marker for every cable below grade, regardless of whether direct-buried, protected in conduit, or conduit in duct bank.
- D. Wire/Cable Identification Bands:
1. General: Apply cable/conductor identification bands, including circuit number, on each wire/cable in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for project's electrical work.

SECTION 260553 - ELECTRICAL IDENTIFICATION: continued

- E. Operational Identification and Warning Plasticized Tags and Metal Signs and Plastic Signs:
 - 1. General: Install signs with instruction or warnings wherever reasonably required to ensure safe and efficient operation and maintenance of electrical systems, electrically connected mechanical systems and general systems and equipment. Signs shall be placed to prevent misuse of electrical facilities by unauthorized personnel. When signs are installed on switches, outlets, controls, devices and covers of electrical enclosures they may be self-adhesive vinyl or plastic. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for intended purposes.
- F. Danger Signs:
 - 1. General: In addition to installation of danger signs specified, indicated, and required by governing regulations and authorities, install appropriate danger signs at locations indicated and at locations subsequently identified by Installer of electrical work as constituting similar dangers for persons in or about Project.
 - 2. Critical Switches/Controls: Install danger signs on switches and similar controls, regardless of whether concealed or locked up, where untimely or inadvertent operation (by anyone) could result in significant danger to persons or damage to or loss of property.
 - 3. Provide the following danger sign on the equipment indicated:
 - a. "Danger This Machine Starts Automatically" on all air compressors.
- G. Warning Signs:
 - 1. Provide an orange background sign with black letters reading "WARNING: LOAD SIDE OF SWITCH MAY BE ENERGIZED BY BACKFEED" on all tie switches and tie circuit breakers.
 - 2. Provide cable tray warning signs with 1-1/2-inch high black letters on an orange background that reads: "Warning! Not to be used as a walkway, ladder, or support for ladders for personnel." Provide on each side of cable tray at 10-foot intervals, visible from the floor below.
- H. Equipment/System Identification Nameplates:
 - 1. General: Install engraved plastic-laminated nameplates on each major unit of electrical equipment in the building; including central or master unit of each electrical system including communication/control/signal/alarm systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide single line of text, 1/2-inch high lettering on 1-1/2-inch high sign (2 inches high where two lines are required), black lettering on white field. Provide text matching terminology and numbering of the contract documents and shop drawings. Nameplate shall include unit designation, normal source circuit number ("Fed from..."), circuit voltage, and other data specifically indicated. Nameplate shall indicate normal source circuit number ("Fed from..."), and emergency source circuit number ("Fed from..."), when the equipment is a transfer switch or fed directly from a transfer switch. Provide nameplates for each unit of the following categories of electrical work:
 - a. Switchboards, panelboards, electrical cabinets, and enclosures. (Include main bus ampacity on the nameplate.)
 - b. Access panel/doors to electrical facilities.
 - c. Major electrical switchgear (include main bus ampacity on the nameplate).
 - d. Electrical substations (include main bus ampacity on the nameplate).
 - e. Motor control centers (include main bus ampacity on the nameplate), and individual motor starters.
 - f. Disconnect switch.

SECTION 260553 - ELECTRICAL IDENTIFICATION: continued

- g. Push buttons, selector switches, indicating lights (circuit number and voltage not required on nameplate).
 - h. Power transfer equipment: Contactors and transfer switches.
 - i. Transformers (include primary voltage, secondary voltage, and number of phases).
 - j. Inverters (include input voltage, output voltage, number of input phases).
 - k. Frequency converters (include input and output frequency).
 - l. Battery racks.
 - m. Telephone cabinets and switching equipment (circuit number and voltage not required on nameplate).
 - n. TV/audio monitoring master station.
 - o. Fire alarm master station.
 - p. Security monitoring master station.
 - q. Public address system.
 - r. Wireway used as auxiliary gutter tap locations with circuit number of circuit being tapped. Provide on outside of wireway.
 - s. Provide "EMERGENCY" conduit markers on all conduit and pullboxes that contain emergency power conductors.
 - t. Switchboard main switches and circuit breakers.
 - u. Provide wire color coding posted on each panelboard, as required by NEC 200.6(D).
 - v. All non-120Vac, 60-hertz receptacles.
2. Install markers, tags, nameplates, and signs at locations indicated, or where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. Secure the identification with fasteners, except use adhesive where fasteners should not or cannot penetrate surface.
- I. Provide self-adhesive white strips with printed branch circuit number on all light switch wall plates and 120Vac, 60-hertz receptacle wall plates.

END OF SECTION 260553

SECTION 260910 - ELECTRICAL SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The purpose of this section is to specify Division 26 responsibilities in the Commissioning (Cx) process which are being directed by the Commissioning Authority (CA).
 - a. The list of commissioned systems is found in Section 019113, Part 1.6.
- B. Commissioning (Cx) requires the participation of Division 26 to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Section 019113. Division 26 shall be familiar with all parts of Section 019113 and the Commissioning Plan issued by the CA and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

1.2 RESPONSIBILITIES

- A. Electrical Contractor. The commissioning responsibilities applicable to the Electrical Contractor are as follows (*all references apply to commissioned equipment only*):

Construction and Acceptance Phases

1. Attend a commissioning scoping meeting and other necessary meetings scheduled by the CA to facilitate the Cx process.
2. Contractor shall provide normal cut sheets and shop drawing submittals of commissioned equipment to the Commissioning Agent (CA).
3. Provide additional requested documentation, prior to normal O&M manual submittals, to the CA for development of start-up checklists and testing procedures.
 - a. Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full factory testing reports, if any, and full warranty information, including all responsibilities of the School District to keep the warranty in force clearly identified. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the CA.
 - b. The CA may request further documentation necessary for the commissioning process.
 - c. This data request may be made prior to normal submittals.
4. Provide a copy of the O&M manuals submittals of commissioned equipment, through normal channels, to the CA for review and comments.
6. Electrical Contractor shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, wiring diagrams or equipment documentation is not sufficient for writing start-up checklists and procedures.
7. Provide assistance to the CA in preparation of the specific test procedures. Electrical Contractor shall review test procedures to ensure feasibility, safety and equipment protection during the tests.
8. Develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the pre-functional checklists from the CA. Submit manufacturer's detailed start-up procedures and the full start-up plan and procedures to the CA for review.

SECTION 260910 - ELECTRICAL SYSTEMS COMMISSIONING: continued

9. During the startup and initial checkout process, execute and document the electrical-related portions of the pre-functional checklists provided by the CA for all commissioned equipment.
10. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CA.
11. Provide skilled technicians to execute starting of equipment and to execute the pre-functional start-up tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests and adjustments.
12. Correct deficiencies (differences between specified and observed performance) as interpreted by the CA and retest the equipment.
13. During construction, maintain as-built red-line drawings for all drawings and final as-builts for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing). Prepare red-line as-built drawings for all drawings and final as-builts for contractor-generated coordination drawings.
14. Provide training of the School District's operating personnel as specified.
15. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

Warranty Period

1. Execute deferred start-up and performance testing, witnessed by the CA, according to the specifications.
2. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any deferred testing.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Division 26 shall provide all test equipment necessary to fulfill the testing requirements of this Division.
- B. Refer to Section 019113 for additional Division 26 requirements.

PART 3 - EXECUTION

3.1 SUBMITTALS

- A. Division 26 shall provide submittal documentation relative to commissioning to the CA as requested by the CA. Refer to Section 019113 for additional Division 26 requirements.

3.2 STARTUP

- A. The Electrical Contractor shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section. Division 26 has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and pre-functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the Commissioning Authority or the School District.

SECTION 260910 - ELECTRICAL SYSTEMS COMMISSIONING: continued

- B. Pre-functional testing is intended to begin upon completion of a system. Pre-functional testing may proceed prior to the completion of systems, or sub-systems at the discretion of the CA. Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all pre-functional checklists as soon as possible.

3.3 TESTING DOCUMENTATION, NON-CONFORMANCE AND APPROVALS

- A. Refer to Section 019113 for specific details on pre-functional checklists and start-up testing.

3.4 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. Division 26 shall compile and prepare documentation for all equipment and systems covered in Division 26 and deliver to the CM.
- B. The CA shall receive a preliminary copy of the O&M manuals for review.

3.5 TRAINING OF OWNER'S PERSONNEL

- A. The CA shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed.
- B. The CA shall be responsible for overseeing and approving the content and adequacy of the training of the Owner's personnel for commissioned equipment.
- C. Electrical Contractor. The Electrical Contractor shall have the following training responsibilities:
 - 1. Provide the CA with a training plan four (4) weeks before the planned training.
 - 2. Provide designated School District personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned electrical equipment or system.
 - 3. Training shall start with classroom sessions, if necessary, followed by hands on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, power failure, etc.
 - 4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
 - 5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of electrical equipment. This person may be the start-up technician, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of operation of the specific piece of equipment is required.
 - 6. The training sessions shall follow the outline of the operation and maintenance (O&M) manuals and illustrate whenever possible the use of the O&M manuals for reference.
 - 7. Training shall include:
 - a. Use the printed installation, operation and maintenance instruction material included in the O&M manuals.
 - b. Include a review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare

SECTION 260910 - ELECTRICAL SYSTEMS COMMISSIONING: continued

- parts inventory suggestions. The training shall include start-up, shut-down and any emergency procedures.
- c. Discuss relevant health and safety issues and concerns.
 - d. Discuss warranties and guarantees.
 - e. Cover common troubleshooting problems and solutions.
 - f. Explain information included in the O&M manuals and the location of all plans and manuals in the facility.
8. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and maintenance of all pieces of equipment.
9. Training shall occur after performance testing by the Commissioning Agent is complete, unless approved otherwise by the Commissioning Agent.

3.7 WRITTEN WORK PRODUCTS

- A. Written work products of the Electrical Contractor will consist of the filled out initial checkout/installation, start-up and functional testing forms.

END OF SECTION 260910

SECTION 262213 - TRANSFORMERS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section specifies transformer work as indicated by drawings and schedules.
- B. Types of transformers specified in this Section include the following:
 - 1. Dry-type transformers.
 - 2. Pad mounted transformer.
- C. Related Work Specified Elsewhere:
 - 1. SECTION 260526 - GROUNDING.

1.02 REFERENCES:

- A. Applicable Standards: Comply with applicable requirements of the following standards:
 - 1. American National Standards Institute (ANSI):
 - a. C2 - National Electrical Safety Code.
 - b. C57.12.01 - General Requirements for Dry-Type Distribution and Power Transformers.
 - c. C57.12.50 - Requirements for Ventilated Dry-Type Distribution Transformers 1-500 kVA, Single-Phase, and 15-500 kVA, Three-Phase with High-Voltage 601-34,500V, Low Voltage 120-600V.
 - d. C57.12.91 - Test Code for Dry-Type Distribution and Power Transformers.
 - 2. National Electrical Manufacturers Association (NEMA):
 - a. TR1 - Transformers, Regulators, and Reactors. (Supplements ANSI C57 - Series Standards.)
 - b. TR27 - Commercial, Institutional, and Industrial Dry-Type Transformers.
 - c. ST20 - Dry-Type Transformers for General Applications.
 - 3. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code (NEC). Comply with NEC as applicable to installation and construction of electrical power/distribution transformers.
 - 4. Underwriters Laboratories (UL): Comply with applicable requirements of ANSI/UL 506 Safety Standard for Specialty Transformers. Provide transformers and components which are UL-listed and labeled.
 - a. UL 1561 - Large General Purpose Transformers.

1.03 SUBMITTALS:

- A. Refer to DIVISION 01 and SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS for administrative and procedural requirements for submittals.
- B. Include, but not limited to, the following:
 - 1. Product Data: Submit manufacturer's technical product data including rated kVA, frequency, primary and secondary voltages, wiring diagram, percent taps, polarity, impedance and certification of transformer performance efficiency at 100% load, percentage voltage regulation at 100% load at 75°C, full-load losses in watts, percent impedance at 75°C, hot-spot and average temperature rise above 40°C ambient temperature, sound level in decibels, and standard published data.
 - 2. Shop Drawings: Submit manufacturer's drawings indicating dimensions and weight loadings for transformers and wall brackets. Submit transformer nameplate data (include center of gravity information in seismic zones).
 - 3. Wiring Diagrams: Submit wiring and control diagrams for transformers. Clearly differentiate between portions of wiring that are manufacturer factory installed and portions to be field-installed.

SECTION 262213 - TRANSFORMERS: continued

4. Submit all field test data.
5. Submit operation and Maintenance manuals.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Subject to compliance with requirements, provide products of one of the following or approved equal, but not limited to (for each type of transformer):
 1. Cutler-Hammer.
 2. General Electric Co.
 3. Hevi-Duty Electric Div.
 4. Siemens Energy and Automation.
 5. Square D Co.
 6. ABB.
 7. Cooper.

2.02 TRANSFORMERS:

- A. General: Except as otherwise specified or indicated, provide manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by manufacturer, and as required for complete installation. Provide transformers designed to withstand the forces of a Seismic Zone 2A event without failure.
- B. Dry-Type Transformers (45 kVA or less): Factory-assembled, general-purpose, air-cooled, dry-type transformers; of sizes, characteristics, and rated capacities indicated. Single-phase transformer (where indicated): 60 hertz, 10 kV BIL, (manufacturer's standard impedance) with 480V primary and 240/120V secondary with grounded neutral. Three-phase transformer (where indicated): 60 hertz, 30 kV BIL (manufacturer's standard impedance) with 480V delta connected primary and 208/120V wye connected secondary with grounded neutral. Provide K=4 rated transformers where indicated. Copper primary and secondary windings. Provide primary winding with 4 full capacity taps; two 2-1/2% increments below and above full-rated voltage for de-energized tap-changing operation. Insulate with Class 220 insulation and rate for continuous operation with a maximum temperature rise of 80°C at rated kVA. Limit transformer surface temperature rise to maximum of 65°C. Provide terminal enclosure, with cover, to accommodate primary and secondary winding connections and raceway connectors. Equip terminal leads with connectors installed. Limit terminal compartment temperature to 75°C when transformer is operating continuously at rated load with ambient temperature of 40°C. Provide wiring connectors suitable for copper wiring. Cushion-mount transformers with external vibration isolation supports; sound-level ratings shall not exceed ANSI/NEMA standards. Electrically ground core and coils to transformer enclosure by means of flexible metal grounding strap. Provide transformers with ventilated or fully enclosed sheet steel enclosures. Apply manufacturer's standard light gray indoor enamel over cleaned and phosphatized steel enclosure. Provide transformer wall mounting bracket for single-phase transformers less than 25 kVA and for three-phase transformers less than 45 kVA. All other transformers shall be suitable for floor mounting.
- C. Dry-Type Transformers (above 45 kVA): Factory-assembled, general-purpose, ventilated, dry-type transformers; of sizes, characteristics, and rated capacities indicated; 3-phase, 60 hertz, 5.75% impedance; with 480V delta-connected, 10 kV BIL primary; 208Y/120V 4-wire, wye-connected secondary with grounded neutral or 240V, 3-wire, delta connected secondary (as indicated). Provide K=4 rated transformers where indicated. Provide primary windings with a minimum of 4 full capacity taps; two 2-1/2% increments above full-rated voltage and two

SECTION 262213 - TRANSFORMERS: continued

- 2-1/2% increments below full-rated voltage for de-energized tap-changing operation. Copper primary and secondary windings. Insulate with Class 220 insulation rated 80°C rise. Rate transformer for continuous operation at rated kVA. Provide terminal enclosure, with hinged cover, to accommodate primary and secondary winding connections and raceway connectors. Provide terminal board with clamp type connectors. Limit terminal compartment temperature to 75°C when transformer is operating continuously at rated load with ambient temperature of 40°C. Provide wiring connections suitable for copper wiring. Integrally mount vibration isolation supports between core and coil assembly and transformer enclosure; electrically ground core and coils to transformer enclosure by means of flexible metal grounding strap. Do not exceed maximum sound-level rating in accordance with ANSI/NEMA standards. Provide transformers with ventilated steel enclosures and lifting lugs. Apply manufacturer's standard light gray outdoor enamel over cleaned and phosphatized steel enclosure. Provide transformers suitable for floor mounting.
- D. Pad-Mounted Oil-Filled Transformers: Factory-assembled, oil-filled, outdoor type, tamper-resistant, pad-mounted transformer where shown, of sized, characteristics, and rated capacities indicated; 3-phase, 60 hertz, manufacturer's standard impedance, with 12,470V delta 95 kV BIL primary and 208Y/120V, 30 kV BIL secondary with grounded neutral. Provide integral lightning arresters. Provide integral primary fuse protection. Provide copper primary and secondary windings. Provide primary winding with 4 taps; two 2-1/2% increments above and two 2-1/2% increments below full-rated primary voltage for de-energized tap-changing operation. Limit transformer surface temperature rise to 65°C. Equip sealed transformer tank with drain and sampling valves, filter-press connections, magnetic oil gauge with alarm contact, automatic pressure relief device, grounding block, pressure-vacuum gauge with alarm contacts and top-oil dial-type thermometer with alarm contacts. Provide steel enclosure with side-hinged, removable, weather-resistant cover with hinged lift-off cabinet doors capable of being padlocked closed. Equip with high-voltage/low-voltage compartment barrier. Apply manufacturer's standard light-gray outdoor enamel over cleaned and phosphatized steel enclosure.
- E. Equipment/System Identification: Provide equipment/system identification nameplates complying with SECTION 260553 - ELECTRICAL IDENTIFICATION.
- F. Finishes: Coat interior and exterior surfaces of transformer, including bolted joints, with manufacturer's standard color baked-on enamel.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Examine areas and conditions under which transformers and ancillary equipment are to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF TRANSFORMERS:

- A. Install transformers as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NESC, NEMA, ANSI and IEEE standards, and in accordance with recognized industry practices to ensure that products fulfill requirements. Arrange equipment to provide adequate space for access and for cooling air circulation.
- B. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A.

SECTION 262213 - TRANSFORMERS: continued

- C. Provide bracing and supports to resist the forces of a Seismic Zone 2A event without collapse or over-turning of the transformer.
- D. Do not mount transformer within 40 inches of cable tray.
- E. Provide concrete raised housekeeping pads for floor-mounted transformer.

3.03 GROUNDING:

- A. Provide equipment grounding connections for transformers as specified, indicated, and as required. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent and effective grounding. Provide grounding in accordance with SECTION 260526.

3.04 IDENTIFICATION:

- A. Provide identification of transformers as specified in SECTION 260553 - ELECTRICAL IDENTIFICATION.

3.05 TESTING:

- A. Prior to energization of transformers, check all accessible connections for compliance with manufacturer's torque tightening specifications. Clean out any dust and dirt.
- B. Prior to energization, check circuitry for electrical continuity and for short circuits.
- C. Perform insulation resistance test: High-voltage winding to low-voltage winding, low-voltage winding to ground, and high-voltage winding to ground. Record and submit test results.
- D. Perform transformer turns ratio test (TTR) on the full winding and all taps. Record and submit test results.
- E. Upon completion of installation of transformers and testing, energize primary circuitry at rated voltage and frequency from normal power source, and test transformers, including, but not limited to, audible sound levels, to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at the site then retest to demonstrate compliance; otherwise, remove and replace with new units or components and proceed with retesting.
- F. Adjust transformer primary taps for nominal system voltage at initial installation and again when the transformer reaches its designed "full" load condition after occupancy by the Contracting Officer. Schedule all required electrical outages with the Contracting Officer.

END OF SECTION 262213

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section specifies panelboards, including cabinets and boxes, as indicated by drawings and schedules, and as specified herein.
- B. Types of panelboards and enclosures required for the project include the following:
 - 1. Service entrance panelboards.
 - 2. Power distribution panelboards.
 - 3. Lighting and small power panelboards.
 - 4. Emergency power panelboards.
- C. Related Work Specified Elsewhere:
 - 1. Wires/cables, electrical boxes, fittings, and raceways required in conjunction with the installation of panelboards and enclosures: Other DIVISION 26 Sections.
 - 2. SECTION 260553 - ELECTRICAL IDENTIFICATION.
 - 3. SECTION 260526 - GROUNDING.

1.02 REFERENCES:

- A. Applicable Standards (comply with applicable requirements of the following standards):
 - 1. National Electrical Manufacturers Association (NEMA):
 - a. 250 - Enclosures for Electrical Equipment (1,000V Maximum).
 - b. PB1 - Panelboards.
 - c. PB1.1 - Instructions for Safe Installation, Operation, and Maintenance of Panelboards Rated 600V or Less.
 - d. PB2.2 - Application Guide for Ground-Fault Protective Devices for Equipment.
 - 2. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code (NEC): Comply with applicable local code requirements of the authority having jurisdiction and NEC as applicable to installation and construction of electrical panelboards and enclosures.
 - 3. Underwriters Laboratories (UL): Provide panelboard units which are UL-listed and labeled.
 - a. 50 - Electrical Cabinets and Boxes.
 - b. 67 - Electrical Panelboards.
 - c. 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 - d. 489 - Molded Case Circuit Breakers and Circuit Breaker Enclosures.
 - e. 869 - Electrical Service Equipment.
 - f. 1053 - Ground-Fault sensing and Relaying Equipment.
 - g. 1283 - Electromagnetic Interference Filters.
 - h. 1449 - Transient Voltage Surge Suppressors.
 - i. Special Use Markings: Provide panelboards constructed for special use with appropriate UL markings which indicate that they are "Suitable for Use As Service Equipment."
 - 4. Federal Specification (FS) Compliance: Comply with applicable requirements of the following standards:
 - a. FS W-C-375 Series - Molded-Case Circuit-Breakers, Branch Service and Circuit.
 - b. FS W-S-115 - Power Distribution Panel.
 - c. FS W-S-865 - Surface-Mounted Switch Box (Enclosed).
 - d. FS W-F-870/Gen - Fuseholders and Fuseclips.

SECTION 262416 - PANELBOARDS: continued

1.03 SUBMITTALS:

- A. Refer to DIVISION 01 and SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS for administrative and procedural requirements for submittals.
- B. Includes, but not limited to, the following:
 - 1. Product Data: Submit manufacturer's data on panelboards and enclosures.
 - a. Panelboard dimensions and weight (provide center-of-gravity information for each seismic rated panelboard).
 - b. Complete data on circuit breakers. Submit time - current characteristic curves of all devices.
 - c. Panelboard short-circuit interrupting capacity, and information on buses: phase, neutral, and ground.
 - d. Information on whether panelboard is fed from top or bottom.
 - e. Data on maximum and minimum incoming and outgoing feeder and branch circuit wire size.
 - f. Data on door, locks, and mounting: surface or flush.
 - g. Data on total number of poles and number of unused poles that are available for future use.

PART 2 - PRODUCTS

2.01 MANUFACTURERS: Subject to compliance with requirements, provide panelboard and mini-power center products of one of the following (for each type and rating of panelboard and enclosure) or approved equal:

- 1. Crouse-Hinds Company.
- 2. General Electric Company.
- 3. Siemens-Energy and Automation, Inc.
- 4. Square D Company.

2.02 PANELBOARDS:

- A. General: Except as otherwise indicated, provide panelboards, enclosures, and ancillary components of types, size, and ratings indicated, which comply with manufacturer's standard materials and with the design and construction in accordance with published product information. Provide panelboards that shall resist the forces of a Seismic Zone 2A event without damage. Equip with proper number of panelboard switching and protective devices as required for complete installation. Provide ground fault circuit interrupter type circuit breakers where indicated. Where types, sizes, or ratings are not indicated, comply with NEC, UL, and established industry standards for those applications indicated. Provide terminals UL-rated for 75°C (minimum) conductors. All bus shall be tin plated copper. Bus shall be braced to withstand available short circuit currents indicated.
- B. Service Entrance Panelboards: Factory-assembled, dead-front, safety constructed, service entrance circuit breaker type panelboards in sizes and ratings indicated. Equip with panelboard switching and protective devices, of types, ratings, and characteristics indicated. Construct with anti-turn solderless lugs bolted to main bus bars, suitable for service with 480Y/277V, 3-phase, 4-wire, 60 hertz system. Provide unit with incoming service connecting at top or bottom of panel as required. Provide full-sized neutral bus; provide suitable lugs on neutral bus for incoming and outgoing feeders requiring neutral connections. Provide ground bus. Provide bolt-on, molded-case, main circuit breaker and branch circuits with bolt-on, molded-case type, single-pole and multi-pole circuit breakers, with toggle handles that indicate when tripped. Where multiple-pole breakers are indicated, provide common trip for all poles.

SECTION 262416 - PANELBOARDS: continued

- Provide enclosures which are fabricated by the same manufacturer as panelboards, and which mate and match properly with panelboards. Provide panelboards with UL markings which indicate "suitable for use as service entrance equipment."
- C. Power Distribution Panelboards: Dead-front, safety type, power distribution panelboards as indicated with panelboard switching and protective devices in quantities, ratings, types, and with arrangement shown; with anti-turn solderless pressure type main lug connectors approved for use with copper conductors. Provide unit with incoming feeder connecting at top or bottom of panel as required. Provide 480Y/277V, 3-phase, 4-wire, 60 hertz panelboard with full-sized neutral bus; provide suitable lugs on neutral bus for incoming and outgoing feeders requiring neutral connections. Provide bolt-on, molded-case, main and branch circuit breaker types for each circuit with toggle handles that indicate when tripped. Where multiple-pole breakers are indicated, provide with common trip so overload on one pole will trip all poles simultaneously. Provide panelboard with bare uninsulated grounding bars suitable for bolting to enclosures. Provide enclosures fabricated by same manufacturer as panelboards which mate and match properly with panelboards.
- D. Lighting and Small Power Panelboards: Dead-front, safety type, 480Y/277V; 208Y/120V (voltage rating as required), 3-phase, 4-wire, 60 hertz; 200Y/115Vac, 400 hertz; and 28Vdc lighting and small power panelboards as indicated, with switching and protective devices in quantities, ratings, types, and arrangements shown; with anti-turn solderless pressure type lug connectors approved for use with copper conductors; construct unit for connecting incoming feeder at top or bottom of panel as required; Equip with full-sized neutral bar, with bolt-on type, heavy-duty, quick-make, quick-break, single- and multi-pole circuit breakers, with toggle handles that indicate when tripped. Where multiple-pole breakers are indicated, provide common trip for all poles. Provide suitable lugs on neutral bus for each incoming and outgoing feeder required; and provide bare uninsulated grounding bars suitable for bolting to enclosures. Provide insulated ground bus for isolated ground circuits that terminate or pass through the panelboard, as indicated. Provide enclosures fabricated by same manufacturer as panelboards, which mate and match properly with panelboards. Provide double neutral where indicated.
- E. Panelboard Enclosures: Galvanized sheet steel cabinet type enclosures, in sizes required, NEMA Type 1 (unless indicated or specified otherwise) and code gauge (minimum 16-gage) thickness. Construct with multiple knockouts and wiring gutters. Provide fronts with adjustable trim clamps and front doors with flush locks and three keys per panelboard, all panelboard enclosures keyed alike, with concealed piano front door hinges. Provide hinged doors over vertical wiring gutter. Equip with interior circuit directory frame and removable card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor coating. Design enclosures for recessed or surface mounting as indicated. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate and match properly with panelboards to be enclosed.
- F. Molded-Case Circuit Breakers: Circuit breakers shall be manufactured by the panelboard manufacturer and shall be UL-listed to be installed in the panelboard. Factory-assembled, bolt-on, molded-case circuit breakers of frame sizes, characteristics, voltage, poles, RMS symmetrical interrupting ratings indicated and other ratings indicated. The minimum interrupting rating for 120Vac, 208Vac and 240Vac circuit breakers shall be 10,000 amperes, RMS symmetrical unless indicated otherwise. The minimum interrupting rating for 277Vac, 480Vac and 600Vac circuit breakers shall be 14,000 amperes RMS symmetrical, unless indicated otherwise. All circuit breakers applied at 480Vac shall be rated 480Vac. All circuit breakers applied at 208 or 240Vac shall be rated 240Vac. Provide integral ground fault protection on all 480V service entrance main circuit breakers and all 480V feeder circuit

SECTION 262416 - PANELBOARDS: continued

- breakers rated 1,000 amperes or more. Provide breakers with thermal and instantaneous magnetic trip, with fault-current limiting protection when required and ampere ratings as indicated. Provide fixed, non-interchangeable trips for circuit breakers rated 15-400A. Provide fixed, interchangeable magnetic and thermal trips for circuit breakers rated higher than 400A. Construct with over center, trip free, toggle-type operating mechanisms with quick-make, quick-break action and positive handle trip indication. Construct breakers for mounting and operating in any physical position, and operating in an ambient temperature of 40°C. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated. Provide "SWD" switching duty circuit breakers for all single pole circuit breakers that directly control (no switch provided) 120 and 277V fluorescent and HID lighting circuits in lighting panelboards.
- G. Accessories: Provide panelboard accessories and devices including, but not necessarily limited to, ground fault circuit interrupter (GFCI) breakers, integral contactors, feed through lugs, split bus construction, circuit breaker handle locks, etc., as recommended by panelboard manufacturer for ratings and applications indicated. Provide circuit breaker handle locks on all circuits that supply night lights, exit signs, emergency lights, emergency power, energy management control system (EMCS) panels and fire alarm panels.
- H. Metering: CTs, PTs, kWh meter, and instrument phase selector switches as indicated. Mount meters semi-recessed in front doors and install meter wiring and lacing with sufficient flexibility at hinged edge of meter front mounting plates to prevent damage. Provide the following meter devices:
1. Volt and ampere meters: Switchboard type, semi-flush unit that is 4-1/2 inches square. Provide 1% accuracy of full scale. Provide black metal trim, white dial, black figures, and black pointer. Provide ammeters with a 0-5 ampere range (scale as required) and voltmeters with a 0-150V range (scale as required).
 2. Voltmeter transfer switches: Provide a knurled knob handle with a minimum of seven positions (A-B, B-C, C-A, A-N, B-N, C-N and OFF).
 3. Ammeter transfer switches: Provide a knurled knob handle with four positions (A, B, C and OFF).
 4. Potential transformers: Provide dry type, 600Vac insulated, 480V primary, 120V secondary. Provide accuracy to conform to ANSI classification 0.3 W, X, Y with burdens corresponding to meters connected.
 5. Current transformers: Dry type, toroidal brushing (or wound type), ratio as indicated, secondary terminals connected to short-circuiting-type terminal blocks. Provide thermal and mechanical ratings corresponding to applied equipment.
 6. kWh meters: Provide with mechanical, resettable, pointer type, demand register. Provide with kW demand pulsed contact closures for remote indication.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas and conditions under which panelboards and enclosures are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF PANELBOARDS:

- A. Install panelboards and enclosures as indicated, providing NEC required working space, in accordance with manufacturer's written instructions, applicable requirements of NEC and in compliance with recognized industry practices to ensure that products fulfill requirements.

SECTION 262416 - PANELBOARDS: continued

- Provide seismic support and bracing that shall resist the forces of a Seismic Zone 2A event without damage.
- B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A.
 - C. Fasten enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically anchored.
 - D. Provide properly wired electrical connections for panelboards within enclosures.
 - E. Install numbers on all circuit breakers, and type the panelboard's circuit directory card upon completion of installation work. Clearly identify the load on each circuit and the circuit number.
 - F. Provide circuit breaker handle locks on all circuits that supply night lights, exit signs, emergency lights, emergency power, energy management control system (EMCS) panels and fire alarm panels.
 - G. Provide panelboard electrical identification as specified in SECTION 260553.
 - H. Provide filler plates in all unused spaces.
 - I. Provision for future circuits at all flush mounted panelboards (unless indicated otherwise): Extend four 1-inch empty conduit from panelboard into accessible ceiling space or space designated to be ceiling space in the future.
 - J. Route branch circuit groupings in conduit as indicated, from load to panelboard. Do not route multiple branch circuit groupings (beyond the groupings indicated) in a common conduit from the panelboard to a wireway (or box) above the panelboard.
- 3.03 GROUNDING:
- A. Provide equipment grounding connections for panelboard enclosures as indicated and as required by NEC. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent and effective grounds. Provide grounding as specified in SECTION 260526.
- 3.04 FIELD QUALITY CONTROL:
- A. Prior to energization of electrical circuitry, check all accessible connections to manufacturer's tightening torque specifications.
 - B. Prior to energization, check panelboard circuits for short circuits, electrical continuity of circuits, enclosure grounding and neutral grounding at service entrance and at derived source transformers.
 - C. Prior to energization of panelboards, check with insulation resistance tester: Phase-to-phase and phase-to-ground insulation resistance levels of each phase bus to ensure requirements are fulfilled. Record and submit test results.
- 3.05 ADJUSTING AND CLEANING:
- A. Set all adjustable trip settings to values provided by the Manufacturer.
 - B. Adjust operating mechanisms for free mechanical movement.
 - C. Upon completion of installation, clean interior and exterior of panelboards. Remove paint splatters, spots, dirt and debris.
 - D. Touch-up scratched or marred surfaces to match original finishes.

SECTION 262416 - PANELBOARDS: continued

3.06 DEMONSTRATION:

- A. Subsequent to wire and cable hook-ups, energize panelboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section specifies the following:
 - 1. Receptacles.
 - 2. Industrial Heavy-Duty Receptacles.
 - 3. Ground Fault Circuit Interrupter Receptacles.
 - 4. Plugs.
 - 5. Plug Connectors.
 - 6. Snap Switches.
 - 7. Incandescent Lamp Dimmer-Switches.
 - 8. Fluorescent Lamp Dimmer-Switches.
 - 9. Wall Plates.
 - 10. Floor Receptacles.
- B. Related Work Specified Elsewhere:
 - 1. Devices other than snap switches and plug/receptacle sets used as disconnects for motors: SECTION 262816 - CIRCUIT AND MOTOR DISCONNECT SWITCH.
 - 2. Requirements for identification to be engraved on wall plates: SECTION 260553 - ELECTRICAL IDENTIFICATION.

1.02 REFERENCES:

- A. Applicable Standards: Comply with applicable requirements of following standards.
 - 1. National Electrical Manufacturers Association (NEMA):
 - a. WD-1 - General Requirement for Wiring Devices.
 - b. WD-2 - Wiring Devices - Dimensional Requirements.
 - c. FB-11-83 - Plugs, Receptacles and Connectors of the Pin and Sleeve Type for Hazardous Locations.
 - d. PR 2-86 - Enclosures for Plugs, Receptacles and Connectors of the Pin and Sleeve Type.
 - e. PR 3-86 - Guide to Pin and Sleeve Plugs, Receptacles, and Connectors.
 - 2. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code (NEC).
 - 3. Underwriters Laboratories (UL):
 - a. 20 - General Use Snap Switches.
 - b. 498 - Electrical Attachment Plugs and Receptacles.
 - c. 943 - Ground-Fault Circuit Interrupters.
 - d. 1010 - Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations.
 - e. 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 - f. 1449 - Transient Voltage Surge Suppressors.
 - 4. Lockheed Martin:
 - a. Facility Requirement Plan - 15 December 2008.

1.03 SUBMITTALS:

- A. Refer to DIVISION 01 and SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS for administrative and procedural requirements for submittals.
- B. Includes, but not limited to, the following:
 - 1. Product data for each type of product specified.

SECTION 262726 - WIRING DEVICES: continued

2. Samples of those products indicated for Sample submission for Contracting Officer's comments. Include color and finish Samples of device plates and other items per Contracting Officer's request.
- 1.04 SEQUENCE AND SCHEDULING:
- A. Schedule installation of wall plates after the surface upon which they are installed has received the final finish.

PART 2 - PRODUCTS

- 2.01 WIRING DEVICES:
- A. General: Provide wiring devices, in types, characteristics, heavy duty, specification grades, colors, and electrical ratings for applications indicated which are UL-listed and which comply with NEMA WD-1, WD-6, and other applicable UL standards. Provide ivory color devices (except isolated ground receptacles shall be orange and emergency power receptacles shall be red) devices except as otherwise indicated. Provide wall plates as specified (except emergency power receptacle wall plates shall be stainless steel with red label) except as otherwise indicated. Verify color selections with Contracting Officer.
 - B. Receptacles: As scheduled in specifications and on drawings. Comply with UL 498 and NEMA WD 1.
 1. Duplex Convenience: Provide heavy duty, specification grade, 20A, 125Vac, 2-pole, 3-wire, grounding type receptacle, straight blade type and NEMA configuration 5-20R unless otherwise indicated. Receptacles shall have nylon faces and bodies. Receptacles shall comply with UL 498 and NEMA WD-1. Receptacles shall have only side wiring screw terminals. Back-wired receptacles are not acceptable. Isolated ground type where indicated. Weatherproof receptacles shall be UL-listed and have a metal door for wet locations with cord and plug connected.
 2. Industrial Heavy Duty: Provide pin and sleeve design receptacles conforming to UL 498. Comply with UL 1010 where installed in hazardous locations. Provide features indicated.
 3. Ground-Fault Circuit Interrupter (GFCI) Receptacles: "Termination" type, 20A ground-fault circuit interrupter, with integral heavy-duty NEMA 5-20R duplex receptacles arranged to protect connected downstream receptacles on same circuit. Receptacles shall have nylon faces and bodies. Receptacles shall have only side wiring screw terminals. Provide unit designed for installation in a 2-3/4-inch deep outlet box without adapter, grounding type, Class A, Group 1, per UL Standard 943. Provide units that render themselves incapable of providing power at either the end of their life or if the line-load is wired incorrectly.
 - C. Plugs: 15 ampere, 125V, 3-wire, grounding, plugs, parallel blades with cord clamp, and 0.4-inch cord hole; match NEMA configuration with power source receptacle. The plug body shall be nylon with integral cable grip which has offset cable gripping jaws secured with two screws.
 - D. Plug Connectors: 15 ampere, 125V, connectors, 3-wire, grounding, parallel blades, double wipe contact, with cord clamp, and 0.4-inch cord hole, match NEMA configuration to mating plugs. The connector body shall be nylon with integral cable grip which has offset cable gripping jaws secured with two screws. Arrange as indicated.
 - E. Snap Switches: 20 ampere, 120-277Vac, quiet type, AC switches. Single-pole, double-pole, three-way, four-way, as indicated. Switch handle and switch body shall be high strength

SECTION 262726 - WIRING DEVICES: continued

nylon. Switches shall have only side wiring screw terminals. Comply with UL 20 and NEMA WD1.

- F. Dimmer Switches: Solid-state dimmer switches conforming to NEMA WD-1, mounted in outlet boxes as indicated and in accordance with the following.
 - 1. Incandescent Lamp Dimmers: Modular dimmer switches for incandescent fixtures; switch poles and wattage as indicated, 120V, 60 hertz, with continuously adjustable rotary knob or slide bar, anodized aluminum face and single-pole switch. Equip with electromagnetic filter to eliminate noise, RF and TV interference, 5-inch wire connecting leads and quiet on-off switch. Device yoke shall ground metal wall plate.
 - 2. Fluorescent Lamp Dimmers: Full-wave modular type AC dimmer switches, for fluorescent fixtures; wattage and voltage ratings as indicated, and electromagnetic filters to minimize noise, RF and TV interference. Construct with continuously adjustable trim potentiometer for adjustment of low end dimming, anodized heat sinks, 5-inch wire connecting leads, and quiet on-off switch. Device yoke shall ground metal wall plate.

2.02 WIRING DEVICE ACCESSORIES:

- A. Wall Plates: Single and combination, of types, sizes, and with ganging and cutouts as required. Provide plates which mate, and match wiring devices to which attached. Provide metal screws for securing plates to devices with screw heads colored to match finish of plates. Provide stainless steel wall plate except as otherwise indicated or specified. Provide wall plates with engraved legend where indicated. Conform to requirements of SECTION 260553 - ELECTRICAL IDENTIFICATION. Provide plates possessing the following additional construction features (exception: emergency power receptacle wall plates shall be red nylon with the word "Emergency" engraved in black letters) and isolated ground receptacle wall plates shall be orange.
 - 1. Finished Rooms (unless indicated or specified otherwise):
 - b. Material and Finish: Smooth, 0.04-inch thick, Type 302/304, satin finished stainless steel.
 - 2. Unfinished Rooms (unless indicated or specified otherwise):
 - a. Material and Finish: Smooth, steel plate, galvanized.

PART 3 - EXECUTION

3.01 INSTALLATION OF WIRING DEVICES AND ACCESSORIES:

- A. Install wiring devices and accessories as indicated, in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate with other Work, including painting, electrical boxes, and wiring installations, as necessary to interface installation of wiring devices with other Work.
- C. Mount bottom of device box for duplex convenience receptacles 18 inches above finished floor unless indicated otherwise.
- D. Mount wall switches 48 inches above finished floor.
- E. Install wiring devices only in electrical boxes which are clean-free from building materials, dirt, and debris.
- F. Install wiring devices after wire pulling is completed.
- G. Install wall plates after painting work is completed.
- H. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's

SECTION 262726 - WIRING DEVICES: continued

torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A. Use properly scaled torque indicating hand tool.

- I. Circuits connected to isolated ground receptacles and GFCI receptacles shall have a dedicated neutral conductor that is not shared with any other branch circuits.
 - J. If dimmer yoke does not automatically ground the metal wall plate, bond the yoke to ground such that the metal wall plate is grounded when connected to yoke.
 - K. Install wall-mounted vertical convenience receptacles with ground pin up and horizontal convenience receptacles with ground pin to the left.
- 3.02 PROTECTION:
- A. Protect installed components from damage. Replace damaged items prior to final acceptance. Replace stained or field painted wall plates and devices.
- 3.03 FIELD QUALITY CONTROL:
- A. Testing: Prior to energizing circuits, test wiring for electrical continuity and for short-circuits. Ensure proper polarity of connections is maintained. Subsequent to energizing, test wiring devices and demonstrate compliance with requirements.
 - B. Test each receptacle with a receptacle tester to ensure proper polarity. Insure that the phase rotation is identical on all multiphase receptacles of each rating type.
 - C. Test ground fault circuit interrupter operation with both local test button and remote ground fault simulation with receptacle tester.

END OF SECTION 262726

SECTION 262730 - ELECTRICAL CONNECTIONS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section specifies electrical connections as required or indicated by Drawings and schedules. Electrical connections are hereby defined to include connections used for providing electrical power or control to Equipment.
- B. Applications of electrical connections are specified in this Section include the following:
 - 1. To resistance type heaters.
 - 2. From electrical source to motor starters.
 - 3. From motor starters to motors.
 - 4. To lighting fixtures and wiring devices.
 - 5. To converters, transformers specified in this Division, switchboards, panelboards, and similar equipment specified in this Division.
 - 6. To grounds including ground electrode connections.
 - 7. Splices.
 - 8. Terminations.
 - 9. To master units of communication, signal, alarm, public address systems (unless indicated otherwise).
 - 10. Equipment furnished in other Divisions (unless indicated otherwise).
 - 11. All control wiring indicated on electrical drawings.
- C. Related Work Specified Elsewhere:
 - 1. Electrical connections for Equipment not furnished as integral part of Equipment are specified in DIVISIONS 21, 22, 23, 26, 27, 28 and 48.
 - 2. Motor starters and controllers not furnished as integral part of Equipment: Applicable DIVISION 26 Sections.
 - 3. Motor starters and controllers furnished integrally with Equipment: DIVISIONS 21, 22, and 23.
 - 4. Junction boxes and disconnect switches required for connecting motors and other electrical units of Equipment: Applicable DIVISION 26, 27, 28 and 48 Sections.
 - 5. Electrical connections to all Equipment in other Divisions unless specifically indicated otherwise.
 - 6. Electrical identification for wire/cable conductors: SECTION 260553 - ELECTRICAL IDENTIFICATION.
 - 7. Raceways and wires/cables required for connecting motors and other electrical units of Equipment: Applicable DIVISION 26, 27, 28 and 48 Sections.
 - 8. Temperature control system wiring: Not work of this Section, but work of DIVISIONS 23.

1.02 REFERENCES:

- A. Applicable Standards: Comply with applicable requirements of following standards.
 - 1. American National Standards Institute (ANSI):
 - a. ANSI/EIA RS-364-21A - Insulation Resistance Test.
 - 2. Institute of Electrical and Electronic Engineers (IEEE):
 - a. 241 - IEEE Recommended Practice for Electric Power Systems in Commercial Buildings, pertaining to connections and terminations.
 - 3. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code (NEC): Comply with applicable requirements of NEC as to type of products used and installation of electrical power connections (terminals and splices), junction boxes, motor starters, and disconnect switches.

SECTION 262730 - ELECTRICAL CONNECTIONS: continued

4. Underwriters Laboratories (UL) Compliance: Provide electrical connection products and materials which are UL-listed and labeled. Comply with applicable requirements of the following standards:
 - a. 486A - Wire Connectors and Soldering Lugs for use with Copper Conductors.
 - b. 486C - Splicing Wire Connectors.
 5. National Electrical Manufacturers Association (NEMA):
 - a. SG-14 - Unplated Split-Bolt and Vise-Type Electrical Connectors for Copper Conductors.
- 1.03 SUBMITTALS:
- A. Refer to DIVISION 01 and SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS for administrative and procedure requirements for Submittals.
 - B. Includes, but not limited to, the following:
 1. Product Data: Submit manufacturer's data on electrical connections for equipment products and materials.
- 1.04 DELIVERY, STORAGE, AND HANDLING:
- A. Deliver electrical connection products wrapped in proper factory-fabricated type containers.
 - B. Store electrical connection products in original cartons and protect from weather, construction traffic, and debris.
 - C. Handle electrical connection products carefully to prevent breakage, denting, and scoring finish.

PART 2 - PRODUCTS

- 2.01 MATERIALS AND COMPONENTS:
- A. General: For each electrical connection provide complete assembly of materials, including, but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, electrical solder, electrical soldering flux, heat-shrinkable insulating tubing, cable ties, stress cones, splice kits, termination kits, solderless wirenuts, and other items and accessories as needed to complete splices and/or terminations of types indicated or recommended for use by accessories manufacturers for type services indicated. Electrical connectors shall be marked for the suitable conductor material. All equipment conductor terminations shall be UL-listed for 75°C conductors.
 - B. Connectors and Terminals: Provide UL-listed factory-fabricated electrical connectors and terminals which mate and match, including sizes and ampacity ratings, with Equipment terminals and which are recommended by equipment manufacturer for intended applications. Provide insulated compression ring lugs for all control wire terminations. Wirenut splices shall only be used for No. 10 AWG and No. 12 AWG lighting circuits, receptacle circuits, motor terminal box connections size 10 AWG and smaller and control devices with size 10 AWG and smaller factory wired leads. Provide silicone filled watertight/raintight wirenuts manufactured by King Technology for receptacle circuits and light fixture circuits installed outdoors and in wet locations. Provide compression connectors for all power conductors #8 AWG and larger.
 - C. Use connectors with temperature ratings equal to or greater than those of the wires being used.
 - D. Power Connectors (sizes 8-3 AWG) 600V and Below:
 1. Non-insulated, ring-tongue type.
 2. Ring tongue sized to match terminal stud size.
 3. Brazed barrel seam.

SECTION 262730 - ELECTRICAL CONNECTIONS: continued

4. Application tooling designed to crimp the wire barrel (conductor grip) with a one-step crimp.
- E. Power Connectors (sizes 2 AWG - 500 kcmil) 600V and Below:
 1. Non-insulated, one-hole rectangular tongue for sizes 2 AWG through 3/0 AWG and two-hole rectangular tongue for 4/0 AWG through 500 kcmil.
 2. Application tooling shall be hydraulic operated.
- F. Power Connectors (sizes 2 AWG - 500 kcmil) above 600V:
 1. Non-insulated, one-hole rectangular tongue for sizes 2 AWG through 3/0 AWG and two-hole rectangular tongue for 4/0 AWG through 500 kcmil.
 2. Voltage rating equal or greater than that of the cable being used.
 3. Application tooling shall be hydraulic operated.
- G. Motor Lead Termination/Splice (Low-Voltage, 600V and Below, Power Cable):
 1. Splices shall be made using compression-type connectors bolted together. The compression-type connectors shall be properly sized for the cables. Reference acceptable connector manufacturer's cross-reference chart.
 2. Splice to be covered with heat-shrinkable tubing connector insulators.
 3. Splicing shall be done in accordance with the instructions provided with the Raychem brand MCK Motor Connector Kit.
- H. Terminal Blocks:
 1. For Mounting in Terminal Boxes (TBs):
 - a. Designed and sized for the cables being terminated.
 - b. Thermoplastic block rated 600V.
 - c. Solderless box lug type terminals for power cables and flat terminal connectors with wire clamp for control and instrument cables.
 - d. Rated current carrying capacity equal to or greater than the cable being terminated.
 - e. Marking strip.
 2. For Mounting in Cabinets, Panels, Control Boards, etc.:
 - a. Designed and sized for the cables being terminated.
 - b. Thermoplastic block rated 600V.
 - c. Solderless box lug type terminals for power cables. Flat terminal connectors for current transformer circuits. Sliding link type flat terminal connectors with wire clamp for control and instrument cables.
 - d. Rated current carrying capacity equal to or greater than the cable being terminated.
 - e. Marking strip on blocks for power cables, control and instrument cables.
 - f. Short-circuit straps with one shorting screw for each terminal for current transformer circuits.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Inspect area and conditions under which electrical connections for Equipment are to be installed. If unsatisfactory conditions exist, do not proceed with the work until they have been corrected.

3.02 INSTALLATION OF ELECTRICAL CONNECTIONS:

- A. Install electrical connections as indicated, as required, and as specified. Provide in accordance with Equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL and NEC to ensure that products fulfill requirements.

SECTION 262730 - ELECTRICAL CONNECTIONS: continued

- B. All medium voltage splices and terminations above 600V shall be made by a certified cable splicer/terminator.
- C. Coordinate with other work, including wires/cables, raceway installation, and Equipment installation, as necessary to properly interface installation of electrical connections for Equipment with other work.
- D. Connect electrical power supply conductors to equipment conductors in accordance with Equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.
- E. Maintain existing electrical service and feeders to occupied areas and operational facilities, unless otherwise indicated or when authorized otherwise in writing by Contracting Officer. Provide temporary service during interruptions to existing facilities. When necessary, schedule momentary outages to replace existing wiring systems with new wiring systems. When that "cutting-over" has been successfully accomplished, remove temporary wiring and existing wiring as indicated.
- F. Cover splices with electrical insulating material equivalent to, or of greater insulation rating, than electrical insulation rating of those conductors being spliced.
- G. Prepare cables and wires by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while stripping insulation from wire.
- H. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing, and maintenance.
- I. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torquing requirements are not available, tighten connectors and terminals to comply with torquing values contained in UL 486A.
- J. Adjust overhead door and coiling door travel limit switches and torque switches in accordance with the manufacturer's instructions.
- K. Connect all nonisolated ground conductors to equipment ground bus, equipment ground lug, or equipment enclosure (where no other equipment grounding provisions are available).
- L. Control conductor terminations made on terminal blocks or terminal strips shall comply with the following:
 - 1. All current transformer terminations shall be made with insulated, compression type, ring lugs.
 - 2. All control terminations shall be made with insulated, compression type, (spade) (ring) lugs. Provide one lug per conductor.
 - 3. All control terminations shall be made by inserting the striped, bare, conductor under the flat terminal wire clamp. No more than two wires shall be terminated under one wire clamp connection point.
- M. Keep conductor splices to a minimum.
- N. Install splice and tap connectors which possess equivalent or better mechanical strength and insulation rating than conductors being spliced.
- O. Use splice and tap connectors which are compatible with conductor material.
- P. In-line splices shall not be accepted unless provided in a junction box.
- Q. Where conductors have been up-sized for voltage drop, the Contractor shall provide a properly sized device box. Additionally where required, the Contractor shall provide a box adjacent to

SECTION 262730 - ELECTRICAL CONNECTIONS: continued

the device box where the circuit conductor shall be "pig-tailed" down to a smaller wire size or insulated spade lugs shall be used to terminate on the device terminals.

3.03 FIELD QUALITY CONTROL:

- A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor is correct. Correct improper motor rotation; then retest to demonstrate compliance.

END OF SECTION 262730

SECTION 262816 - CIRCUIT AND MOTOR DISCONNECT SWITCH

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section specifies circuit and motor disconnects.
- B. Related Work Specified Elsewhere: The following Sections contain requirements that relate to this Section.
 - 1. Fuses: SECTION 262813.
 - 2. Manual switches used as motor disconnects: SECTION 262726 - WIRING DEVICES.
 - 3. Combination type starters which incorporate disconnect switches in the same enclosure as the starter and manual motor starters which include the disconnect function as part of the starter switch assembly: SECTION 262900 - MOTOR CONTROLLERS, CONTACTORS, PUSH BUTTONS, SELECTOR SWITCHES, INCLUDING LIGHTS AND RELAYS.
 - 4. Electrical Identification: SECTION 260553.

1.02 REFERENCES:

- A. Applicable Standards: Comply with applicable requirements of the following standards.
 - 1. National Electrical Manufacturers Association (NEMA):
 - a. 250 - Enclosures for Electrical Equipment (1,000V maximum).
 - b. KS 1 - Enclosed Switches.
 - 2. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code (NEC).
 - 3. Underwriters Laboratories (UL):
 - a. 98 - Enclosed and Dead-Front Switches.
 - b. 869 - Electrical Service Equipment.
 - c. 894 - Switches for Use in Hazardous (Classified) Locations.
 - d. 977 - Fused Power-Circuit Devices.

1.03 SUBMITTALS:

- A. Refer to DIVISION 01 and SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS for administrative and procedural requirements for submittals.
- B. Includes, but not limited to, the following:
 - 1. Product data for each type of product specified.
 - 2. Ampere rating and fused switch short-circuit interrupting ratings.
 - 3. Maintenance data for circuit and motor disconnects for inclusion in Operation and Maintenance Manual specified in DIVISION 01 and SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS.

PART 2 - PRODUCTS

2.01 CIRCUIT AND MOTOR DISCONNECT SWITCHES:

- A. General: Provide 3-pole circuit and motor disconnect switches in types, sizes, duties, features, ampere ratings, short-circuit interrupting ratings, energy withstand ratings, and enclosures as indicated. Provide NEMA 1 enclosure for indoor dry locations. For outdoor disconnect switches and other indicated wet locations (including hangar bay), provide NEMA 3R enclosures with raintight hubs. Provide enclosure suitable for hazardous location where indicated. Switch mechanism shall be interlocked with door mechanism to prevent door from opening when switch is closed and to prevent switch from being closed when door is open (provide defeat of this interlock to be used by qualified personnel.) Switch mechanism shall

SECTION 262816 - CIRCUIT AND MOTOR DISCONNECT SWITCH: continued

- have provisions for pad locking (up to 3 padlocks) in the open or closed position. For motor and motor starter disconnect switches, provide units with horsepower ratings suitable for the loads. Provide 60-hertz, 600V and 240V units as required by application. Provide terminals UL rated for 75°C (minimum) conductors. Provide equipment ground conductor lug. Provide solid neutral assemblies when indicated, specified, or required. Provide only load-break rated motor disconnect switches.
- B. Fusible Single-Throw Disconnect Switches: 600Vac heavy-duty switches, with fuses of classes, current ratings and interrupting ratings indicated. See SECTION 262813 - FUSES for specifications. Where current limiting fuses are specified or indicated, provide switches with noninterchangeable rejection feature suitable only for current limiting type fuses.
 - C. Nonfusible Single-Throw Disconnect Switches: 600Vac heavy-duty switches with current ratings as indicated.
 - D. Disconnect Switches for Classified (Hazardous) Locations: Heavy-duty switches with UL labels and listings for hazardous location classifications in which they are installed.

PART 3 - EXECUTION

3.01 INSTALLATION OF CIRCUIT AND MOTOR DISCONNECTS:

- A. General: Provide circuit and motor disconnect switches as indicated or required. Provide fused type disconnect switches on all packaged mechanical equipment such as HVAC units, condensing units, air-conditioning units, and other items, that require fuse protection as listed on the unit nameplate or as required for equipment short-circuit protection. Install fuse type and size as indicated on unit nameplate. Comply with NEC and disconnect switch manufacturers' printed installation instructions. Where practicable, install switch at an elevation such that the centerline of the switch operator is 5 feet and 6 inches above the finished floor. Tighten connectors and terminals in accordance with manufacturer's instructions. All fuses in each disconnect switch shall be of the same type and from the same manufacturer. Where switches can be backfed provide a warning sign reading: "Warning: Load side of switch may be energized by backfeed" per SECTION 260553.

3.02 FIELD QUALITY CONTROL:

- A. Testing: Inspect all contacts and clean, if required. Inspect all arc chutes if provided on switches. Subsequent to completion of installation of electrical disconnect switches, energize circuits and demonstrate capability and compliance with requirements. Do not test switches by operating them under load. However, demonstrate switch operation through six opening/closing cycles with circuit de-energized. Open each switch enclosure for inspection of interior, mechanical and electrical connections, fuse installation (if required on switch), and for verification of power on load side of fuse (fuse has not blown), fuse type and rating of fuses installed (if required on switch). Correct deficiencies then retest to demonstrate compliance. Remove and replace defective units with new units and retest.

END OF SECTION 262816

SECTION 262900 - MOTOR CONTROLLERS, CONTACTORS, PUSH BUTTONS, SELECTOR SWITCHES, INDICATING LIGHTS AND RELAYS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section specifies contactors, push buttons, selector switches, indicating lights, relays, and motor controller work as indicated and specified.
- B. Types of motor controllers specified in this Section include the following:
 - 1. Full voltage, nonreversing.
 - 2. Full voltage, reversing.
 - 3. Combination circuit breaker.
 - 4. Combination motor circuit protector.
 - 5. Combination disconnect.
 - 6. Fractional HP, manual.
 - 7. Solid-state, reduced voltage.
 - 8. Autotransformer, reduced voltage.
 - 9. Wye-delta, reduced voltage.
 - 10. Part winding, reduced voltage.
 - 11. Solid-state, variable frequency drives (VFDs).
- C. Refer to applicable DIVISION 26 Sections for wires/cables, fuses, grounding, identification, electrical raceways, and boxes and fittings required in connection with motor controllers.

1.02 REFERENCES:

- A. Applicable Standards: Comply with applicable requirements of the following:
 - 1. National Electrical Manufacturers Association (NEMA):
 - a. 250 - Enclosures for Electrical Equipment (1,000V Maximum).
 - b. ICS 1 - General Standards for Industrial Control Systems.
 - c. ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
 - d. ICS 3 - Industrial Systems.
 - e. ICS 6 - Enclosures for Industrial Controls and Systems.
 - f. KS 1 - Enclosed Switches.
 - g. MG1 - Motors and Generators.
 - 2. Institute of Electrical and Electronic Engineers (IEEE): Comply with recommended practices contained in the following sections:
 - a. 241 - Recommended Practice for Electric Power Systems in Commercial Buildings.
 - b. 519 - Guide for Harmonic Control and Reactive Compensation of Static Power Converters Pertaining to Motor Controllers.
 - 3. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code (NEC): Comply with applicable local electrical code requirements of the authority having jurisdiction and NEC Articles 200, 250 and 430, as applicable to installation and construction of motor controllers.
 - 4. Underwriters Laboratories (UL): Provide controllers and components which are UL-listed and labeled.
 - a. 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 - b. 508 - Electric Industrial Control Equipment.

1.03 SUBMITTALS:

- A. Refer to DIVISION 01 and SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS for administrative and procedural requirements for Submittals.

SECTION 262900 - MOTOR CONTROLLERS, CONTACTORS, PUSH BUTTONS, SELECTOR SWITCHES, INDICATING LIGHTS AND RELAYS: continued

- B. Includes, but not limited to, the following:
 - 1. Product Data: Submit manufacturer's data and installation instructions on motor controllers, contactors, push buttons, selector switches, indicating lights and relays.
 - 2. Shop Drawings: Submit Shop Drawings of motor controllers showing dimensions and weights. Submit dimensional data on push buttons, selector switches, indicating lights and relays.
 - 3. Wiring Diagrams: Submit power and control schematic and wiring diagrams for motor controllers. Differentiate between portions of wiring which are manufacturer factory installed and portions which are field-installed.
 - 4. Variable Frequency Drive (VFD) Bill of Material.
 - 5. In seismic zones submit center of gravity and weight of each floor mounted piece of equipment.
 - 6. Recommended spare parts list with prices for frequency drives.
 - 7. Operation and maintenance manuals for variable frequency drives.
 - 8. All field test data.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING:

- A. Deliver Equipment and components properly packaged in factory-fabricated type containers.
- B. Store Equipment and components in original packaging and in a clean dry space; protect from weather and construction traffic.
- C. Handle Equipment and components carefully to avoid breakage, impact, denting, and scoring of finishes. Do not install damaged Equipment; replace and return damaged units to Equipment manufacturer.

1.05 SEQUENCING AND SCHEDULING:

- A. Sequence equipment installation work with other work to minimize possibility of damage and soiling during remainder of construction period.

1.06 MAINTENANCE:

- A. Maintenance Data: Submit maintenance data and parts list for each motor controller and component, including "troubleshooting" maintenance guide. Include that data, product data, and Shop Drawings in a maintenance manual, in accordance with requirements of DIVISION 01.
- B. Maintenance Stock:
 - 1. Fuses: For types and ratings required, furnish additional fuses, amounting to one unit for every 10 installed units, but not less than three units of each.
 - 2. Furnish one spare lamp for each indicating light.

PART 2 - PRODUCTS

2.01 MOTOR CONTROLLERS:

- A. General: Except as otherwise indicated, provide motor controllers (motor starters) and control components which comply with manufacturer's standard materials, design, and construction in accordance with published product information, and as required for a complete installation. Provide NEMA rated motor controllers. Provide terminals UL rated for 75°C (minimum) conductors. Design motor controllers to withstand without damage the forces of a Seismic Zone 2A event. Provide nameplate in accordance with NEC 409.110 where the minimum short-circuit current rating (SCCR) shall be as indicated on the drawings.

SECTION 262900 - MOTOR CONTROLLERS, CONTACTORS, PUSH BUTTONS, SELECTOR SWITCHES, INDICATING LIGHTS AND RELAYS: continued

- B. Combination Disconnect and Full Voltage Controllers: Provide full-voltage nonreversing (FVNR) or full voltage reversing (FVR), alternating-current combination controllers, consisting of controller, fused 120V control transformer, push buttons, selector switches, indicating lights, nonfused disconnect switch mounted in common enclosure, of types, sizes, ratings, and NEMA sizes indicated or required. Equip controller with electrical interlocks specified and indicated. Provide controller with two normally open and two normally closed spare auxiliary contacts. Equip controller with block type manual external reset three-phase overload relay. Provide operating handle for disconnect mechanism with indication and control of switch position, with enclosure door either opened or closed and capable of being locked in "OFF" position with three padlocks. Construct and mount controllers and disconnect mechanism in single NEMA Type 1 enclosure for indoor, dry, nonhazardous locations and NEMA 3R for Hangar Bay and other wet locations. Coat with manufacturer's standard color finish.
- C. Fractional HP Manual Controllers: Provide single-phase, fractional HP manual motor controllers, of sizes and ratings indicated. Equip with manually operated quick-make, quick-break toggle mechanisms; and with one-piece melting alloy type thermal units. Controller to become inoperative when thermal unit is removed. Provide controllers with double break silver alloy contacts, visible from both sides of controller; and switch capable of being padlocked-OFF. Enclose controller unit in NEMA Type 1 general purpose enclosure for indoor dry, nonhazardous locations suitable for flush or surface mounting (as indicated). Coat with manufacturer's standard color finish. Provide green pilot light where indicated or specified.
- D. Combination Disconnect and Solid-State Reduced Voltage Controllers: Provide solid-state reduced voltage controllers for use with 3-phase squirrel cage induction motors, of types, sizes, ratings, and electrical characteristics indicated; construct with silicon-controller rectifiers (SCRs) for controlling motor voltages during acceleration and three-pole thermal overload relay. Provide integral main thermal magnetic circuit breaker or main motor circuit protector. Manufacturer shall size and coordinate the main protective device with the characteristics of the controller, motor and load furnished to provide proper protection by the main protective device, without nuisance tripping. Equip controllers with fused 120V control transformer, push buttons, selector switches, indicating lights, and closed-loop feedback system to maintain motor acceleration at constant rate. Provide two normally open and two normally closed spare auxiliary contacts. Provide operating handle for main circuit protective mechanism with indication and control of position, with enclosure door either open or closed, and capable of being locked in "OFF" position with three padlocks. Enclose controller in NEMA Type 1 enclosure for indoor, dry, nonhazardous locations. Coat with manufacturer's standard color finish.
- E. Combination Disconnect and Automatic Autotransformer Reduced Voltage Controllers: Provide autotransformer type reduced voltage controllers, of sizes, ratings, electrical characteristics and NEMA sizes as indicated or required, with closed-circuit transition feature. Construct controllers with two 3-pole contactors, 3-phase starting autotransformers, adjustable pneumatic timer, fused 120V control transformer, push buttons, selector switches, indicating lights, and 3-pole block type overload relay. Provide required and specified interlocks. Construct autotransformer with voltage taps at 65% and 80% of full line voltage and with thermal overload protection device on each phase to protect against overheating. Provide duty cycle of 15-second operation out of each four minutes for one hour followed by rest period of two hours. Provide integral main thermal magnetic circuit breaker or main motor circuit protector. Manufacturer shall size and coordinate the main protective device with the

SECTION 262900 - MOTOR CONTROLLERS, CONTACTORS, PUSH BUTTONS, SELECTOR SWITCHES, INDICATING LIGHTS AND RELAYS: continued

- characteristics of the controller, motor and load furnished to provide proper protection by the main protective device, without nuisance tripping. Provide operating handle for main circuit protective mechanism with indication and control of position, with enclosure door either open or closed and capable of being locked in "OFF" position with three padlocks. Construct controller with NEMA Type 1 enclosure for indoor, dry, nonhazardous locations. Coat with manufacturer's standard color finish.
- F. Combination Disconnect and Wye-Delta Controllers: Provide wye-delta controllers, of sizes, ratings, electrical characteristics, and NEMA sizes indicated or required. Provide integral main thermal magnetic circuit breaker or main motor circuit protector. Manufacturer shall size and coordinate the main protective device with the characteristics of the controller, motor and load furnished to provide proper protection by the main protective device, without nuisance tripping. Construct controllers with open-circuit transition, including three pole thermal overload protection relay, fused 120V control transformer, push buttons, selector switches, and indicating lights. Equip with START-STOP push button for control. Provide controller with electrical interlocks specified and as required. Provide two normally open and two normally closed spare auxiliary contacts. Provide operating handle for disconnect main circuit protective mechanism with indication and control of position, with enclosure door either open or closed, and capable of being locked in "OFF" position with three padlocks. Construct controller with NEMA Type 1 enclosure for indoor, dry, nonhazardous locations. Coat with manufacturer's standard color finish.
- G. Combination Disconnect and Part Winding Controllers: Provide two-step, part-winding, alternating-current controllers, of NEMA sizes, ratings, and electrical characteristics indicated or required, suitable for use with motors with two wye-connected windings. Provide integral main thermal magnetic circuit breaker or main motor circuit protector. Manufacturer shall size and coordinate the main protective device with the characteristics of the controller, motor and load furnished to provide proper protection by the main protective device, without nuisance tripping. Controller shall have two 3-pole contactors, pneumatic timer, fused 120V control transformer, push buttons, selector switches, indicating lights, and two 3-pole manual external reset motor overload relays. Provide controller with electrical interlocks specified and as required. Provide two normally open and two normally closed spare auxiliary contacts. Provide operating handle for main circuit protective mechanism with indication and control of position, with enclosure door either open or closed and capable of being locked in "OFF" position with three padlocks. Enclose controller unit in NEMA Type 1 general purpose enclosure for indoor, dry, nonhazardous locations. Coat enclosure with manufacturer's standard color finish.
- H. Combination Disconnect and Solid-State, Variable Frequency Drives (VFDs): Provide solid-state speed adjustment with adjustable frequency and voltage output that shall provide constant volts per hertz excitation of a three-phase, squirrel-cage induction motor up to 60 Hz. The controller shall have a 100% overload rating for one minute. The controller shall have a minimum efficiency of 95% at rated load. The controller shall operate in an ambient temperature of -10°C to 50°C for elevations up to 3,300 feet above sea level and within a humidity range of 0 to 95% noncondensing. The variable torque controller starting current shall be limited to 150% of the full load current.
1. Enclosures shall be NEMA Type 1 for indoor, dry, nonhazardous locations. Provide wall mounted enclosures for control of motors smaller than 75 horsepower and free standing enclosures (with lifting eyes and enclosure suitable for pushing and being moved on rollers) for control of motors 75 horsepower and larger. Coat enclosure with manufacturer's standard color finish.

SECTION 262900 - MOTOR CONTROLLERS, CONTACTORS, PUSH BUTTONS, SELECTOR SWITCHES, INDICATING LIGHTS AND RELAYS: continued

2. Only a single 480Vac, 3-phase, 60-Hz, power input shall be required for all control and power. The controller input shall be rated 460V (+10% to -10%), three-phase, and 60-Hz (+2% to -2%). The converter shall utilize a three-phase, full-wave, diode bridge. Provide 6 pulse unit. Provide fused 120V control power transformer on line side of converter. Control power transformer shall be sized for controls, space heaters, and air conditioners (if air conditioning is necessary because of ambient conditions.) The controller shall maintain a minimum lagging power factor of 0.95 at any speed or load. The controller shall have input line filtering in compliance with IEEE 519 and shall not generate harmonics of a magnitude that create power line disturbances objectionable to the local utility. Provide an input power isolation transformer UL-listed for nonlinear loads (UL 1561) with the proper "K" rating in a NEMA Type 1 enclosure, if necessary, to limit the total harmonic voltage and current distortion to values in IEEE 519 Tables 10.1 and 10.3.
3. Provide integral main thermal magnetic circuit breaker or main motor circuit protector with AIC RMS SYM rating at rated voltage as indicated. Manufacturer shall size and coordinate the main protective device with the characteristics of the controller, motor and load furnished to provide proper protection by the main protective device, without nuisance tripping. The main circuit protective mechanism shall have a door interlocked, padlockable handle mechanism suitable for up to three padlocks. Provide current limiting fuse for short circuit current protection of the converter. Provide controller trip and visual indication in door for each of the following: control logic malfunction, output motor overload, output ground, output short circuit, input instantaneous overload, input inverse time overload, input overvoltage, input under-voltage, input phase-loss, input over-frequency, cabinet over-temperature and ac input surge. Unit shall trip if 150% of motor full load current (or more) is drawn for 4 minutes. The controller shall be able to withstand a phase-to-phase short circuit at the output terminals without any component failure.
4. The DC voltage shall be inverted with a pulse width modulated (PWM) transistor inverter to an adjustable frequency output. The output frequency stability to be +1.0% to -1.0% and the output voltage regulation to be +2% to -2%.
5. Provide the following features: Provide internal factory wiring and wiring terminal strips field for the following located remote from the unit:
 - a. Two remote stops.
 - b. One remote start.
 - c. One remote speed control potentiometer.
 - d. One remote bypass on-off input.
 - e. Remote-Local-Off selector switch position output.
 - f. Manual-Off-Automatic selector switch position output.
 - g. Speed range from 30 Hz to 60 Hz.
 - h. (0-10Vdc) (4-20 mA DC) (3-15 psig) analog input process signal follower.
6. Provide the following on the door of the unit:
 - a. Power ON indicating light.
 - b. Motor running green indicating light.
 - c. Motor not running red indicating light.
 - d. Output digital frequency meter calibrated in hertz.
 - e. Minimum speed potentiometer (30-40 Hz).
 - f. Provide low speed boost for low speed starting of motors.
 - g. Maximum speed potentiometer (40-60 Hz).

SECTION 262900 - MOTOR CONTROLLERS, CONTACTORS, PUSH BUTTONS, SELECTOR SWITCHES, INDICATING LIGHTS AND RELAYS: continued

- h. Hertz.
 - i. Acceleration potentiometer (0.5 to 30 Hz per second with a range of 1-60 seconds for 0-60 Hz).
 - j. Deceleration potentiometer (0.5 to 30 Hz per second with a range of 1-60 seconds for 0-60 Hz).
 - k. Output meter, with voltage, amps, and kilowatt readings.
 - l. Motor running elapsed time hour meter.
 - m. Remote-Local selector switch.
 - n. Manual-Off-Automatic selector switch.
7. Start/stop momentary push buttons. In the manual position unit front door mounted push button controls are operational. In the automatic mode the unit front door mounted push buttons are not operational.
- a. Provide additional controls as indicated:
 - (1) Controller inverter mode "ON" DPDT status relay.
 - (2) 0-5Vdc analog speed reference output that is proportional to 0-60 Hz output.
 - (3) Field wiring terminal block.
8. Spare Parts: Complete set of recommended start-up spare parts including a complete set of power fuses for each unit.
9. Provide kilowatt-hour meter. Meter shall be connected to Facility Energy Management System.
- 2.02 PUSH BUTTONS AND SELECTOR SWITCHES:
- A. Provide round, heavy-duty type. Provide NEMA Type 13, oil-tight for dry indoor applications. Provide NEMA 4, watertight for outdoor and indoor wet locations.
 - B. Provide number of and type of momentary contacts for push buttons, contact configuration and selector switch positions as required, indicated or specified.
 - C. Provide start push buttons with guards. Provide mushroom head operators where specified or indicated.
 - D. Provide round push buttons with button approximately 1 inch in diameter and with integral legend plate.
 - E. Provide maintained position, round, selector switches with integral legend plate and knob type operators unless required, specified or indicated otherwise.
 - F. Provide identification in conformance with SECTION 260553.
 - G. Provide illuminated push buttons where indicated or specified.
- 2.03 INDICATING LIGHTS:
- A. Provide NEMA Type 13 oil-tight for dry indoor applications. Provide NEMA Type 4 watertight for outdoor and indoor wet locations.
 - B. Provide transformer type, with round lens approximately 1 inch in diameter with integral legend plate. Provide voltage rating as required for 60 Hz application.
 - C. Provide lens color as specified, required or indicated.
 - D. When mounted separately, provide NEMA 1 enclosure for dry indoor locations and NEMA 4 enclosure for outdoor and indoor wet locations.
 - E. Provide identification in conformance with SECTION 260553.
 - F. Provide push to test indicating lights where indicated.
 - G. Furnish one spare indicating lamp for each indicating light.

SECTION 262900 - MOTOR CONTROLLERS, CONTACTORS, PUSH BUTTONS, SELECTOR SWITCHES, INDICATING LIGHTS AND RELAYS: continued

2.04 CONTACTORS:

- A. Provide electrically or mechanically held lighting contactors, as indicated.
- B. Provide multipole: Number-poles as indicated or required.
- C. Each pole shall be rated 480Vac, 30 amperes ballast, and 20 amperes tungsten. Each pole shall be field convertible (NO or NC).
- D. Provide contactor in NEMA 1 surface mount or 3R surface mount enclosure, as indicated.
- E. Contactor shall have 120V, 60-Hz coil.
- F. Provide "Hand-Off-Automatic" selector switch in contactor cover.
- G. Provide red and green indicating lights in contactor cover.
- H. Provide an integral fused control circuit transformer of adequate volt-ampere capacity for the required control circuit loads.
- I. Provide NEMA 1 type enclosures with suitably sized factory standard knock-outs in bottom in indoor dry locations of enclosure. Provide NEMA 4 and 4X type with suitably sized conduit hub in top and bottom of enclosure in outdoor and wet indoor locations.
- J. Provide two-wire control for electrically held contactors. Provide three-wire control for mechanically held contactors.
- K. Provide auxiliary contacts as required, indicated and specified.
- L. Provide nameplate in accordance with NEC 409.110 where the minimum short-circuit rating (SCCR) shall be as indicated on the drawings.

2.05 RELAYS:

- A. Provide industrial 600Vac relays with 10 ampere NEMA B600 rated contacts. Contact cartridges shall be removable and field convertible (NO or NC). Coil voltage rating shall be as required. Provide number of contacts as required, indicated or specified.
- B. Provide accessory latching and timing modules as required.
- C. Provide NEMA 1 enclosure when relay is mounted separately in dry indoor locations.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas and conditions under which motor controllers and controls are to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF MOTOR CONTROLLERS AND CONTROLS:

- A. Install motor controllers and controls where indicated, in accordance with equipment manufacturer's written instructions and with recognized industry practices; complying with applicable requirements of NEC, UL and NEMA standard, to ensure that products fulfill requirements.
- B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 468A and the National Electrical Code.
- C. Install fuses, of sizes indicated, and type specified in each fusible disconnect switch, if any.
- D. Provide seismic bracing such that the equipment will not be damaged during a Seismic Zone 2A event.

SECTION 262900 - MOTOR CONTROLLERS, CONTACTORS, PUSH BUTTONS, SELECTOR SWITCHES, INDICATING LIGHTS AND RELAYS: continued

3.03 FIELD QUALITY CONTROL:

- A. Provide the on-site services of the manufacturer's service representative for the direct supervision of inspection, start-up, final adjustments, operational tests functional tests and Contracting Officer training of all variable frequency drives. Provide 16 hours of on-site training of the Contracting Officer's personnel on the start-up, operation, trouble-shooting, servicing, and preventative maintenance of the variable frequency drives. Submit all meter readings and field test results.
- B. Prior to energization of motor controller equipment, check with insulation resistance tester and phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.
- C. Check all equipment grounds for continuity.
- D. Remove all blocking used for shipment.
- E. Check motor overload relays for proper current range in accordance with motor nameplate full load amperes. Adjust relays for manual reset.
- F. Check motor starter and control relay coils for proper operating voltage.
- G. Clean all contacts and magnetic surfaces.
- H. Check all auxiliary contacts for proper arrangement (NO or NC).
- I. Test each pole of starter for freedom from grounds.
- J. Check all fuses and circuit breakers for proper rating.
- K. Check connectors for tightness.
- L. With motor disconnected, energize control circuits and test for correct operation.
- M. Adjust timing cycle of all time delay relays.
- N. Prior to energization, check circuitry for electrical continuity and for short-circuits.
- O. Ensure that direction of rotation of each motor fulfills requirements. Correct if necessary.

3.04 GROUNDING:

- A. Provide equipment grounding connections for motor controller and control equipment as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding. Grounding shall conform with SECTION 260526.

3.05 ADJUSTING AND CLEANING:

- A. Adjust operating mechanisms, where necessary, for free mechanical movement.
- B. Touch-up scratched or marred enclosure surfaces to match original finishes.
- C. Adjust motor circuit protector trip settings (when provided) in accordance with the manufacturer's instructions.

3.06 IDENTIFICATION:

- A. Provide identification for motor controllers and controls as specified in SECTION 260553 - ELECTRICAL IDENTIFICATION.

SECTION 262900 - MOTOR CONTROLLERS, CONTACTORS, PUSH BUTTONS, SELECTOR SWITCHES, INDICATING LIGHTS AND RELAYS: continued

3.07 DEMONSTRATION:

- A. Upon completion of installation of motor controller and control equipment and electrical circuitry, energize circuitry and demonstrate functioning of equipment in accordance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and retest to demonstrate compliance.

END OF SECTION 262900

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section specifies transfer switch work, including associated control devices as indicated by drawings, schedules, and as specified herein.
- B. Types of transfer switches required for the project include the following:
 - 1. Automatic transfer switch with manual bypass-isolation.
- C. Related Work Specified Elsewhere:
 - 1. Wires/cables, electrical raceways, boxes and fittings which are required in conjunction with transfer switch work: specified in other DIVISION 26 Sections.
 - 2. Concrete and grout for transfer switch pads and foundations: Specified in DIVISION 03.

1.02 REFERENCES:

- A. Applicable Standards: Comply with applicable requirements of the following standards:
 - 1. Underwriters Laboratory (UL): Provide transfer switches and components which are UL listed and labeled:
 - a. 1008 - Automatic Transfer Switches.
 - b. 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 - 2. National Electrical Manufacturers Association (NEMA):
 - a. ICS1 - General Standards for Industrial Control and Systems.
 - b. ICS2 - Industrial Control Devices, Controllers, and Assemblies.
 - c. ICS6 - Enclosures for Industrial Controls and Systems.
 - d. 250 - Enclosures for Electrical Equipment (1,000V Maximum).
 - 3. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code.
 - b. 101 - Code for Safety to Life from Fire in Buildings and Structures Pertaining to Transfer Switches.

1.03 DELIVERY, STORAGE AND HANDLING:

- A. Deliver transfer switches and associated devices in factory-fabricated type containers or wrappings that properly protect equipment from damage.
- B. Store transfer switches and associated devices in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping.
- C. Handle transfer switches and associated devices carefully to prevent physical damage to equipment. Do not install damaged equipment; remove from site and replace damaged equipment with new equipment.

1.04 SUBMITTALS:

- A. Refer to DIVISION 01 and SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS for administrative and procedural requirements for submittals.
- B. Includes, but not limited to, the following:
 - 1. Product Data: Submit manufacturer's data and installation instructions for transfer switches.
 - 2. Shop Drawings: Submit dimensioned drawings of transfer switches also showing equipment weight. (Provide center-of-gravity for seismic rated switches.)
 - 3. Wiring Diagrams: Submit wiring diagrams for electrical transfer switches, and associated control devices showing connections to prime and alternate power sources,

SECTION 263600 - TRANSFER SWITCHES: continued

- electrical load, and equipment components. Differentiate between portions of wiring that are manufacturer factory-installed and portions that are field-installed.
4. Operation and Maintenance Manuals: Submit operation and maintenance manuals complete with schematics and wiring diagrams.
 5. All field test data.

PART 2 - PRODUCTS

2.01 THREE-PHASE TRANSFER SWITCHES:

- A. General: Except as otherwise indicated, provide manufacturer's standard design, materials, and components as indicated by published product information, designed and constructed as recommended by manufacturer for duty indicated and as required for a complete installation. Provide terminals UL-rated for 75°C (minimum) conductors. Provide transfer switch designed to resist forces of a Seismic Zone 2A event without damage.
- B. Automatic Transfer Switches:
 1. Provide factory-fabricated automatic transfer switches and auxiliary equipment of types, sizes, ratings, and electrical characteristics for services indicated, which are electrically operated, mechanically held, and electrically and mechanically interlocked. Provide switch that monitors all three phase voltages. Provide Hand-Test-Automatic Selector Switch:
 - a. Hand position: manual emergency generator starting with load transfer.
 - b. Test position: manual emergency generator starting with no load transfer.
 - c. Automatic position: automatic emergency generator starting and load transfer during power failure.
 2. Provide switches capable of automatically transferring the load from normal to emergency source when normal line voltage drops below 70% of rated value and transfers load back to normal source when voltage is restored to greater than 90% of rated value. Provide switch with operating time of transfer to emergency in 10 seconds including engine-generator starting and transfer emergency to normal in 1/6 second after retransfer time delay. Equip switch with time delays to:
 - a. Prevent excessive transfer (adjustable 0-30 seconds) during momentary line voltage dips.
 - b. Load retransfer (adjustable 0-15 minutes).
 - c. Engine cool down after retransfer and before shutdown (adjustable 0-20 minutes).
 3. Provide spare NO switch contact which shall close when the load is on the emergency source.
 4. Provide switch with appropriate 10A, 32Vdc engine-starting contacts for starting emergency engine-generator unit.
 5. For inductive loads, equip poles with magnetic blowouts and arc barriers; for noninductive loads, equip switches with arc barriers between poles.
 6. Equip unit with test switch for manual simulation of power outages including emergency generator unit operation and load transfer.
 7. Provide one white (normal power) and one yellow (emergency power) indicating lamp.
 8. Provide two spare 10A, 480Vac, SPDT auxiliary contacts.
 9. Provide free-standing or wall mounted 14-gage welded steel NEMA Type 1 enclosure for indoor, dry, non-hazardous locations with swing out service panel and door locks. Coat enclosure with manufacturer's standard color acrylic enamel finish over a corrosion-resisting primer.
 10. Provide all locks keyed identically, furnish five keys per lock.

SECTION 263600 – TRANSFER SWITCHES: continued

11. Provide indicating lights for:
 - a. Normal power available.
 - b. Emergency power available.

PART 3 - EXECUTION

- 3.01 EXAMINATION: Examine areas and conditions under which transfer switches are to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.
- 3.02 INSTALLATION OF TRANSFER SWITCHES:
 - A. Install transfer switches, including associated control devices as indicated, in accordance with equipment manufacturer's written instructions with recognized industry practices. (Provide support and bracing to resist forces of a Seismic Zone 2A event without collapse or overturning of switch.) Ensure that transfer switches comply with requirements. Comply with applicable requirements of NEC and NFPA pertaining to wiring practices and installation of electrical power transfer switches.
 - B. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors.
 - C. All adjustable settings shall be set to values provided by the manufacturer.
- 3.03 GROUNDING: Provide equipment grounding connections for transfer switch units as indicated. Tighten connectors to comply with tightening torques recommended by the manufacturer to assure permanent and effective grounding.
- 3.04 FIELD QUALITY CONTROL:
 - A. Test that phasing of normal and emergency power sources are identical.
 - B. Test switch insulation resistance phase to phase and phase to ground.
 - C. Adjust transfer switch timers for proper system coordination.
 - D. Test transfer switches by means of simulated normal power supply outage. Verify that the following occur:
 1. Load is transferred to emergency source with required time delay.
 2. Auxiliary contacts all operate properly. Load is transferred to normal source when it is restored with required time delay.
 3. Auxiliary contacts all operate properly.
 4. Engine cool down has required time delay.
 5. All timed functions operate properly.
 - E. Upon completion of installation and after circuitry has been energized, demonstrate capability and compliance of transfer switches with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.
 - F. Record and submit all field test data.
- 3.05 PERSONNEL TRAINING:
 - A. Building Operating Personnel Training: The manufacturer's authorized service representative shall train the Contracting Officer's building personnel on-site for eight hours in the procedures for starting-up, testing, operating, troubleshooting, servicing and preventative maintenance of transfer switches and auxiliary equipment.
 - B. Coordinate with the requirements of SECTION 017900 - DEMONSTRATION AND TRAINING.

SECTION 263600 - TRANSFER SWITCHES: continued

- 3.06 SPARE PARTS (FURNISH FOR EACH SWITCH): Furnish four spare indicating lamps and four fuses of each size and type used in each switch.
- 3.07 IDENTIFICATION: Provide identification for all transfer switches as specified in SECTION 260553 - ELECTRICAL IDENTIFICATION.

END OF SECTION 263600

SECTION 264100 - LIGHTNING PROTECTION SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes lightning protection systems components including, but not limited to, the following:
 - 1. Air terminals.
 - 2. Bonding plates.
 - 3. Conductors.
 - 4. Connectors.
 - 5. Fasteners.
 - 6. Grounding rods.
 - 7. Splicers.
- B. Related Work Specified Elsewhere:
 - 1. Raceways used for lightning protection system conductors are specified in SECTION 260533 - RACEWAYS.
 - 2. Grounding is specified in SECTION 260526 - GROUNDING.

1.02 REFERENCES:

- A. Applicable Standards: Comply with applicable requirements of the following standards.
 - 1. American National Standards Institute (ANSI):
 - a. C2 - National Electrical Safety Code.
 - 2. National Fire Protection Association (NFPA):
 - a. 780 - Lightning Protection Code.
 - b. 70 - National Electrical Code.
 - 3. Underwriters Laboratories (UL):
 - a. 96 and 96A - Lightning Protection Components.
 - 4. Lightning Protection Institute (LPI):
 - a. 177 - Inspection Guide for LPI Certified Systems.

1.03 SUBMITTALS:

- A. Refer to DIVISION 01 and SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS for administrative and procedural requirements for Submittals.
- B. Includes, but not limited to, the following:
 - 1. Product data for each type of product specified, including roof adhesive where used.
 - 2. Shop Drawings detailing lightning protection system including, but not limited to, air terminal locations, bonding locations, raceways, conductor routing, connections, and grounding.

1.04 SEQUENCING AND SCHEDULING:

- A. Coordinate installation of lightning protection system with the installation of other building systems and components, including electrical wiring, supporting structures, building materials, roof, and metal components requiring interface with lightning protection systems.

PART 2 - PRODUCTS

2.01 LIGHTNING PROTECTION SYSTEM COMPONENTS:

- A. Provide lightning protection system materials and components that comply with manufacturer's standard design in accordance with published product information. Provide air terminals, bonding plates, conductors, connectors, conductor straps, fasteners, grounding rods, rod

SECTION 264100 - LIGHTNING PROTECTION SYSTEMS: continued

clamps, splicers, and other components required for a complete system that meets UL 96A standards.

1. Type of metal for air terminals and cables: copper. Provide 24-inch long, 1/2- and 5/8-inch solid copper air terminals, copper lightning protection cable with a minimum strand size #13 AWG, minimum total cross sectional area of 192,000 CM and minimum weight of 190 lbs/1,000 feet (unless indicated otherwise).
2. Air terminals for roof mounting: Provide units with bases that shall be attached with adhesive provided by electrical contractor. The adhesive shall be approved by the roof membrane manufacturer. Air terminals on the metal roofs shall have mounting hardware compatible with the roof.
3. Ground rods: 3/4-inch minimum diameter by 10 feet long, copper clad steel with a minimum of 27% of the rod weight in the copper cladding.
4. Conductor supports shall be attached with adhesive provided by electrical contractor to the roof. The adhesive shall be approved by the roof membrane manufacturer. Conductor supports on the metal roofs shall have mounting hardware compatible with the roof.
5. Provide bonding conductors as required by NFPA 780.

PART 3 - EXECUTION

3.01 INSTALLATION OF LIGHTNING PROTECTION SYSTEMS:

- A. Install lightning protection systems as indicated, in accordance with Equipment manufacturer's written instructions, and in compliance with applicable installation standards specified above. Suitably protect cable and air terminals from damage during construction.
- B. Install conductors with direct paths from air terminals to ground connections avoiding sharp bends (minimum radius = 8 inches and no bend shall be less than 90 degrees) and narrow loops. Where indicated, run conductors in nonmetallic PVC raceway, Schedule 40, with a minimum elbow radius of 8 inches.
- C. Air terminals shall be installed within 2 feet of all ends, edges, and corners of the building.
- D. Splices and Clamps: Install cable with as few joints as possible. Use approved exothermic welded connections for all underground conductor splices and all underground connections between conductors and ground rods. Use approved mechanical compression connections for all above grade connections.
- E. Provide Bimetallic Connectors when joining copper to aluminum conductors.
- F. Ground Rods:
 1. Install rods as indicated by driving and not by drilling or jetting.
 2. Drive rods into unexcavated portion of the earth where possible.
 3. Where rods must be installed in excavated areas, drive rods into earth after compaction of backfill is completed.
 4. Drive to a depth such that top of rod will be approximately 18 inches below final grade, or subgrade, and connect to main grid ground cable.

3.02 CORROSION PROTECTION:

- A. Use no combination of materials that may form an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture, unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist that would cause deterioration or corrosion of conductors, use conductors with suitable protective coatings. Protect cable at all points where cable leaves concrete by wrapping rubber tape on 2 inches either side of the plane formed by the finished concrete surface.

SECTION 264100 - LIGHTNING PROTECTION SYSTEMS: continued

3.03 GROUNDING AND BONDING:

- A. Provide equipment grounding and bonding connections sufficiently tight to assure permanent and effective grounds and bonds.

3.04 FIELD QUALITY CONTROL:

- A. Perform inspections of the lightning protection system installation in accordance with LPI-177, "Inspection Guide for LPI Certified Systems." Provide Contracting Officer with one copy of LPI-177 and retain one copy at the Project Site throughout construction for reference.
- B. Provide UL inspection and delivery of UL Master Label to Contracting Officer.

END OF SECTION 264100

SECTION 264300 - TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS)

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section describes the mechanical and electrical requirements for transient voltage surge suppressors (TVSS) with high frequency electrical line noise filtering.
- B. The specified units shall be of the multi-stage parallel design and shall provide high energy transient voltage suppression, surge current diversion, high frequency attenuation, and line control for all electrical modes of equipment connected downstream from the units.
- C. The units shall be designed and manufactured by a qualified manufacturer of suppression filter system equipment. The qualified manufacturer shall have been engaged in the commercial design and manufacture of such products for a minimum of three years. Each unit shall be manufactured after February 9, 2007 to the latest UL directive.

1.02 REFERENCES:

- A. The specified units shall be designed, manufactured, tested and installed in compliance with the following standards:
 - 1. American National Standards Institute (ANSI/IEEE):
 - a. C62.1 - Standard for Surge Arresters for Alternating Current Power Circuits.
 - b. C62.11 - Metal-Oxide Surge Arresters for Alternating Current Power Circuits.
 - c. C62.41 - IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
 - d. C62.45 - IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.
 - 2. Federal Information Processing Standards (FIPS):
 - a. Publication 94 - Guideline on Electrical Power for ADP Installations.
 - 3. National Electrical Manufacturers Association (NEMA):
 - a. LS1 - Low Voltage Surge Protection Devices.
 - 4. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code.
 - b. 75 - Standard for the Protection of Electronic Computer/Data Processing Equipment.
 - c. 780 - Standard for the Installation of Lightning Protection Systems.
 - 5. Underwriters Laboratories (UL):
 - a. 1283 - Electromagnetic Interference Filters.
 - b. 1449 - Second Edition Transient Voltage Surge Suppressors.
 - 6. Military Standard (MIL-STD):
 - a. 220B - Method of Insertion Loss Measurement.
- B. The units shall be UL 1449 Second Edition Listed and CSA Approved as a Class C, Transient Voltage Surge Suppressor for Service Entrance Class Devices and Class A TVSS for Branch Panels, and UL 1283 Listed as Electromagnetic Interference Filters. Each unit shall be manufactured after February 9, 2007 to the latest UL directive.

1.03 SUBMITTALS:

- A. Refer to DIVISION 01 and SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS, for administrative and procedural requirements for Submittals.
- B. Includes, but is not limited to, the following:
 - 1. The manufacturer shall provide equipment specifications, installation manuals, start-up and operating instructions.

SECTION 264300 - TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS): continued

2. Documentation of UL 1449 testing including suppression ratings. For units supplied with a fused disconnect, submit the UL 1449 voltage suppression rating with a fused disconnect.
3. Documentation of minimum repetitive surge current capacity testing and documentation of single pulse surge current capacity testing in accordance with ANSI/IEEE C62.41.
4. Documentation of short circuit fuse testing in accordance with the following: Each design configuration shall be short circuit tested in accordance with the type of fusing used in the suppression path. Testing shall include application of a sustained overvoltage that causes the unit to enter a bolted fault condition. This bolted fault condition shall occur with the full rated AIC current of the fuse available. The fuse shall fail in a safe manner with no physical or structural damage to the unit and any failure shall be self-contained within the unit.
5. Documentation of surge current fuse testing in accordance with the following: Each design configuration shall be surge tested with the fusing in series to verify that a surge of maximum surge current capacity magnitude is fully suppressed. This testing shall also verify that, in the event of fuse failure, the full magnitude of the event shall be suppressed prior to fuse failure.

1.04 WARRANTY:

- A. The manufacturer shall provide a five-year limited warranty from the date of shipment against failure when installed in compliance with applicable national/local electrical codes, and the manufacturer's installation, operation, and maintenance instructions.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Subject to compliance with requirements, provide TVSS units manufactured by one of the following:
 1. Current Technology, Inc.
 2. Liebert Corp.
 3. L.E.A. International.
- B. All other manufacturers shall submit detailed compliance or exception statements to all provisions of this Specification, at least 10 days prior to Bid opening to allow consideration. Additionally, manufacturers shall submit independent test data from a nationally recognized testing laboratory verifying the following: life cycle testing, overcurrent protection, UL 1449, noise attenuation, and surge current capacity.

2.02 TVSS GENERAL:

- A. TVSS units shall be compatible with the electrical system, voltage, current, and distribution configuration indicated. Service entrance rated units shall contain an integral fused disconnect switch. The unit enclosures shall be NEMA 12.
- B. The unit shall include an engineered suppression system, using arrays of individually fused nonlinear voltage dependent metal oxide varistors (MOVs) with matched operating characteristics.
 1. The suppression system shall not use gas tubes, spark gaps, or silicon avalanche diodes (SADs).
 2. The modules shall be constructed in a manner that ensures surge current sharing.
 3. All internal connections associated with the suppression filter system and subject to surge currents shall use low-impedance copper bus bar and appropriately sized copper wire.

SECTION 264300 - TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS): continued

- 4. Internal connections associated with the suppression filter system and subject to surge currents shall be made with solderless compression type lugs and shall be bolted to the bus bars in order to reduce overall system impedance.
- 5. No plug-in component modules, quick-disconnect terminal, nonfield replaceable fusing, or printed circuit boards shall be used in surge current carrying paths.
- C. Unit Status Indicators:
 - 1. The unit shall include externally visible LED visual status indicators that monitor the on-line status of each phase of the unit.

2.03 TVSS PERFORMANCE AND TESTING:

- A. TVSS maximum continuous operating voltage (MCOV) shall be capable of sustaining 115% of the facility's nominal operating voltage continuously without degradation.
- B. Protection Modes: In accordance with NEMA standard LS 1, the unit shall provide protection in all modes. Wye configured systems shall provide Line-to-Neutral, Line-to-Ground, Line-to-Line, and Neutral-to-Ground protection. Delta configured systems shall provide Line-to-Line protection in ungrounded systems, and Line-to-Line and Line-to-Ground protection in grounded systems.
- C. Single Pulse Surge Current Capacity: Based on ANSI/IEEE C62.41 and in accordance with NEMA Publication No. LS-1-1992 [R2000], the tested single pulse surge current capacity, in amps, for each mode of protection of the unit shall be no less than as follows:

<u>Exposure Level</u>	<u>L-L</u>	<u>L-N</u>	<u>L-G</u>	<u>N-G</u>	<u>Panelboard Prefix</u>
					<u>Designations</u>
Distribution Panelboards	80,000	80,000	80,000	80,000	SE, SEP, SW, WLP, 2LP
Branch Panelboards	50,000	50,000	50,000	50,000	ESP, SH0, WSP, 2SP

- D. Unit Suppression Voltage Ratings: The TVSS published suppression voltage ratings shall be the UL 1449 listed suppression voltage ratings tested and assigned by Underwriters Laboratories.

UL 1449 Ratings

<u>Electrical System Voltage</u>	<u>Phases</u>	<u>UL 1449 Suppression Voltage Rating</u>	
		<u>without fused disconnect</u>	<u>with fused disconnect</u>
120/208	3	400V	500V
277/480	3	800V	1,000V
480	3	1,500V	1,500V

An additional rating of 330V can be achieved for 120/208V systems when two or more units are used with a separation of at least 100 feet.

- E. High Frequency Extended Range Power Filter:
 - 1. The unit shall include a high frequency extended range power filter and shall be UL 1283 listed as an Electromagnetic Interference Filter.
 - 2. The filter shall reduce fast rise-time, high frequency, error-producing transients, and electrical line noise to harmless levels, thus eliminating disturbances which may lead to electronic system upset.
 - 3. The system shall be tested to MIL-STD 220A for electrical line noise attenuation per 50 Ohm insertion loss measurement method of RF frequencies up to 100 MHz.

SECTION 264300 - TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS): continued

4. The filter shall provide minimum noise attenuation as follows:

<u>Attenuation Frequency</u>	<u>100 kHz</u>	<u>1 MHz</u>	<u>10 MHz</u>	<u>100 MHz</u>
Insertion Loss (ratio)	50-1	350-1	500-1	250-1
Insertion Loss (dB)	34	51	54	48

F. Overcurrent Protection: All components, including suppression, filtering, and monitoring components, shall be individually fused and rated to allow maximum specified surge current capacity.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Install the TVSS with insulated copper conductors sized per the manufacturer's recommendations.
- B. Conductors connecting the TVSS to the system shall be connected directly to the panelboard circuit breaker indicated.
- C. The conductors shall be as short and straight as possible and shall not exceed 10 feet in length.
- D. The conductors shall be twisted together to reduce the TVSS system input impedance.
- E. The TVSS shall be installed following the TVSS manufacturer's recommended practices and in compliance with all applicable codes.

END OF SECTION 264300

SECTION 265000 - INTERIOR LIGHTING FIXTURES

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section specifies interior lighting fixture work as indicated on drawings and schedules.
- B. Types of interior lighting fixtures in this Section include the following:
 - 1. LED solid-state lighting.

1.02 REFERENCES:

- A. Applicable Standards: Comply with applicable requirements of the following standards:
 - 1. Certified Ballast Manufacturers (CBM) - Provide fluorescent lamp ballasts which comply with Certified Ballast Manufacturers Association standards and carry the CBM label.
 - 2. Energy Policy Act of 1992 (EPACT) - Provide incandescent and fluorescent lamps that are in compliance with these efficiency standards.
 - 3. American National Standards Institute (ANSI)/Institute of Electrical and Electronic Engineers (IEEE):
 - a. ANSI/IEEE C62.41-1991 - Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
 - 4. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code (NEC). Comply with applicable local code requirements of the authority having jurisdiction and the NEC.
 - 5. Underwriters Laboratories (UL): Provide interior lighting fixtures and components which are UL-listed and labeled.
 - a. 57 - Electric Lighting Fixtures.
 - b. 506 - Specialty Transformers.
 - c. 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 - d. 542 - Lampholders, Starters, and Starter Holders for Fluorescent Lamps.
 - e. 844 - Electric Lighting Fixtures for Use in Hazardous Locations.

1.03 SUBMITTALS:

- A. Refer to DIVISION 01 and SECTION 260000 - BASIC ELECTRIC REQUIREMENTS for administrative and procedural requirements for submittals.
- B. Includes, but not limited to, the following:
 - 1. Product Data: Submit manufacturer's product data and installation instructions on each type of interior building lighting fixture, lamp, and component. Submit fluorescent lamp color in degrees Kelvin, color rendering index (CRI), and average lamp efficacy in lumens per watt. Submit ballast factor and total harmonic distortion (THD) for each ballast type.
 - 2. Shop Drawings: Submit fixture shop drawings in booklet form with a separate sheet for each fixture, assembled in "luminaire type" alphabetical or numerical order, with proposed fixture, lamp type, and accessories clearly indicated on each sheet. Submit details indicating compatibility with ceiling grid system.
 - 3. Wiring Diagrams: Submit wiring diagrams for interior lighting fixtures showing connections. Differentiate between portions of wiring which are manufacturer factory-installed and portions which are field-installed.
 - 4. Samples: Submit one complete operating unit (at no cost to the Contracting Officer) for each interior light fixture specified.
 - 5. Illumination Data: Provide fixture efficiency and coefficients of utilization. Provide recommended maximum spacing-to-mounting ratio. Provide candlepower distribution

SECTION 265000 - INTERIOR LIGHTING FIXTURES: continued

curves (drawn to scale such that candlepower can be scaled at different angles) or provide candlepower data in tabular form at 10-degree increments.

6. Maintenance Data: Submit maintenance data and parts list for each interior lighting fixture and accessory; include "trouble-shooting" maintenance guide. Include in this product data and shop drawings in a maintenance manual, in accordance with general requirements of DIVISION 01.

1.04 DELIVERY, STORAGE AND HANDLING:

- A. Deliver interior lighting fixtures in factory-fabricated containers or wrappings that properly protect fixtures from damage.
- B. Store interior lighting fixtures in original packaging. Store inside well-ventilated area, protected from weather, moisture, soiling, extreme temperatures, humidity. Lay flat and block off of floor.
- C. Handle interior lighting fixtures carefully to prevent damaging, breaking, or scoring finishes. Do not install damaged units or components; replace with new.

1.05 SEQUENCING AND SCHEDULING:

- A. Sequence interior lighting installation with other work to minimize possibility of interference with pipes, ductwork, and conduit. Protect light fixtures from damage and soiling during remainder of construction.

1.06 MAINTENANCE:

- A. Extra stock:
 1. Furnish stock or replacement LED lamps amounting to 20%, but not less than four lamps in each case, of each type and size lamp used in each type of fixture on the project. Deliver replacement stock, as directed, to Contracting Officer's storage space and obtain receipt.

PART 2 - PRODUCTS

2.01 FIXTURES:

- A. General: Provide lighting fixtures of sizes, types, and ratings indicated, complete with, but not limited to, housings, high power factor ballasts, energy-efficient lamps, lamp holders, reflectors, energy efficient ballasts, starters, and wiring. Light fixture catalog numbers indicated in the light fixture schedule do not necessarily denote required mounting hardware, equipment or accessories. Provide mounting hardware, equipment and accessories as required. Ship fixtures factory-assembled, with those components required for a complete installation. Design fixtures with concealed hinges and catches, with metal parts grounded as common unit, and constructed to dampen ballast generated noise. All equipment and materials shall bear the UL label.
- B. Electronic Solid State High Frequency Fluorescent Lamp Ballasts: Energy efficient, high frequency, rapid start ballast that shall operate without reducing the light output or creating flicker. The ballast shall be Class P thermally protected, high power factor (95% or higher), sound rates "A" (or better), contain no PCBs, UL-listed and ETL tested. The ballast shall meet EMI and RFI specifications of FCC Regulations, Part 18, 15.J, and will not interfere with the operation of delicate electronic equipment. The ballast shall limit the inrush current to 20 times of its operating current for 8 milliseconds or less. The ballast shall maintain rated light output with a voltage variation of $\pm 10\%$. Total harmonic distortion shall not exceed 20%. The light fixture lamp holders shall be those recommended by the electronic ballast manufacturer.

SECTION 265000 - INTERIOR LIGHTING FIXTURES: continued

- Ballast shall comply with CBM Ballast Efficacy Factors (BEF) and be CBM labeled. Provide transient protection per ANSI/IEEE C62.41. Ballast shall comply with ANSI C82.2.
- C. Lamps:
 - 1. LED lamps in wattage indicated, of 4,000 K, types as specified and indicated. Provide lamps that comply with the efficiency standards of the Energy Act of 1992 (EPACT).
 - D. Interior Lighting Fixture Types:
 - 1. General: Various fixture types required are listed on the fixture schedule on the drawings. Fixtures must comply with minimum requirements as stated herein. Review architectural drawings and specifications to verify ceiling types, modules, and suspension systems appropriate to installation.
 - E. Occupancy Sensors:
 - 1. The occupancy sensor lighting control systems shall be used to control the lighting fixtures in areas where the sensors are indicated.
 - 2. The system shall consist of individual power packs, sensors and relays for controlling fixtures in individual rooms or areas by controlling the power to the room light switches.
 - 3. The system indicated on the drawings was designed around a Leviton system and the Leviton model numbers indicated in the schedule on the drawings are to establish the standard of performance.
 - 4. The supplier shall prepare a set of installation shop drawings indicating the detector type, and location, wiring diagrams similar to those on the drawings along with installation, aiming and adjusting instructions for the Contractor to install the systems.
 - 5. The Contractor shall provide the system supplier architectural and electrical plans; including reflected ceiling plans for the system supplier to prepare their drawings.
 - 6. The Contractor shall install the systems per the shop drawings and installation instructions including the outlet boxes, conduit devices, 120V and low-voltage wiring, etc., required for a complete system. All occupancy sensors shall be installed on outlet boxes installed in the wall or ceiling. Low voltage wiring shall be 3-conductor, #18 copper stranded cable with an overall jacket; NEC type CL2. Wiring may be run without conduit but shall be supported in accordance with the NEC with approve fasteners. All splices shall be made in the junction boxes. Proper fittings shall be used where the cable enters the box.
 - 7. After the systems have been installed, the supplier will commission the systems including testing each device for proper operation and performing required adjustments. After the systems have been commissioned, the supplier shall instruct the hospital staff on how the devices and systems function.
 - 8. Manufacturers:
 - a. Leviton.
 - b. Watt Stopper.
 - F. Dimmers, Individual Circuits:
 - 1. These shall be Lutron "Nova" Model NTF-10, integrated into LED Driver (Ballast) to provide 10 to 100V dimming range.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine the mounting surface for supporting lighting fixtures and the areas and conditions under which lighting fixtures are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

SECTION 265000 - INTERIOR LIGHTING FIXTURES: continued

3.02 INSTALLATION OF INTERIOR LIGHTING FIXTURES:

- A. Light fixture locations indicated on electrical drawings are approximate. Architectural reflected ceiling plans and floor plans define exact locations of light fixtures. Install interior lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation," NEMA standards, and with recognized industry practices, to ensure that lighting fixtures fulfill requirements.
- B. Provide fixtures and/or fixture outlet boxes with hangers to properly support fixture weight. Submit design of hangers and method of fastening, other than that which is indicated or specified herein, for review by Contracting Officer.
- C. Install flush mounted fixtures properly to eliminate light leakage between fixture frame and finished surface.
- D. Provide plaster frames for recessed fixtures installed in other than suspended grid type acoustical ceiling systems. Brace frames temporarily to prevent distortion during handling.
- E. Fasten fixtures securely to structural supports and ensure that pendant fixtures are plumb and level. Provide individually mounted fluorescent pendant fixtures with pendants longer than 2 feet with twin stem hangers. Provide all pendant stem hangers with ball aligners and provisions for minimum 1 inch vertical adjustment. Mount continuous rows of fixtures with an additional stem hanger greater than the number of fixtures in the row.
- F. All recessed light fixtures supported by suspended ceilings shall be securely attached (from a minimum of 4 points) to the structural steel above by four diagonally opposite, adequately sized safety chains. All support wire shall be same size and strength as the ceiling system support wires.
- G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and the National Electrical Code.
- H. Support surface mounted fixtures greater than 2 feet in length at another point in addition to the outlet box fixture stud.
- I. Provide seismic bracing and support such that the light fixtures and/or lamps will not fall during a Seismic Zone 2A event.

3.03 FIELD QUALITY CONTROL:

- A. At the Date of Substantial Completion, replace lamps in interior lighting fixtures which are observed to be noticeably dimmed as judged by the Contracting Officer, after Contractor's use and testing.
- B. Refer to DIVISION 01 for the replacement/restoration of lamps in interior lighting fixtures where used for temporary lighting prior to Date of Substantial Completion.

3.04 COMMISSIONING:

- A. Clean interior lighting fixtures of dust, dirt, and construction debris upon completion of installation. Clean fingerprints and smudges from lenses.
- B. Protect installed fixtures from damage during the remainder of the construction period.
- C. Provide new lamps at the start of building occupancy by the Contracting Officer.
- D. Coordinate with SECTION 017900 - DEMONSTRATION AND TRAINING.

SECTION 265000 - INTERIOR LIGHTING FIXTURES: continued

3.05 GROUNDING:

- A. Provide equipment grounding connections for interior lighting fixtures as indicated and specified. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent and effective grounds.

3.06 DEMONSTRATION:

- A. Upon completion of the installation of interior lighting fixtures, and after building circuitry has been energized, apply electrical power to demonstrate capability and compliance with requirements. All interior lighting shall be demonstrated during nighttime lighting demonstrations. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

END OF SECTION 265000

SECTION 265200 - EMERGENCY LIGHTING

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section specifies emergency lighting as indicated by drawings and schedules.
- B. Types of self-contained emergency lighting fixtures in this Section include the following:
 - 1. Unitized battery powered fixtures.
 - 2. Illuminated exit sign fixtures.
 - 3. Emergency fluorescent lamp power supply.

1.02 REFERENCES:

- A. Applicable Standards: Comply with applicable requirements of the following standards.
 - 1. National Electrical Manufacturers' Association (NEMA):
 - a. 1B 4 - Determination of Amperhour and Watthour Capacity of Lead-Acid Industrial Storage Batteries for Stationary Service.
 - b. 1B 5 - Life Testing of Lead-Acid Industrial Storage Batteries for Stationary Service.
 - c. 1B 7 - Testing Arrester Vents Used on Lead-Acid Industrial Storage Batteries for Stationary Service.
 - d. LE 1 - Fluorescent Luminaires.
 - 2. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code (NEC).
 - b. 101 - Life Safety Code.
 - 3. Underwriters Laboratories (UL) Compliance: Provide emergency lighting fixtures which are UL-listed and labeled.
 - a. 57 - Electric Lighting Fixtures.
 - b. 924 - Emergency Lighting and Power Equipment
 - c. 1570 - Fluorescent Lighting Fixtures.
 - d. 1571 - Incandescent Lighting Fixtures.

1.03 SUBMITTALS:

- A. Refer to DIVISION 01 and SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS for administrative and procedural requirements for submittals.
- B. Includes, but not limited to, the following:
 - 1. Product Data: Submit manufacturer's technical product data on emergency lighting fixtures. Provide scaled candlepower distribution curves for light fixtures.
 - 2. Shop Drawings: Submit fixture shop drawings in booklet form with separate sheet for each fixture, assembled in luminaire "type" alphabetical or numerical order, with proposed fixture and accessories clearly indicated on each sheet.
 - 3. Maintenance Data: Submit maintenance data and parts list for each emergency lighting fixture and accessory, including "troubleshooting" maintenance guide. Include this data, product data and shop drawings in maintenance manual, in accordance with requirements of DIVISION 01.

1.04 DELIVERY, STORAGE, AND HANDLING:

- A. Handle lighting fixtures carefully to prevent damage, breaking, and scoring. Do not install damaged fixtures or components; replace with new.
- B. Store lighting fixtures in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

SECTION 265200 - EMERGENCY LIGHTING: continued

PART 2 - PRODUCTS

2.01 EMERGENCY LIGHTING FIXTURES:

- A. General: Provide lighting fixtures of sizes, types, and ratings specified and indicated.
- B. Unitized Battery Powered Fixtures:
 - 1. Fixture Type EA Illuminated Exit Sign Fixtures - Emergency Powered: Surface, wall, or ceiling mounted fixtures, as required. Provide 120/277Vac unit with extruded aluminum fixture with no external hardware, satin aluminum exterior finish and white baked enamel interior, with capability for adjusting face panel for: no arrow, left arrow and/or right arrow. Provide red, 6.5-watt LED face with 10-footcandle face illumination and 80-year LED life. Provide internal 6Vdc battery.
 - a. Plastic Face Panels: White panels with permanent, red letters 6 inches high, 3/4 inch stroke. Provide single or double face as indicated.
 - b. Furnish battery powered unit with 12-hour automatic charger, complete with nickel-cadmium battery which automatically connects 6V lamps to 20-hour battery upon normal power loss and disconnects upon restoration of normal AC supply. Low voltage disconnect shall prevent damage to the battery.

2.02 EMERGENCY FLUORESCENT LAMP POWER SUPPLY:

- A. General: Provide self-contained battery powered inverter unit for direct mounting in designated fluorescent fixtures. Provide unit with dual 120 or 277Vac, 60 Hz, input, fully automatic two rate charger, nickel-cadmium battery, automatic low voltage battery disconnect, and remote AC "ON" pilot light with test switch on a stainless steel wall plate. Design unit to automatically transfer to battery supply on loss of normal AC power and operate two 4-foot 28WT5 fluorescent lamps with an initial total output of 3,400 lumens and a minimum total output of 3,000 lumens at the end of 1-1/2 hours.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Examine areas and conditions under which emergency lighting is to be installed and substrate which will support lighting fixtures. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF EMERGENCY LIGHTING FIXTURES:

- A. Install emergency lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation," NEMA standards, and with recognized industry practices to ensure that the lighting fixtures fulfill requirements.
- B. All emergency lighting conductors shall be routed in conduit separate from the normal power circuits.
- C. Emergency light fixture circuit shall be identified at fixture and at panel board.

3.03 ADJUSTING AND CLEANING:

- A. Clean emergency lighting fixtures of dirt and debris upon completion of installation.
- B. Protect installed fixtures from damage during remainder of construction period.
- C. Aim adjustable lighting heads as directed by the Contracting Officer in a night time test.

SECTION 265200 - EMERGENCY LIGHTING: continued

3.04 GROUNDING:

- A. Provide equipment grounding connections for emergency lighting fixtures as indicated. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent and effective grounds.

3.05 FIELD QUALITY CONTROL:

- A. Upon completion of the installation of emergency lighting fixtures, and after building circuitry has been energized with the normal power source for a minimum of 12 hours, perform a night time test by turning off the normal power source for 90 minutes to demonstrate operation, capability, and compliance with requirements under emergency conditions. Re-aim adjustable lighting heads as directed by the Contracting Officer during a night-time demonstration. Re-demonstrate again at night after the readjustments have been made. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

END OF SECTION 265200

SECTION 265610 - EXTERIOR LIGHTING FIXTURES

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section specifies exterior lighting fixture work as indicated by drawings, schedules, and as specified herein.
- B. Types of exterior lighting fixtures in this Section include the following:
 - 1. High-intensity discharge (HID).
 - a. Metal halide (MH).
- C. Applications of exterior lighting fixtures required for this Project include the following:
 - 1. Outdoor area lighting.
 - 2. Outdoor flood lighting.

1.02 REFERENCES:

- A. Applicable Standards: Comply with applicable requirements of the following standards:
 - 1. Certified Ballast Manufacturers Association (CBMA): Provide fluorescent lamp ballasts which comply with Certified Ballast Manufacturers Association and carry the CBMA label.
 - 2. National Electrical Manufacturers' Association (NEMA): Comply with applicable requirements of NEMA Stds Pub/No. LE2 pertaining to lighting equipment.
 - 3. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code (NEC). Comply with applicable local code requirements of the authority having jurisdiction and the NEC.
 - b. 780 - Lightning Protection Code. Comply with applicable requirements pertaining to installation of exterior lighting fixtures.
 - 4. Underwriters Laboratories (UL): Provide exterior lighting fixtures and components which are UL-listed and labeled. Comply with applicable requirements of the following standards:
 - a. 57 - Electric Lighting Fixtures.
 - b. 506 - Specialty Transformers.
 - c. 1029 - High-Intensity-Discharge Lamp Ballasts.
 - d. 1572 - High-Intensity-Discharge Lighting Fixtures.

1.03 SUBMITTALS:

- A. Refer to DIVISION 01 and SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS for administrative and procedural requirements for Submittals.
- B. Includes, but not limited to, the following:
 - 1. Product Data: Submit manufacturer's product data and installation instructions on each type of exterior building lighting fixture.
 - 2. Shop Drawings: Submit fixture Shop Drawings in booklet form with a separate sheet for each fixture, assembled in "luminaire type" alphabetical or numerical order with proposed fixture, lamp type, voltage, complete illumination data (as specified below), and accessories clearly indicated on each sheet.
 - 3. Wiring Diagrams: Submit wiring diagrams for exterior lighting fixtures showing connections. Diagrams shall differentiate between portions of wiring which are manufacturer factory-installed and portions which are field installed.
 - 4. Samples: Submit one complete operating unit for each type of exterior lighting fixture specified when deemed necessary.

SECTION 265610 - EXTERIOR LIGHTING FIXTURES: continued

5. Illumination Data: Provide fixture lumen efficiency. Provide recommended maximum spacing-to-mounting height. Provide isofootcandle (isolux) plot diagram of footcandles on horizontal pavement surface which shows composite values of illuminance projected from the arrangement of light sources from indicated fixture locations and heights. Show on the graphic plots the locations, spacings, and heights of luminaries. Provide candlepower distribution curves (drawn to scale such that candlepower can be scaled at different angles) or provide candlepower data in tabular form at 10-degree increments. When the Contractor proposes a light fixture substitution other than the one the Contracting Officer used for design, the Contractor shall also submit a computer printout of the area with horizontal and vertical maintained footcandles (and aiming criteria where applicable) indicated on a 10- by 10-foot grid for the exterior space being illuminated.
6. Maintenance Data: Submit maintenance data and parts list for each exterior lighting fixture and accessory, including "troubleshooting" maintenance guide. Include in this data, product data and shop drawings in a maintenance manual in accordance with requirements of DIVISION 01.

1.04 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver exterior lighting fixtures in factory-fabricated containers or wrappings which properly protect fixtures from construction debris and physical damage.
- B. Store exterior fixtures in original wrappings in a clean dry space. Protect from weather, dirt, fumes, water, construction debris, and damage.
- C. Handle exterior lighting fixtures carefully to prevent damage, breaking, and scoring. Do not install damaged fixtures or components; remove units from Site and replace with new.

1.05 SEQUENCING AND SCHEDULING:

- A. Sequence exterior lighting installation with other work to reduce possibility of damage and soiling of fixtures during the remainder of construction period.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Subject to compliance with requirements, provide products of one of the following (for each type of exterior lighting fixture):
 1. Exterior Lighting Fixtures:
 - a. Abolite Lighting, Inc.
 - b. Appleton Electric Co.
 - c. Crouse-Hinds Lighting Products Div; Cooper Industries Inc.
 - d. Devine Lighting Div; Kidde & Co., Inc.
 - e. Dual-Lite Mfg. Inc.
 - f. General Electric Co.
 - g. GTE Sylvania, Inc.
 - h. Guth Lighting Div; General Signal Corp.
 - i. Holophane Div; Johns-Manville Corp.
 - j. Hubbell, Inc.
 - k. KIM Lighting, Inc.
 - l. Lithonia Lighting Div; National Services Industries, Inc.
 - m. Sylvania.
 - n. Trimblehouse.

SECTION 265610 - EXTERIOR LIGHTING FIXTURES: continued

- o. Wide-Light Corp.
- 2. High-Intensity Discharge Ballasts:
 - a. Advance Transformer Co.
 - b. Valmont.
 - c. Holophane Div; Johns-Manville Corp.
 - d. Jefferson Electric Co.
 - e. Magne-Tek.
 - f. McGraw-Edison Co.
 - g. Sola Electric Div; General Signal Corp.
 - h. Wide-Lite Corp.
- 3. Lamps:
 - a. General Electric.
 - b. Osram Sylvania.
 - c. Phillips.
 - d. Venture.
- 4. Solar Light Fixtures:
 - a. SOL.

2.02 EXTERIOR LIGHTING FIXTURES:

- A. General: Provide lighting fixtures of sizes, types, and ratings indicated; complete with, but not limited to, housings, high power factor ballasts, energy efficient ballasts, lamps, starters, and wiring. All equipment and materials shall bear the UL label.
- B. High-Intensity Discharge Lamp Ballasts: High power factor HID lamp ballasts rated -20°F, of ratings, types, and makes as recommended by lamp manufacturer, which properly mates and matches lamps to electrical supply by providing appropriate voltages and impedances for which lamps are designed. Design ballasts to operate lamp within the lamp's power trapezoid requirements.
- C. Lamps:
 - 1. Clear metal halide lamps in wattages indicated.
 - 2. Fluorescent lamps in wattages required, with lamp color as indicated on the light fixture schedule.
- D. Provide integral 2-50 footcandle adjustable photocell control when indicated. Photo control shall have internal 2-minute time delay.

2.03 EXTERIOR LIGHTING FIXTURE TYPES:

- A. General: Various fixture types are indicated on the fixture schedule on the drawings. Fixtures shall comply with the minimum requirements as stated on the schedule.

2.04 EXTRA STOCK:

- A. Furnish stock or replacement lamps amounting to 15% of the total number of lamps (but not less than four lamps in each case) of each type and size lamp used on the Project. Deliver replacement lamps as directed to Contracting Officer's storage space and obtain a receipt.

PART 3 - EXECUTION

3.01 EXAMINATION:

SECTION 265610 - EXTERIOR LIGHTING FIXTURES: continued

- A. Examine areas and conditions under which lighting fixtures are to be installed and the substrate which will support lighting fixtures. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF EXTERIOR LIGHTING FIXTURES:

- A. Install exterior lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation," NEMA standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.
- B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and the National Electrical Code.
- C. Fasten electrical lighting fixtures and brackets securely to structural supports, including poles/standards; ensure that installed fixtures are plumb and level.
- D. All exterior lighting shall be demonstrated during night time tests.
- E. All light fixtures which can be aimed (floodlights, etc.) shall be aimed as indicated and shall be re-aimed as directed by Contracting Officer during night time lighting demonstrations. Redemonstrate lighting at night after all adjustments have been made.
- F. All conduit entering building shall be sealed to prevent water and/or insects entering building from light fixtures.

3.03 GROUNDING:

- A. Provide equipment grounding connections for exterior lighting fixtures as indicated. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent and effective grounds.

3.04 FIELD QUALITY CONTROL:

- A. At the Date of Substantial Completion, replace lamps in exterior lighting fixtures which are observed to be noticeably dimmed after Contractor's use and testing, as judged by Contracting Officer.
- B. Refer to DIVISION 01 Sections for the replacement/restoration of lamps in exterior lighting fixtures where used for temporary lighting prior to Date of Substantial Completion.

3.05 ADJUSTING AND CLEANING:

- A. Aim adjustable lighting fixtures and lamps in night test of system. Verify that measured illuminance values comply with submitted isolux plot diagram values.
- B. Clean lighting fixtures of dirt and debris upon completion of installation.
- C. Protect installed fixtures from damage during construction period.
- D. Photoelectric Controls:
 - 1. Aim "north."
 - 2. Adjust to actuate "on" at 3.0 footcandles.
 - 3. Provide FAA listed photoelectric controls for control of aviation obstruction lighting.

SECTION 265610 - EXTERIOR LIGHTING FIXTURES: continued

3.06 DEMONSTRATION:

- A. Upon completion of installation of exterior lighting fixtures and associated electrical supply circuitry, apply electrical power to circuitry to demonstrate capability and compliance with requirements. All exterior lighting demonstrations shall be performed at night. Verify light fixture grouping (verify circuiting as indicated on Drawings) and controls. Where possible, correct malfunctioning units at Site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

END OF SECTION 265610

DIVISION 27 – COMMUNICATIONS

SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. Telecommunications mounting elements.
 - 2. Backboards.
 - 3. Telecommunications equipment racks and cabinets.
 - 4. Grounding.
- B. Related Sections:
 - 1. SECTION 260536 - CABLE TRAY.
 - 2. SECTION 260533 - RACEWAYS.

1.03 DEFINITIONS:

- A. BICSI: Building Industry Consulting Service International.
- B. LAN: Local area network.
- C. RCDD: Registered Communications Distribution Designer.

1.04 ACTION SUBMITTALS:

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
 - 3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

1.05 INFORMATIONAL SUBMITTALS:

- A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- B. Seismic Qualification Certificates: For equipment frames from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions. Base certification on the maximum

SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS: continued

number of components capable of being mounted in each rack type. Identify components on which certification is based.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.06 QUALITY ASSURANCE:

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.
 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician or Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
 3. Field Inspector: Currently registered by BICSI as RCDD or Commercial Installer, Level 2 to perform the on-site inspection.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS:

- A. Seismic Performance: Equipment frames shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 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."

2.02 BACKBOARDS:

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels specified in DIVISION 06, Section "Rough Carpentry."
- B. Manufacturer's fire rating stamp shall not be painted over.

2.03 EQUIPMENT FRAMES:

- A. General Frame Requirements:
 1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
 2. Module Dimension: Width compatible with EIA 310-D standard, 19-inch panel mounting.
 3. Finish: Manufacturer's standard, baked-polyester powder coat.
- B. Floor-Mounted Racks: Four-post type, Modular-type, steel or aluminum construction.
 1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.
 2. Baked-polyester powder coat finish.
 3. Minimum height: 72 inches or as indicated.
- C. Modular Freestanding Cabinets:
 1. Removable and lockable side panels.
 2. Hinged and lockable front and rear doors.
 3. Adjustable feet for leveling.
 4. Screened ventilation openings in the roof and rear door.
 5. Cable access provisions in the roof and base.
 6. Grounding bus bar.

SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS: continued

7. Rack or roof-mounted, 550-cfm fan with filter.
 8. Power strip.
 9. Baked-polyester powder coat finish.
 10. All cabinets keyed alike.
 11. Minimum height: 72 inches or as indicated.
- D. Modular Wall Cabinets:
1. Wall mounting.
 2. Steel or aluminum construction.
 3. Treated to resist corrosion.
 4. Lockable front doors.
 5. Louvered side panels.
 6. Cable access provisions top and bottom.
 7. Grounding lug.
 8. Rack or roof-mounted, 250-cfm fan.
 9. Power strip.
 10. All cabinets keyed alike.
 11. Swing out type with front and back access.
- E. Cable Management for Equipment Frames:
1. Metal, with integral wire retaining fingers.
 2. Baked-polyester powder coat finish.
 3. Vertical cable management panels shall have front and rear channels, with covers.
 4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.04 POWER STRIPS:

- A. Power Strips: Comply with UL 1363.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Rack mounting.
 3. Six, 20-A, 120Vac, NEMA WD 6, Configuration 5-20R receptacles.
 4. LED indicator lights for power and protection status.
 5. LED indicator lights for reverse polarity and open outlet ground.
 6. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
 7. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
 8. Cord connected with 15-foot line cord.
 9. Rocker-type on-off switch, illuminated when in on position.
 10. Peak Single-Impulse Surge Current Rating: 33 kA per phase.
 11. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all three modes shall be not more than 330V.

2.05 GROUNDING:

- A. Comply with requirements in DIVISION 26, Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.
- B. Telecommunications Main Bus Bar:
1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
 2. Ground Bus Bar: Copper, minimum 1/4-inch thick by 4 inches wide with 9/32-inch holes spaced 1-1/8 inches apart.

SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS: continued

3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600V. Lexan or PVC, impulse tested at 5,000V.
- C. Comply with J-STD-607-A.

2.06 LABELING:

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.01 ENTRANCE FACILITIES:

- A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

3.02 INSTALLATION:

- A. Comply with NECA 1.
- B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
- C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- D. Coordinate layout and installation of communications equipment with Contracting Officer's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Contracting Officer to exchange information and agree on details of equipment arrangements and installation interfaces.
 2. Record agreements reached in meetings and distribute them to other participants.
 3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
 4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.
- E. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.03 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS:

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in SECTION 260529.

3.04 FIRESTOPPING:

- A. Comply with requirements in DIVISION 07, Section "Through-Penetration Firestop Systems."
- B. Comply with TIA-569-B, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.05 GROUNDING:

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with J-STD-607-A.

SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS: continued

- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
 - 1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.06 IDENTIFICATION:

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in SECTION 260553 - ELECTRICAL IDENTIFICATION.
- B. Comply with requirements in SECTION 099123 - INTERIOR PAINTING for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Labels shall be preprinted or computer-printed type.

END OF SECTION 271100

SECTION 271300 - COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. UTP cable.
 - 2. 50/125-micrometer, multi-mode optical fiber cabling.
 - 3. 8/125-micrometer single-mode optical fiber cabling.
 - 4. Cable connecting hardware, patch panels, and cross-connects.
 - 5. Cabling identification products.
- B. Related Sections:
 - 1. For Raceways see SECTION 260533.
 - 2. For Cable Tray see SECTION 260536.

1.03 DEFINITIONS:

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. EMI: Electromagnetic interference.
- D. IDC: Insulation displacement connector.
- E. LAN: Local area network.
- F. RCDD: Registered Communications Distribution Designer.
- G. UTP: Unshielded twisted pair.

1.04 BACKBONE CABLING DESCRIPTION:

- A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.05 PERFORMANCE REQUIREMENTS:

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-C.1, when tested according to test procedures of this standard.

1.06 SUBMITTALS:

- A. Product Data: For each type of product indicated.
 - 1. Include the following installation data for each type used:
 - a. Nominal OD.
 - b. Minimum bending radius.
 - c. Maximum pulling tension.

SECTION 271300 - COMMUNICATIONS BACKBONE CABLING: continued

- B. Shop Drawings:
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Contracting Officer.
 - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 - 3. Cabling administration drawings and printouts.
 - 4. Wiring diagrams to show typical wiring schematics including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.
 - 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
 - 6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to side of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

1.07 INFORMATIONAL SUBMITTALS:

- A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.
- D. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.08 CLOSEOUT SUBMITTALS:

- A. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.
- B. As-Built Drawings.
- C. Copy of Test Reports.

1.09 QUALITY ASSURANCE:

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings Cabling Administration Drawings, and field testing program development by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
 - 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: An NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

SECTION 271300 - COMMUNICATIONS BACKBONE CABLING: continued

- C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 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: 450 or less.
- D. 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.
- E. Telecommunications Pathways and Spaces: Comply with EIA-569-B.
- F. Grounding: Comply with ANSI-J-STD-607-A.

1.10 DELIVERY, STORAGE, AND HANDLING:

- A. Test cables upon receipt at Project site.
 - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set
 - 2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
 - 3. Test each pair of UTP cable for open and short circuits.
 - 4. Cables that fail shall be rejected and removed from project site.

1.11 PROJECT CONDITIONS:

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.12 COORDINATION:

- A. Coordinate layout and installation of telecommunications pathways and cabling with Contraction Officer and Hawaii Air National Guard Communication Detachment.

PART 2 - PRODUCTS

2.01 PATHWAYS:

- A. General Requirements: Comply with EIA-569-B.
- B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 2. Lacing bars, spools, J-hooks, and D-rings.
 - 3. Straps and other devices.
- C. Cable Trays: Comply with requirements in SECTION 260536 - CABLE TRAY and SECTION 260537 - UNDER FLOOR WIRE BASKET SUPPORT SYSTEM
- D. Conduit and Boxes: Comply with requirements in SECTION 260533 - RACEWAYS
 - 1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2.02 BACKBOARDS:

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches.

SECTION 271300 - COMMUNICATIONS BACKBONE CABLING: continued

2.03 UTP CABLE:

- A. Description: 100-ohm, 100-pair UTP cable, formed into 25-pair binder groups covered with a gray thermoplastic jacket. See drawings for required number of pairs.
 - 1. Comply with ICEA S-90-661 for mechanical properties.
 - 2. Comply with EIA-568-C.1 for performance specifications.
 - 3. Comply with EIA-568-C.2, Category 6.
 - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, General Purpose: Type CM or CMG.
 - b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
 - c. Communications, Riser Rated: Type CMR; or CMP, complying with UL 1666.

2.04 UTP CABLE HARDWARE:

- A. General Requirements for Cable Connecting Hardware: Comply with EIA-568-C.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- B. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25% spare. Integral with connector bodies, including plugs and jacks where indicated.
- C. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
 - 1. Number of Terminals per Field: One for each conductor in assigned cables.
- D. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - 1. Number of Jacks per Field: One for each four-pair UTP cable indicated.
- E. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals. See Drawings for jacks' color code.
- F. Patch Cords: Factory-made, 4-pair cables in 48-inch lengths; terminated with 8-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
 - 2. Patch cords shall have color-coded boots for circuit identification.
 - 3. Patch cord color shall match jack coloring. See Drawings for color code.

2.05 OPTICAL FIBER CABLE:

- A. Description: Single-mode, 8/125-micrometer, 1,310 nm. Multimode, 50/125-micrometer, fiber, nonconductive, tight buffer, optical fiber cable.
 - 1. Comply with ICEA S-83-596 for mechanical properties.
 - 2. Comply with TIA/EIA-568-C.3 for performance specifications.
 - 3. Comply with TIA/EIA-492AAAA-B for detailed specifications for multimode.
 - 4. Comply with TIA/EIA-492CAAA for detailed specifications for single-mode.
 - 5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. General Purpose, Nonconductive: Type OFN or OFNG.
 - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - c. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
 - d. General Purpose, Conductive: Type OFC or OFCG; or OFNG, OFN, OFCR, OFNR, OFCP, or OFNP.
 - e. Plenum Rated, Conductive: Type OFCP or OFNP, complying with NFPA 262.

SECTION 271300 - COMMUNICATIONS BACKBONE CABLING: continued

- f. Riser Rated, Conductive: Type OFCR; or OFNR, OFCP, or OFNP, complying with UL 1666.
 - 6. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1,300 nm.
 - 7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1,300 nm.
 - B. Jacket:
 - 1. Jacket Color: See drawings for jacket color codes.
 - 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
 - 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.
- 2.06 OPTICAL FIBER CABLE HARDWARE:
- A. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
 - B. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.
 - C. Cable Connecting Hardware:
 - 1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with EIA-568-C.3.
 - 2. Quick-connect, simplex and duplex, Type Duplex LC connectors. Insertion loss not more than 0.75 dB.
 - 3. Type SFF connectors may be used in termination racks, panels, and equipment packages.
- 2.07 GROUNDING:
- A. Comply with requirements in DIVISION 26, Section "Grounding" for grounding conductors and connectors.
 - B. Comply with ANSI-J-STD-607-A.
- 2.08 IDENTIFICATION PRODUCTS:
- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- 2.09 SOURCE QUALITY CONTROL:
- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
 - B. Factory test cables on reels according to EIA-568-C.1.
 - C. Factory test UTP cables according to EIA-568-C.2.
 - D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and EIA-568-C.3.
 - E. Cable will be considered defective if it does not pass tests and inspections.
 - F. Prepare test and inspection reports.
 - G. Defective cables shall be removed and disposed of off the project site.

PART 3 - EXECUTION

- 3.01 ENTRANCE FACILITIES:
- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.
- 3.02 WIRING METHODS:
- A. Wiring Method: Install cables in raceways and cable trays except as noted. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.

SECTION 271300 - COMMUNICATIONS BACKBONE CABLING: continued

2. Comply with requirements for raceways and boxes specified in DIVISION 26, Section "Raceways" and "Electrical Boxes and Fittings."
 - B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
 - C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- 3.03 INSTALLATION OF PATHWAYS:
- A. Cable Trays: Comply with NEMA VE 2 and EIA-569-B.
 - B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in DIVISION 27, Section "Communications Equipment Room Fittings". Drawings indicate general arrangement of pathways and fittings.
 - C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
 - D. Comply with requirements in DIVISION 26, Section "Raceways" for installation of conduits and wireways.
 - E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
 - F. Pathway Installation in Communications Equipment Rooms:
 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 2. Install cable trays to route cables if conduits cannot be located in these positions.
 3. Secure conduits to backboard when entering room from overhead.
 4. Extend conduits 3 inches above finished floor.
 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
 6. Conduit sweeps and long-radius elbows shall meet minimum bending radius requirements for the intended cables.
 - G. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.
- 3.04 INSTALLATION OF CABLES:
- A. Comply with NECA 1.
 - B. General Requirements for Cabling:
 1. Comply with EIA-568-C.1.
 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 3. Install 110-style IDC termination hardware unless otherwise indicated.
 4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.

SECTION 271300 - COMMUNICATIONS BACKBONE CABLING: continued

8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 10. In the communications equipment room, install a 10-foot long service loop on each end of cable.
 11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
1. Comply with TIA/EIA-568-C.2.
 2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
- D. Optical Fiber Cable Installation:
1. Comply with TIA/EIA-568-C.3.
 2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- E. Installation of Cable Routed Exposed under Raised Floors:
1. Install plenum-rated cable only.
 2. Install cabling after the flooring system has been installed in raised floor areas.
 3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.
- F. Outdoor Coaxial Cable Installation:
1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
 2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches.
- G. Group connecting hardware for cables into separate logical fields.
- H. Separation from EMI Sources:
1. Comply with BICSI TDMM and EIA-569-B recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

SECTION 271300 - COMMUNICATIONS BACKBONE CABLING: continued

3.05 FIRESTOPPING:

- A. Comply with requirements in DIVISION 07, Section "Through Penetration Firestop Systems."
- B. Comply with EIA-569-B, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.06 GROUNDING:

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a grounding electrode conductor from grounding bus bar to suitable electrical building ground. See drawings for conductor sizes
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.07 IDENTIFICATION:

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in DIVISION 26, Section "Electrical Identification."
- B. Comply with requirements in DIVISION 09, Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A.
- D. Comply with requirements in DIVISION 27, Section "Communications Horizontal Cabling" for cable and asset management software.
- E. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- G. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
 - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware.

SECTION 271300 - COMMUNICATIONS BACKBONE CABLING: continued

Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

- H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:
 - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.08 FIELD QUALITY CONTROL:

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with EIA-568-C.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - 4. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - (1) Horizontal and multimode backbone link measurements: Test at 850 or 1,300 nm in one direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
 - (2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-C.1.
- D. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- E. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- F. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- G. Defective cables shall be removed from project and disposed of offsite.
- H. Prepare test and inspection reports.

END OF SECTION 271300

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section Includes:
 - 1. UTP cabling.
 - 2. 50/125-micrometer, multi-mode optical fiber cabling.
 - 3. 8/125-micrometer single-mode optical fiber cabling.
 - 4. Coaxial cable.
 - 5. Multiuser telecommunications outlet assemblies.
 - 6. Cable connecting hardware, patch panels, and cross-connects.
 - 7. Telecommunications outlet/connectors.
 - 8. Cabling system identification products.
 - 9. Cable management system.
- B. Related Sections:
 - 1. DIVISION 27, Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.

1.03 DEFINITIONS:

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel.
- D. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- E. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- F. EMI: Electromagnetic interference.
- G. IDC: Insulation displacement connector.
- H. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- I. LAN: Local area network.
- J. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
- K. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- L. RCDD: Registered Communications Distribution Designer.
- M. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom without ventilation openings.
- N. Trough or Ventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom having openings for the passage of air.
- O. UTP: Unshielded twisted pair.

1.04 HORIZONTAL CABLING DESCRIPTION:

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING: continued

the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.

1. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
 2. Bridged taps and splices shall not be installed in the horizontal cabling.
 3. Splitters shall not be installed as part of the optical fiber cabling.
- B. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet in the horizontal cross-connect.

1.05 PERFORMANCE REQUIREMENTS:

- A. General Performance: Horizontal cabling system shall comply with transmission standards in EIA-568-C.1, when tested according to test procedures of this standard.

1.06 ACTION SUBMITTALS:

- A. Product Data: For each type of product indicated.
1. For each cable type, include the following installation data for each type used:
 - a. Nominal OD.
 - b. Minimum bending radius.
 - c. Maximum pulling tension.
- B. Shop Drawings:
1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Contracting Officer.
 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 3. Cabling administration drawings and printouts.
 4. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.
 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
 6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to side of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
- C. Samples: For workstation outlets, jacks, jack assemblies, in specified finish, one for each size and outlet configuration.

1.07 INFORMATIONAL SUBMITTALS:

- A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING: continued

1.08 CLOSEOUT SUBMITTALS:

- A. Maintenance Data: For splices and connectors to include in maintenance manuals.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.
- C. As-builts.
- D. Copy of Test Reports.

1.09 QUALITY ASSURANCE:

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician or a Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
 - 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: An NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Telecommunications Pathways and Spaces: Comply with EIA-569-B.
- E. Grounding: Comply with ANSI-J-STD-607-A.

1.10 DELIVERY, STORAGE, AND HANDLING:

- A. Test cables upon receipt at Project site.
 - 1. Test optical fiber cables to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.
 - 2. Test optical fiber cables while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; including the loss value of each. Retain test data and include the record in maintenance data.
 - 3. Test each pair of UTP cable for open and short circuits.
 - 4. Cables that fail shall be rejected and removed from the project site.

1.11 PROJECT CONDITIONS:

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.12 COORDINATION:

- A. Coordinate layout and installation of telecommunications pathways and cabling with Contracting Officer's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING: continued

PART 2 - PRODUCTS

2.01 PATHWAYS:

- A. General Requirements: Comply with EIA-569-B.
- B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 2. Lacing bars, spools, J-hooks, and D-rings.
 - 3. Straps and other devices.
- C. Cable Trays: Comply with requirements in SECTION 260536 - CABLE TRAY and SECTION 260537 - UNDER FLOOR WIRE BASKET SUPPORT SYSTEM.
- D. Conduit and Boxes: Comply with requirements Comply with requirements in SECTION 260533 - RACEWAYS.
 - 1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2.02 BACKBOARDS:

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements in DIVISION 06, Section "Rough Carpentry" for plywood backing panels.

2.03 UTP CABLE:

- A. Description: 100-ohm, 4-pair UTP, binder groups covered with a green thermoplastic jacket.
 - 1. Comply with ICEA S-90-661 for mechanical properties.
 - 2. Comply with EIA-568-C.1 for performance specifications.
 - 3. Comply with EIA-568-C.2, Category 6.
 - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, General Purpose: Type CM or CMG.
 - b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
 - c. Communications, Riser Rated: Type CMR; or CMP, complying with UL 1666.
 - d. Communications, Limited Purpose: Type CMX; or CMP, CMR.

2.04 UTP CABLE HARDWARE:

- A. General Requirements for Cable Connecting Hardware: Comply with EIA-568-C.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- B. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25% spare. Integral with connector bodies, including plugs and jacks where indicated.
- C. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - 1. Number of Jacks per Field: One for each four-pair UTP cable indicated.
- D. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals. See Drawings for color code.
- E. Patch Cords: Factory-made, four-pair cables in 48-inch lengths; terminated with eight-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
 - 2. Patch cords shall have color-coded boots for circuit identification.
 - 3. Color shall match jack colors.

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING: continued

2.05 OPTICAL FIBER CABLE:

- A. Description: Single-mode, 8/125-micrometer, 1,310 nm Multimode, 50/125-micrometer tight buffer, optical fiber cable.
 - 1. Comply with ICEA S-83-596 for mechanical properties.
 - 2. Comply with EIA-568-C.3 for performance specifications.
 - 3. Comply with TIA/EIA-492AAAA-B for detailed specifications.
 - 4. Comply with TIA/EIA-492CAAA for detailed specifications for single-mode.
 - 5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. General Purpose, Nonconductive: Type OFN or OFNG.
 - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - c. Riser Rated, Nonconductive: Type OFNR or OFNP, complying with UL 1666.
 - d. General Purpose, Conductive: Type OFC or OFCG; or OFNG, OFN, OFCR, OFNR, OFCP, or OFNP.
 - e. Plenum Rated, Conductive: Type OFCP or OFNP, complying with NFPA 262.
 - f. Riser Rated, Conductive: Type OFCR; or OFNR, OFCP, or OFNP, complying with UL 1666.
 - 6. Conductive cable shall be steel armored type.
 - 7. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1,300 nm.
 - 8. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1,300 nm.
- B. Jacket:
 - 1. Jacket Color: See Drawings for color scheme; shall match jack colors.
 - 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
 - 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.06 OPTICAL FIBER CABLE HARDWARE:

- A. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
- B. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.
- C. Cable Connecting Hardware:
 - 1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with EIA-568-C.3.
 - 2. Quick-connect, simplex and duplex, Type Duplex LC connectors. Insertion loss not more than 0.75 dB.
 - 3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.07 COAXIAL CABLE:

- A. Cable Characteristics: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.
- B. RG59/U: NFPA 70, Type CATVR.
 - 1. No. 20 AWG, solid, silver-plated, copper-covered steel conductor.
 - 2. Gas-injected, foam-PE insulation.
 - 3. Triple shielded with 100% aluminum polyester tape and 95% aluminum braid; covered by aluminum foil with grounding strip.
 - 4. Color-coded PVC jacket.
- C. RG-6/U: NFPA 70, Type CATVP.
 - 1. No. 16 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING: continued

2. Double shielded with 100% aluminum-foil shield and 60% aluminum braid.
 3. Plenum Rated.
 4. Suitable for indoor installations.
- D. RG59/U (Plenum Rated): NFPA 70, Type CMP.
1. No. 20 AWG, solid, copper-covered steel conductor; foam fluorinated ethylene propylene insulation.
 2. Double shielded with 100% aluminum-foil shield and 65% aluminum braid.
 3. Copolymer jacket.
- E. NFPA and UL compliance listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655 and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:
1. CATV Cable: Type CATV or CATVP.
 2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
 3. CATV Riser Rated: Type CATVR; or CATVP, complying with UL 1666.
- F. Cable shall be black.
- 2.08 COAXIAL CABLE HARDWARE:
- A. Coaxial-Cable Connectors: Type BNC, 75 ohms.
- 2.09 TELECOMMUNICATIONS OUTLET/CONNECTORS:
- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with EIA-568-C.1.
- B. Workstation Outlets:
1. Plastic Faceplate: High-impact plastic. Coordinate color with DIVISION 26, Section "Wiring Devices."
 2. Metal Faceplate: Stainless steel complying with requirements in DIVISION 26, Section "Wiring Devices."
 3. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
 - a. Flush mounting jacks, positioning the cord at a 45-degree angle.
 4. Legend: Factory labeled by silk-screening or engraving for stainless steel faceplates.
 5. Legend: Machine printed, in the field, using adhesive-tape label.
 6. Legend: Snap-in, clear-label covers and machine-printed paper inserts.
- 2.10 GROUNDING:
- A. Comply with requirements in DIVISION 26, Section "Grounding" for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.
- 2.11 IDENTIFICATION PRODUCTS:
- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in DIVISION 26, Section "Electrical Identification."
- 2.12 SOURCE QUALITY CONTROL:
- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to EIA-568-C.1.
- C. Factory test UTP cables according to EIA-568-C.2.
- D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and EIA-568-C.3.

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING: continued

- E. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- F. Cable will be considered defective if it does not pass tests and inspections.
- G. Defective cable shall be removed and disposed of offsite.
- H. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 ENTRANCE FACILITIES:

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.02 WIRING METHODS:

- A. Wiring Method: Install cables in raceways and cable trays except within consoles and cabinets. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in DIVISION 26, Section "Raceways" and requirements of DIVISION 27.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.03 INSTALLATION OF PATHWAYS:

- A. Cable Trays: Comply with NEMA VE 2 and EIA-569-B-7.
- B. Comply with EIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.
- C. Comply with requirements in DIVISION 26, Section "Raceways" for installation of conduits and wireways.
- D. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- E. Pathway Installation in Communications Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard when entering room from overhead.
 - 4. Extend conduits 3 inches above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
 - 6. Conduit sweeps and long-radius elbows shall meet minimum bending radius requirement for the intended cables.
- F. Backboards: Install backboards with 96 inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.04 INSTALLATION OF CABLES:

- A. Comply with NECA 1.

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING: continued

- B. General Requirements for Cabling:
 - 1. Comply with EIA-568-C.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 - 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 9. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
 - 10. In the communications equipment room, install a 10-foot long service loop on each end of cable.
 - 11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
 - 1. Comply with EIA-568-C.2.
 - 2. Cable shall be installed in conduit or cable tray.
 - 3. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
- D. Optical Fiber Cable Installation:
 - 1. Comply with EIA-568-C.3.
 - 2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- E. Open-Cable Installation:
 - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 - 2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- F. Installation of Cable Routed Exposed under Raised Floors:
 - 1. Install plenum-rated cable only.
 - 2. Install cabling after the flooring system has been installed in raised floor areas.
 - 3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.
- G. Outdoor Coaxial Cable Installation:
 - 1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
 - 2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches.
- H. Group connecting hardware for cables into separate logical fields.
- I. Separation from EMI Sources:
 - 1. Comply with BICSI TDMM and EIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING: continued

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.
- 3.05 FIRESTOPPING:
- A. Comply with requirements in DIVISION 07, Section "Through Penetration Firestop Systems."
 - B. Comply with EIA-569-B, Annex A, "Firestopping."
 - C. Comply with BICSI TDMM, "Firestopping Systems" Article.
- 3.06 GROUNDING:
- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
 - B. Comply with ANSI-J-STD-607-A.
 - C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a grounding electrode conductor from grounding bus bar to suitable electrical building ground. See Drawings for conductor sizes.
 - D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
- 3.07 IDENTIFICATION:
- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in DIVISION 26, Section "Electrical Identification".
 - B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
 - C. Comply with requirements in DIVISION 09, Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
 - D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A.

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING: continued

- E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all Drawings, in software and format selected by Contracting Officer.
- G. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
 - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware.
 - 6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.
- H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
 - 1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.08 FIELD QUALITY CONTROL:

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with EIA-568-C.1.
 - 2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
 - 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in EIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING: continued

Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

5. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in EIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - (1) Horizontal and multimode backbone link measurements: Test at 850 or 1,300 nm in one direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
 - (2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in EIA-568-C.1.
6. UTP Performance Tests:
 - a. Test for each outlet and MUTOA. Perform the following tests according to EIA-568-C.1 and EIA-568-C.2:
 - (1) Wire map.
 - (2) Length (physical vs. electrical, and length requirements).
 - (3) Insertion loss.
 - (4) Near-end crosstalk (NEXT) loss.
 - (5) Power sum near-end crosstalk (PSNEXT) loss.
 - (6) Equal-level far-end crosstalk (ELFEXT).
 - (7) Power sum equal-level far-end crosstalk (PSELFEXT).
 - (8) Return loss.
 - (9) Propagation delay.
 - (10) Delay skew.
7. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to EIA-568-C.1 and EIA-568-C.3.
8. Final Verification Tests: Perform verification tests for UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.
 - a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
 - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Defective cables shall be replaced to the satisfaction of contracting officer.
- G. Prepare test and inspection reports.

END OF SECTION 271500

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

SECTION 283100 - FIRE ALARM SYSTEMS/ MASS NOTIFICATION SYSTEM

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section specifies fire alarm systems to be designed and installed by the Contractor. The alarms shall be transmitted over a Monaco M2 radio transceiver.
- B. Types of fire alarm systems specified in this Section include the following NFPA 72 types:
 - 1. Local Protective Signaling Systems.
 - a. Addressable Fire Alarm Control Panel (FACP)/Mass Notification System (MNS).
 - b. Non-addressable Fire System Control Panel (FSCP).
- C. Provide system suitable for type occupancy as defined by USNGB TAB D and as approved by local Fire Marshall.

1.02 RELATED WORK SPECIFIED ELSEWHERE:

- A. DIVISION 21 - Sprinkler Systems.
- B. SECTION 260526 - GROUNDING.

1.03 REFERENCES:

- A. Applicable Standards: Comply with applicable requirements of the following standards.
 - 1. Americans with Disabilities Act (ADA).
 - 2. Factory Mutual (FM) Global: Provide fire alarm systems and accessories which are FM Global-approved.
 - 3. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code (NEC).
 - b. 13 - Installation of Sprinkler Systems.
 - c. 20 - Centrifugal Fire Pumps.
 - d. 72 - National Fire Alarm Code.
 - e. 75 - Standard for Protection of Electronic Computer/Data Processing Equipment.
 - f. 90A - Air Conditioning and Ventilating Systems.
 - g. 92A - Smoke Control Systems.
 - h. 101 - Life Safety Code.
 - i. 1221 - Public Fire System Communication System.
 - 4. Underwriters Laboratories (UL): Comply with provisions of UL safety standards pertaining to fire alarm systems; provide products and components which are UL-listed and labeled.
 - a. 268 - Smoke Detectors for Fire Protective Signaling Systems.
 - b. 268A - Smoke Detectors for Duct Application.
 - c. 521 - Heat Detectors for Fire Protective Signaling Systems.
 - d. 864 - Control Units for Fire Protective Signaling Systems.
 - e. 1480 - Speakers for Fire Protective Signaling Systems.
 - f. 1711 - Amplifiers for Fire Protective Signaling Systems.
 - g. 1971 - Standard for Signaling Devices for the Hearing Impaired.
- B. Unified Facility Criteria (UFC):
 - 1. UFC 4-021-01 Design and O&M: Mass Notification Systems.
 - 2. UFC 3-600-01 Fire Protection Engineering for Facilities.

SECTION 283100 - FIRE ALARM SYSTEMS/ MASS NOTIFICATION SYSTEM: continued

1.04 SUBMITTALS:

- A. Refer to DIVISION 01 and SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS, for administrative and procedural requirements for submittals.
- B. All submittals shall also be sent to the local Fire Marshall or "authority having jurisdiction" for approval. Each submittal shall be a complete submittal including shop drawings, annotated data sheets and calculating partial submittals will not be accepted.
- C. Includes, but not limited to, the following:
 - 1. Product Data: Submit manufacturer's technical product data, including specifications and installation instructions, for each type of fire alarm system component. Submit device power requirements: maximum voltage, nominal voltage, minimum voltage, amperes and watts for each device requiring power. Submit battery calculations. Submit battery charger calculations. Include standard or typical riser and wiring diagrams, and operation and maintenance instructions for inclusion in maintenance manuals.
 - 2. The use of SFPE Handbook or NFPA 72 Handbook to confirm acoustical requirements where a sounder/speaker is outside its listed spacing shall be acceptable.
 - 3. Shop Drawings: Provide shop drawings showing equipment/device locations, conduit sizes, logic diagrams, and point-to-point field wiring diagrams of entire fire alarm system. Include wiring and riser diagrams. Licensed fire protection engineer shall seal and sign the fire alarm shop drawings.
 - 4. Operation and Maintenance Manual: Submit maintenance data and parts lists for each type of fire alarm equipment installed, including furnished specialties and accessories. Include product data and shop drawings in accordance with requirements of DIVISION 01. Submit when construction is 75% complete. Three copies of final manuals are required. Manuals will be required to include but not limited to:
 - a. Full instructions on servicing and maintenance requirements.
 - b. Operating instructions including start up, emergency shut down and start up, seasonal servicing and start up, etc.
 - c. Contracting Officer's manuals for each item of equipment.
 - d. All equipment wiring diagrams.
 - e. All piping and wiring systems diagrams and operational diagrams.
 - f. Full parts lists and exploded schematic diagrams.
 - g. Full warranty information.
 - h. All available manufacturer installation and O&M manuals.
 - i. Full names, address, phone numbers, suppliers, service companies, contact numbers and other points of contact/information relative to this job.
 - 5. Certification of proper system operation, including all existing and new devices.
 - 6. The contractor shall submit all field test data per NFPA 72, including "NFPA 72 Inspectors and Testing Forms." These reports shall be submitted a minimum of 30 days prior to scheduling of Final ANG acceptance Inspections/Testing and Commissioning. These documents shall be provided as a submittal for review and approval prior to scheduling acceptance inspection and testing. Final inspection will be scheduled upon approval of the submission documents.
 - 7. Commissioning checklists.
 - 8. Posted operation instructions shall be framed under glass and shall include floor plans showing all fire alarm device locations, fire alarm wiring diagrams, and fire alarm schematic diagrams. Posted instructions shall be professionally prepared graphics, printed on full size sheets and shall be in color.
 - 9. As Built drawings.

SECTION 283100 - FIRE ALARM SYSTEMS/ MASS NOTIFICATION SYSTEM: continued

- D. Shop drawing shall be prepared and signed by a Fire Protection Engineer meeting the following qualifications:
1. Bachelor of Science or Master of Science degree in fire protection engineering from an accredited university, plus a minimum of 5 years' work experience in fire protection engineering.
 2. Professional Engineer (PE) registration by examination, National Council of Examiners for Engineering and Surveys (NCEE) fire protection engineering written examination.
 3. Qualification as a GS/GM 804-series FPE.
 4. PE registration in a related discipline with a minimum of 5 years' work experience in fire protection engineering.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Handle fire alarm equipment carefully to prevent damage, breaking, and scoring. Do not install damaged equipment or components; replace with new. Fire alarm cabling that has been walked on shall not be installed.
- B. Store fire alarm equipment in a clean, dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

PART 2 - PRODUCTS

2.01 ELECTRONIC EQUIPMENT COMPLIANCE:

- A. Contractor warrants that all equipment, devices, items, systems, software, hardware, and firmware provided shall properly, appropriately, and consistently function and accurately process date and time data (including without limitation: calculating, comparing, and sequencing). This warranty supersedes anything in the Specifications or other Contract Documents which might be construed inconsistently. This warranty is applicable whether the equipment, device, item, system, software, hardware, or firmware is specified with or without reference to a manufacturer's name, make, or model number.

2.02 FIRE ALARM DETECTION SYSTEMS AND MASS NOTIFICATION SYSTEMS:

- A. General: Fire Alarm Control Panel (FACP) shall comply with USNGB TAB D. Provide complete fire alarm system products of types, sizes, and capacities indicated, which comply with manufacturer's standard design, materials and components; constructed in accordance with published product information and as required for complete installation. Provide fire alarm and detection systems for applications indicated. All components shall be UL and FM listed. Provide nameplate in accordance with NEC 409.110 where the minimum short-circuit rating (SCCR) shall be as indicated on the drawings.
- B. MASS Notification System shall meet the requirements of UFC 4-021-01. MNS shall be installed per NFPA 72 as a Class A system. The sound power levels shall be in accordance with NFPA 72 and the system shall have an intelligibility of 0.8.
- C. Combination, Zoned, Noncoded: Either manual activation of fire alarm pull station or activation of automatic initiating device will energize fire alarm signaling devices, sound noncoded alarm, and provide zone identification on annunciator panel.
1. Provide pulse audible signals at march-time beat of approximately 120 pulses per minute.
- D. System Wiring and Supervision:
1. Provide Class A, initiating circuits with electrical supervision for shorts and open conditions. Provide Class A, Signaling Line Circuit and Notification Appliance Circuits with electrical supervision for shorts and open conditions. Install circuit "end-of-line" diodes and resistors in fire alarm control cabinet. All fire alarm wiring shall be routed in

SECTION 283100 - FIRE ALARM SYSTEMS/ MASS NOTIFICATION SYSTEM: continued

- dedicated 3/4-inch (minimum) size conduit. IDC, SLC and NAC circuits shall be installed in separate conduit.
2. Power Supplies: Provide system for operation on 120Vac power supply.
 3. Provide battery back-up as secondary power supply. Provide back-up battery and battery charger each with 20% spare capacity for future use. Design battery back-up to take over supply to system instantaneously. Provide battery with adequate capacity to be capable of operation of system for 60 hours under normal supervisory (non-alarm) conditions and then for 15 minutes under alarm conditions. Battery charger shall completely recharge batteries within 48 hours. Batteries shall be sealed gel-cell maintenance free type.
- E. Wiring System Materials: Provide basic wiring materials which comply with SECTION 260533 - RACEWAYS, SECTION 260534 - ELECTRICAL BOXES AND FITTINGS, and SECTION 260516 - WIRE AND CABLES.
1. Provide wire and cable in accordance with requirements of manufacturer, except as noted.
 2. Conductor sizes shall be AWG No. 14 or larger 600V, Type THHN or TFFN, with maximum 19 strands copper conductor, 7 strands for sizes AWG No. 16 and No. 18.
 3. Provide conductors with crimp on terminal ends.
 4. Provide conductors which are listed and approved for fire alarm usage.
 5. Do not provide multi-conductor fire alarm cables.
 6. Provide labeling on all termination points.
 7. Provide separate conduits for supply and return loops per NFPA 72 Class A System.
 8. Provide labeling at all termination, junction and pull boxes. Labeling shall be engraved, plastic labels that identify the zone and circuit contained.
- F. Fire Alarm Control Panels (FACP): Provide fire alarm control panel enclosures for housing devices and circuits necessary to perform required functions to service test points and to service trouble-signal points. Control panel shall comply with UL 864. Cabinet shall be lockable steel cabinet. Provide 10 keys to Contracting Officer.
1. FACP shall be addressable.
 2. Provide control panel for operation on 120Vac supply and for 24Vac system operation with integral battery standby power source.
 3. Equip control panel for number of initiating zones indicated plus 10% (but not less than six spare modules).
 4. Provide TVSS protection of 120Vac power supply at the fire alarm control panel in a separate, adjacent enclosure.
- G. The Mass Notification functions shall override the FACP Notification functions. The system shall have the capability of utilizing a remote microphone station with redundant controls of the notification system control panel. Class "A" Notification Appliance Circuits (NAC) shall be provided for the activation of strobe and speakers appliances. The activation of the NAC Circuits shall follow the operation of the speaker NAC circuits. Audio output shall be selectable for line level (600 ohms), 25, 70.7 or 100V output. The audio amplifier outputs shall be not greater than 100 watts RMS output. Amp shall have 50% spare capacity. The strobe NAC Circuits shall provide at least 2 amps of 24Vdc power to operate strobes and have the ability to synchronize all strobes. A hand held microphone shall be provided and, upon activation, shall take priority over any tone signal, recorded message operation in progress, while maintaining the strobe NAC Circuits activation.
1. All outputs and operational modules shall be fully supervised with on-board diagnostics and trouble reporting circuits. Form "C" contacts shall be provided for system alarm and trouble conditions. Circuits shall be provided for operation of auxiliary appliance during trouble conditions. During a Mass Notification event the panel shall not generate nor

SECTION 283100 - FIRE ALARM SYSTEMS/ MASS NOTIFICATION SYSTEM: continued

cause any trouble alarms to be generated with the Fire Alarm system. The Control Panel for the Voice Notification System shall be independent of the Fire Alarm System and shall be capable of autonomous operation. The system shall be housed in a separate panel that contains an independent power supply and batteries, as specified above or same panel with the Fire Alarm System. Mass Notification functions shall take precedence over all other functions performed by the Voice Notification System. Messages shall utilize a male voice and shall be similar to the following: Final messages shall be coordinated with authority having jurisdiction.

- a. 1,000 Hz tones (1 second on, 1/2 second off, 1 second on, 1/2 second off, 1 second on).
 - (1) "May I have your attention, please? May I have your attention, please? A fire emergency has been reported in the building. Please leave the building by the nearest exit or exit stairway. Do not use the elevators." (Provide a 2 second pause.) "May I have your attention, please (repeat the message)."
 - b. 1,000 Hz tones (1 second on, 1/2 second off, 1 second on, 1/2 second off, 1 second on).
 - (1) "Alert! This is the Mass Notification System. There is an emergency situation. DO NOT evacuate the building! Stay in your current location! Stay tuned for further instructions." (Repeat message 2 times.)
 - c. 1,000 Hz tones (1 second on, 1/2 second off, 1 second on, 1/2 second off, 1 second on).
 - (1) "Alert! This is the Mass Notification System. There is a chemical gas emergency. Turn off all HVAC equipment, seal all doors and windows with wet fabric, Don protective gear. DO NOT evacuate the building, Act now! Listen to the MNS system for further instructions." (Repeat message 2 times.)
 - d. 1,000 Hz tones (1 second on, 1/2 second off, 1 second on, 1/2 second off, 1 second on).
 - (1) "Alert! This is the Mass Notification System. There is an explosive blast risk along the South wall of your building. Quietly move towards the North side of the building and exit the North stairs. Move away from the building heading north to the North parking area." (Repeat message 2 times.)
- H. All alarm initiating devices shall be assigned a unique address which is not assigned by their position in the circuit. The system shall allow the future addition of additional addressable initiating devices into any point in the circuit. Addressable initiating devices shall prohibit the insertion of nonaddressable devices. If zone address modules are required remote from the fire alarm control panel and are not an integral part of the initiating device, they shall be housed in NEMA 12 enclosures if located in dry areas indoors. Zone address module enclosures shall not be mounted in damp locations, wet locations, or outdoors.
- I. Manual Fire Alarm Pull Stations: Provide manufacturer's standard construction, red enclosure, manual fire alarm pull station with the following features.
1. Surface mounted in unfinished areas and outdoors. Outdoor units and units located in the aircraft hangar bay and other wet indoor locations shall be weatherproof.
 2. Semi-flush mounted in finished areas.
 3. Nonaddressable.
 4. Nonbreakglass operation.
 5. General alarm.
 6. Annunciator contacts; (NO).
 7. Double action.

SECTION 283100 - FIRE ALARM SYSTEMS/ MASS NOTIFICATION SYSTEM: continued

- J. Fire Alarm Devices: Provide manufacturer's standard construction of the following types and characteristics.
1. Nonaddressable Automatic Heat Detectors shall comply with UL 521:
 - a. Rate-compensated, 24Vdc, 160°F, spot type, restorable, Fenwal #27121-0-160, or approved equal. Provide one terminal strip in each heat detector back box to join the heat detector pig-tails and the field wiring. Do not terminate the two conductors (from the other cross zone) that compass directly through the back box to next conductor. For use in hangar.
 2. Nonaddressable Automatic Smoke (Combustion Products) Detectors: Provide manufacturer's standard construction automatic smoke detectors of the following types.
 - a. Photoelectronic smoke detector, 24Vdc, spot types, with pulsed infrared LED light source for operation on voltage indicated. Design detector for mounting on interchangeable type base. Nominal sensitivity shall be 2.5%-3.5% per foot obscuration when tested per UL 268. Provide self-restoring smoke detector which does not require resetting. Provide flashing LED indicator for normal operation which changes to steady on alarm condition. Detector shall comply with UL 268. Provide where indicated.
 - b. In-duct photoelectronic type, 24Vdc, with integral and remote test-reset-off keyed switch and remote LED alarm light. Provide sampling tubes of design and dimension as recommended by the manufacturer for the specific duct size where it is applied. Detector shall comply with UL 268A. Provide adjacent "Test-Off-Reset" keyed switch mounted 84 inches above the finished floor.
 3. Flow Switch: Nonaddressable vane type water flow switches tested at 300 pounds per square inch that shall activate on a flow of 10 gallons per minute (minimum) rated 24Vdc.
 4. Pressure Switch: Nonaddressable pressure type water flow switch, rated 24Vdc.
 5. Tamper Switch: Nonaddressable valve supervisory switches shall be mounted to signal trouble between the first and second revolution of the valve wheel, removal of the switch, or opening the cover of the switch.
 6. Audible and Visual Alarms:
 - a. Horns: Provide manufacturer's standard construction, 24Vdc, fire alarm horn with the following features. Horn shall not exceed 110 dBA at 10 feet.
 - (1) One-Tone: Three-pulse temporal pattern coded signal with general alarm (steady horn tone that matches existing base standard).
 - (2) Surface mounted (with grille) in unfinished areas and outdoors.
 - (3) Semi-flush mounted at dry indoor locations.
 - (4) Single projection, unless indicated otherwise.
 - b. Speakers shall conform to the applicable requirements of UL 1480. Speakers shall have six different sound output levels and operate with audio line input levels of 100Vac, 70Vac, 7Vac, and 25Vac, by means of selectable tap settings. Tap settings shall include taps of 1/4, 1/2, 1, 2, and 8 watts. Speakers shall incorporate a high efficiency speaker for maximum output at minimum power across a frequency range of 400 to 4,000 Hz, and shall have a sealed back construction. Speakers shall be capable of installation on standard 4 inch square electrical boxes. All polarity supervision of circuit wiring via the Fire Alarm Control Panel and the Mass Notification Control Panel.
 7. Visual Alarm Synchronized Strobes.
 - a. Clear or white lens, lettered red "FIRE" in 1-inch high letters, for Fire Alarm and AMBER lens, lettered red "ALERT" for Mass Notification.

SECTION 283100 - FIRE ALARM SYSTEMS/ MASS NOTIFICATION SYSTEM: continued

- b. One 24Vdc Xenon strobe lamp (synchronized with other "same color" strobes).
- c. Flash shall be a rate of 1-2 flashes per second with a duration of 0.2 seconds and maximum duty cycle of 40%.
- 8. Terminal Boxes and Floor Terminal Panels: Provide fire alarm junction boxes and floor terminal panels that are painted with red enamel. Provide each box with suitable number of terminals and of proper size to hold wiring both for immediate floor and floors above.
- 9. Test Chart Instructions: Provide fire alarm system test instructions chart mounted in Lexan enclosed frame assembly on control cabinet hinged door.
- 10. Remote Annunciator: Provide one of the manufacturer's standard construction remote annunciators that indicate the type of alarm (manual pull station, heat detector, smoke detector, water flow, valve tamper and trouble) and of the following type.
 - a. A back-lighted alpha-numeric display with liquid crystal display. The display shall be provided a minimum 160 characters. The annunciator shall store up to 352 messages.
- K. Monaco Radio Transmitter:
 - 1. Provide all required programming for the fire alarm to interface with the Monaco M2 radio transmitter and existing Post Monaco Radio System.
 - 2. Transmitter shall receive hard-wired alarm inputs from the fire alarm control panel.
 - 3. Provide transient voltage surge suppression for the antenna coaxial cable in a separate enclosure adjacent to the radio transmitter.
 - 4. Provide transient voltage surge suppression for the 120Vac power supply in a separate enclosure adjacent to the radio transmitter.
 - 5. Provide signal to Post Monaco receiving station as indicated on the fire alarm.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas and conditions under which fire alarm systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF BASIC IDENTIFICATION:

- A. Install electrical identification in accordance with SECTION 260553 - ELECTRICAL IDENTIFICATION.

3.03 INSTALLATION OF BASIC WIRING SYSTEM MATERIALS:

- A. Install wiring, raceways, and electrical boxes and fittings in accordance with SECTION 260533 - RACEWAYS, 260516 - WIRES AND CABLES, and 260534 - ELECTRICAL BOXES AND FITTINGS.
- B. Install all wiring in dedicated fire alarm conduit. Minimum conduit size shall be 3/4-inch. Provide separate conduit for IDC, SLC and NAC circuit.
- C. Install wires and cables without splices. Make connections and splices at terminal strips in terminal boxes, cabinets or at equipment terminals. Do not use wire nuts or butt-type crimp connections. Fire alarm devices provided with "pig-tail" wire connections (such as rate-compensated heat detectors) shall be provided with terminal strips in their back boxes for connection to fire alarm circuit wiring.
- D. Paint all pullboxes, junction boxes, terminal boxes, and conduit that contain fire alarm circuits RED and MNS circuits BLUE. Provide the word "FIRE" or "MNS" stenciled in white letters on all box covers. Provide engraved labels with each device designation, zone number, etc., that correlates with posted operating instructions.

SECTION 283100 - FIRE ALARM SYSTEMS/ MASS NOTIFICATION SYSTEM: continued

- E. Pigtail or "T" tap connections to alarm initiating devices, horns, and strobes are unacceptable.

3.04 INSTALLATION OF FIRE ALARM SYSTEMS:

- A. Install fire alarm system as indicated, in accordance with equipment manufacturer's written instructions and complying with applicable portions of NEC. All fire alarm wiring shall be in conduit. Install fire alarm manual pull stations 48 inches above finished floor. Install audible alarms not less than 90 inches above finished floor nor less than 6 inches below ceiling. Install visual alarm strobes 6 inches below the ceiling or 80 inches above finished floor, whichever is lower.
- B. Wiring: Wiring of fire alarm system is work of this Section but is not specifically detailed on drawings:
 - 1. Complete wiring in accordance with manufacturer's requirements. Color code wiring and install per manufacturer's point-to-point wiring diagram. Determine exact number of wires for each fire area zone from number and types of devices installed. Connect each device with sufficient wiring to complete its intended operation. Size all conduits per NEC. Minimum separation between outgoing and incoming fire alarm conduit is 1-foot vertical and 4-feet horizontal.
 - 2. Where there are a number of devices requiring power such as smoke detectors, fan relays, and smoke damper operators installed in a circuit, group in numbers so power required does not exceed 80% of manufacturer's power supply rating. Provide extra wiring and extra power supplies required to fulfill that requirement. In addition, provide extra or larger size wiring to alleviate voltage drops which would make devices operate below the voltage limits for which they are designed. Calculate voltage drops taking into account the maximum ambient temperatures anticipated before wire and equipment is installed.

3.05 FIELD QUALITY CONTROL:

- A. Connection and Supervision: Make connections to panel and perform all testing under the supervision of the manufacturer's authorized service representative.
- B. Where work consists of additions or extensions to existing system, prior to starting work, establish that the existing system is in proper working order. If conditions exist which prevent normal operation of specified additions and extensions, bring them up with the Contracting Officer prior to doing work affecting the existing system. Where work is done without such notification, it is assumed that connections have been made to a working system, and performance requirements will apply to entire system.
- C. System Test and Approval:
 - 1. Contractor shall submit appropriate NFPA 13 and NFPA 72 forms, a comprehensive "Test Plan," all field test reports, and a written request for the final acceptance testing.
 - 2. Provide the on-site services of the HEF and fire alarm control panel factory-authorized representatives for final system testing and acceptance.
 - 3. Provide any special tools or equipment necessary for maintenance, repair, inspection or programming of installed equipment.
 - 4. Commissioning requirements, checklists, tool, and parts requirements shall be comprehensive and shall be submitted for final acceptance.
 - 5. In presence of the Contractor, Fire Marshal (or Authority Having Jurisdiction), Contracting Officer's Representative, and Contracting Officer's representative, prior to final acceptance of system, the manufacturer's authorized representative shall test the system per NFPA 72 requirements. Test each manual, automatic, sensing, detecting, and alarm device. All resettable smoke detection devices shall be tested with "canned smoke." All water flow devices shall be tested with actual water flow. All resettable

SECTION 283100 - FIRE ALARM SYSTEMS/ MASS NOTIFICATION SYSTEM: continued

thermal sensors shall be tested with heat, and nonrenewable thermal sensors shall be tested by short-circuiting each end-of-line device's contacts. Test all Monaco radio, HVAC, door, exhaust fan, and annunciator interfaces for proper operation.

6. After being signed by the Contracting Officer's Representative, submit a copy of test results in duplicate to the Contracting Officer, Contracting Officer, and Local Fire Protection Authority. Mount copy of inspection record in Lexan enclosed frame adjacent to the control panel.
- D. Training: Manufacturer's authorized service representative shall provide 8 hours of on-site training of the Contracting Officer's personnel on procedures related to start-up, shutdown, operation, troubleshooting, servicing, adjusting and preventative maintenance for the system. Provide Contracting Officer with 10 days advance notice of training. Provide a professionally edited DVD for training on the fire alarm and HEF system.
- E. Spare Parts:
 1. General: Furnish Contracting Officer, with receipt, the following spare parts:
 - a. Provide 10% spare initiating device of each type used (not less than 1).
 - b. Provide one spare indicating device of each type used.
 - c. Provide three spare fuses of each rating used.
 - d. Provide 10% spare strobe lamps.
 - e. Provide 2% spare detector bases (not less than 1).
 - f. Provide 10% spare LEDs and indicating lights.
 - g. Provide one extra end of line resistor for each zone.

END OF SECTION 283100

DIVISION 31 - EARTHWORK

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Site Clearing shall consist of clearing of the site within the limits of construction to include the following:
 1. Removal and disposal of trees and brush, weeds, roots, and similar materials.
 2. Removal and disposal of civil structures, paving, base course, utilities, and all other obstructions which are designated on the Plans for removal during construction.
 3. Topsoil stripping and stockpiling.
 4. Saw-cutting existing concrete and paved surfaces.
 5. Protection of existing utilities and adjacent property, structures, benchmarks, and monuments.

1.02 STANDARDS:

- A. The quality and performance of work specified in this Section shall be in accordance with the Delaware Department of Transportation Standard Specifications for Road and Bridge Construction, dated August 2001 (hereinafter referred to as the "Standard Specifications").
 1. Section 201 - Clearing and Grubbing.
 2. Section 211 - Removal of Structures and Obstructions.
 3. Section 762 - Saw Cutting Portland Cement and Hot-Mix, Hot-Laid Bituminous Concrete.

1.03 PHASING:

- A. Clearing, grubbing, and removal shall be performed prior to the grading and stripping operations, within the limits of grading, as indicated on the drawings and as specified herein. Following clearing, topsoil shall be stripped and stored for later use on the site or disposition by the Owner.

1.04 PROTECTION:

- A. The Contractor shall protect all trees, shrubs, ground plants, roads, walks, pavements, structures, civil improvements, and appurtenances not indicated to be cleared from the site. Methods of protection shall be by use of substantial wood or chain link fences, barriers, or other methods, as approved by the Engineer. Any trees, shrubs, ground plants, roads, walks, pavements, structures, or appurtenances indicated to remain that become damaged during construction of the project shall be repaired or replaced by the Contractor, as directed by the Engineer, at no additional cost to the Owner.
- B. The Contractor shall contact all utility companies to mark the location of their facilities. The contractor shall protect all existing utilities in place and maintain continuous service to the Owner. Any damage to the utilities shall be corrected by the Contractor at his expense. The Contractor shall also be responsible for coordinating and/or relocating any utilities which must be relocated to accommodate the proposed construction.

PART 2 - PRODUCTS - NOT APPLICABLE.

SECTION 311000 SITE CLEARING: continued

PART 3 - EXECUTION

3.01 CLEARING AND GRUBBING:

- A. Clearing shall consist of the removal of all trees and shrubs, brush, down timber, rotten wood, heavy growth of grass and weeds, vines, rubbish, walks, roads, curbs, walls and foundations, existing utilities already abandoned, and all objectionable debris. All walls, foundations, slabs, pavements, curbs, and footings shall be removed to their full depth.
- B. Grubbing shall consist of the removal of stumps, roots, root mats, stubs, buried logs, and other debris within the project limits. The Contractor shall remove all stumps and root mats in their entirety and all buried logs and other debris from within building areas and from the limits of proposed drives and walks. Within proposed lawn areas, stumps, roots and debris shall be removed to a minimum depth of one foot below design rough grade.
- C. Construction methods shall be in accordance with Section 201 of the Standard Specifications.

3.02 DISPOSAL OF CLEARED MATERIALS:

- A. All timber and cleared materials shall become the property of the Contractor, and shall be disposed of lawfully by the Contractor. Burning of materials on site is prohibited.

3.03 SALVAGED MATERIALS:

- A. Materials listed to be salvaged for reuse shall be stored by the Contractor in such a manner to prevent damage to the material. Salvaged materials which are not reused shall be disposed of lawfully by the Contractor unless the Owner specifically requests to take possession of the material.

3.04 STRIPPING AND STORING TOPSOIL:

- A. Topsoil shall be considered to mean original surface soil, typical of the area, which is capable of supporting native plant growth.
- B. All topsoil suitable for reuse, in the opinion of the Engineer, shall be stripped to its full depth, and stockpiled.
- C. Topsoil stripping shall be accomplished from all topsoiled areas to be disturbed.
- D. Existing lawn sods may be left to decompose with the topsoil. Heavier strands of weeds and grasses shall be removed or turned over, as directed by the Engineer or Construction Manager, prior to the stripping operations.
- E. The topsoil shall be kept separate from the excavated material and stored in stockpiles, the location of which shall be as directed by the Engineer or Construction Manager. Topsoil shall be stockpiled so that it shall not be subject to abnormal erosion and loss, and it does not impede the flow of drainage runoff. Topsoil shall be stockpiled in the location shown on the Plans or as approved by the Engineer or Construction Manager.

3.05 REMOVAL OF STRUCTURES AND OBSTRUCTIONS:

- A. Removal of civil structures and obstruction shall be in accordance with Section 211 of the Standard Specifications.

3.06 SAW-CUTTING:

- A. Mechanically saw cut patch edges or tie-in joints into existing paving or sidewalk using a concrete cutting machine with a suitable motor-driven diamond blade and a circular cutter unless otherwise approved by the Engineer.

SECTION 311000 SITE CLEARING: continued

- B. Saw-cut grooves shall be straight lines to a sufficient depth so that an even, neat joint can be cut to allow removal of material without damage to the adjacent pavement, sidewalk, or curb. A continuous water supply shall be supplied to the cutting blade.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Provide labor, materials, and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Filling and backfilling to attain indicated grades.
 - 2. Excavation, rough and finish grading.
 - 3. Furnishing and installing graded aggregate base course material for pavements, hot-mix patches and other structures.
 - 4. Undercut excavation and furnishing graded aggregate base course for undercut excavation.
 - 5. Furnishing excavation support systems, as required, including shoring and bracing.
 - 6. Excavation for trenches.
 - 7. Preparing topsoil stripped from the site and placing topsoil in locations requiring seeding or sodding.
- B. Definitions:
 - 1. Excavation: Removal and disposal of all material encountered when establishing required grade elevations, including pavements and other obstructions visible on the ground surface, and underground structures and utilities indicated to be demolished and removed, and unsuitable subgrade material.
 - 2. Unauthorized excavation: Removal of materials beyond specified subgrade elevations without approval of Engineer.

1.02 QUALITY ASSURANCE:

- A. Requirements of Regulatory Agencies:
 - 1. All excavations shall be in compliance with Federal Occupational Safety and Health Act.
 - 2. Excavation work shall be in compliance with application requirements of other governing authorities having jurisdiction.
- B. Standards:
 - 1. The quality and performance of work specified in this Section shall be in accordance with the Delaware Department of Transportation Standard Specifications for Road and Bridge Construction, dated August 2001 (hereinafter referred to as the "Standard Specifications").
 - a. Section 202 - Excavation and Embankment.
 - b. Section 205 - Rock Excavation for Roadway.
 - c. Section 206 - Rock Excavation for Structures and Trenches.
 - d. Section 207 - Excavation and Backfill for Structures.
 - e. Section 208 - Excavation and Backfill for Pipe Trenches.
 - f. Section 209 - Borrow.
 - g. Section 210 - Furnishing Borrow for Pipe Trench, Utility Trench, and Structure Backfill.
 - h. Section 212 - Undercut Excavation.
 - i. Section 302 - Graded Aggregate Base Course.
 - j. Section 732 - Topsoil.
 - k. Section 733 - Topsoiling.
 - l. Section 813 - Grading Requirements Minimum and Maximum Percentages Passing.
 - m. Section 821 - Graded Aggregates.

SECTION 312000 - EARTH MOVING: continued

2. American Society for Testing and Materials (ASTM):
 - a. D1556 - Density of Soil in Place by the Sand-Cone Method.
 - b. D698 - Moisture Density Relations of Soils and Soil Aggregate Mixtures.
 - c. D2049 - Relative Density of Cohesionless Soils.
 - d. D2166 - Unconfined Compressive Strength of Cohesive Soil.
 - e. D2922 - Density of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth).
- 1.03 SUBMITTALS:
- A. Material certification and delivery slips for:
 1. Select Borrow.
 2. Graded Aggregate Base Course.
- 1.04 JOB CONDITIONS:
- A. Existing Utilities:
 1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult the Utility Owner immediately for directions. Cooperate with the Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of Utility Owner.
 2. Do not interrupt existing utilities serving facilities occupied and used by the Owner.
 3. Demolish and completely remove from the site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.
 - B. Use of Explosives: The use of explosives is not permitted unless approved by the Engineer.
 - C. Protection of Persons and Property:
 1. Barricade open excavations occurring as part of this work and post with warning signs as required to protect persons on the site.
 2. Protect trees, shrubs, lawns and other features remaining as part of final landscaping.
 3. Protect structures, utilities, sidewalks, pavements and other facilities from damage caused by settlement lateral movement undermining, washout and other hazards created by earthwork operations.
 4. In the event of damage, immediately make all repairs and replacements to the approval of the Engineer at no cost to the Owner.
 - D. Dust Control:
 1. Use the means necessary to control dust on and near the work if such dust is caused by the Contractor's operations during performance of the work or if resulting from the conditions in which the Contractor leaves the site.
 2. Thoroughly moisten all surfaces as required to prevent dust being a nuisance to the public, neighbors and concurrent performance of other work on the site.
 - E. Weather Conditions: Do not place, spread, or roll fill material during freezing, raining, or otherwise unfavorable weather conditions.

PART 2 - PRODUCTS

- 2.01 GENERAL:
- A. For approval of borrow materials, at least 5 working days in advance of intention to import material, designate the proposed borrow area, and provide samples to prove the quality and suitability of the material.

SECTION 312000 - EARTH MOVING: continued

2.02 ON-SITE FILL:

- A. All on-site materials used for fill shall be acceptable to the Engineer and shall be minimally subject to the following requirements:
 - 1. Free from deleterious substances, stumps, brush, weeds, roots, sod, rubbish, garbage and matter that may decay.
 - 2. Free of large rocks or lumps that may create voids or prevent proper compaction.

2.03 BORROW FILL MATERIAL:

- A. Free from deleterious substances, stumps, brush, weeds, roots, sod, rubbish, garbage and matter that may decay, and shall be Borrow Type "G" (Select Borrow), grade IV or V, conforming to Section 209 of the Standard Specifications.

2.04 TRENCH AND CIVIL STRUCTURE BACKFILL MATERIAL:

- A. Backfill for civil structures shall conform to the requirements of Section 207 of the Standard Specifications.
- B. Backfill for trenches shall conform to the requirements of Section 208 of the Standard Specifications.
- C. All trench and civil structure backfill material shall meet the requirements of Section 209.03C of the Standard Specifications for Borrow Type C backfill. All suitable excavated material, which meets the requirements of Section 209.03C of the Standard Specifications shall be used for structure or trench backfill as far as practicable.

2.05 GRADED AGGREGATE BASE COURSE:

- A. Graded Aggregate base course for bituminous and concrete pavements and other structures shall be Type "B" conforming to the requirements for Graded Aggregate in Section 821 of the Standard Specifications.

2.06 TOPSOIL:

- A. Topsoil furnished from within or outside the project limits shall conform to Section 732 of the Standard Specifications except as modified by the following requirements.
 - 1. Topsoil shall not contain stones, lumps, roots or other objects larger than 1/2 inch in any dimension.
 - 2. Acid-Alkaline Range: pH 5.8 to 6.5.
 - 3. Free of pests, pest larvae, and matter toxic to plants.
 - 4. Maximum soluble salts: 500 ppm.
 - 5. Free of viable Bermudagrass, quackgrass, Johnsongrass, nutsedge, poison ivy, Canada thistle and other objectionable grassy or broadleaf weeds.
- B. Topsoil Furnished from Outside Project Limits:
 - 1. Gradation range:
 - a. Sand (2.00 mm to 0.05 mm): 40-80%.
 - b. Silt (0.050 mm to 0.005 mm): 10-30%.
 - c. Clay (0.005 mm and smaller): 10-30%.
 - (1) When one-half of the sand content is larger than 0.500 mm, the maximum sand content shall be 75% and maximum clay content shall be 15%.
 - d. Lower limits of silt and clay shall be flexible to extent that soils with minimum combined silt and clay content of 20% shall be satisfactory. However, if more than one-half of the sand is larger than 0.50 mm, then minimum clay content shall be 15%, or the minimum combined silt and clay content shall be 25%.

SECTION 312000 - EARTH MOVING: continued

2. Organic content:
 - a. Minimum of 2.75% by weight.
 - b. If necessary, add peat at the rate necessary to attain minimum organic content.

PART 3 - EXECUTION

3.01 INSPECTION BY CONTRACTOR:

- A. Examine the areas and conditions under which excavating, filling and grading are to be performed. No extra cost or time allowances will be granted for conditions existing and visible at the time of the bid opening.

3.02 PREPARATION:

- A. Prior to commencement of work, establish location and extent of all utilities in the work areas. Maintain and protect, as required, existing utilities which pass through the work area.
- B. Prior to excavation in pavement areas, saw cut existing pavement in accordance with SECTION 311000 of these Specifications.

3.03 EXCAVATION:

- A. Unauthorized Excavation:
 1. Unauthorized excavation shall not be at the Owner's expense. Under roadways and pipes, fill unauthorized excavation by removing all loosened material and providing select material as required to attain a firm and unyielding subgrade and/or foundation and to attain required grade elevations.
- B. Rock excavation shall apply to the removal of bedrock and ledgerrock, which cannot be accomplished without blasting, or the use of rippers and the use or disposal of such material. Excavation of material classified as "rock" shall conform to the requirements of Section 205 of the Standard Specifications.
- C. Rock excavation for structures and trenches shall apply to the removal, use or disposal of all boulders or other detached stones having a volume of 1/3 cubic yard or more. Excavation of such material shall conform Section 206 of the Standard Specifications.
- D. Undercut Excavation:
 1. If unsuitable bearing materials are encountered at the required subgrade elevations notify the Engineer immediately.
 2. Unstable bearing materials shall be removed to a depth of 1 foot below subgrade and replaced with graded aggregate base course Type B.
 3. Base course shall be placed in 6-inch lifts.
- E. Stability of Excavations:
 1. Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space.
 2. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.
- F. Shoring and Bracing:
 1. Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.
 2. Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction
 3. Maintain shoring and bracing in excavations regardless of time period excavations will be open.

SECTION 312000 - EARTH MOVING: continued

4. Brace, sheet and support trench walls in such a manner that they will be safe and that the ground alongside the excavation will not slide or settle, and that all existing improvements of every kind, whether on public or private property, will be fully protected from damage.
 5. In the event of damage to such improvements, immediately make all repairs and replacements necessary at no additional cost to the Owner.
 6. Arrange bracing, sheeting and shoring so as to not place stress on any portion of the completed work until the general construction thereof has proceeded far enough to provide sufficient strength.
 7. Exercise care in the drawing and removal of sheeting, shoring, bracing and timbering to prevent collapse and caving of excavation faces being supported.
- G. Dewatering:
1. Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding the project site and surrounding area.
 2. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to the stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water from excavations.
 3. Convey water removed from excavations and rainwater to collecting or runoff areas, which are not subject to erosion. Establish and maintain temporary drainage ditches and other diversions outside excavation limits for each structure. Do not use trench excavations as temporary drainage ditches.
- H. Material Storage:
1. Stockpile satisfactory excavated materials where directed until required for use as backfill or fill. Place, grade and shape stockpiles for proper drainage.
 2. Locate and retain soil materials away from edge of excavations.
 3. Dispose of excess soil material and waste materials as herein specified. Excavated material unsuitable for backfilling shall be kept separate from other materials excavated, and disposed of. Materials suitable for backfilling shall not be disposed of until completion of filling or backfilling operations.
- I. Excavation for Pavements and Pavement Patches:
1. Cut surface under pavements to comply with cross-sections, elevations and grades as shown.
- J. Excavation for Trenches:
1. Dig trenches to the uniform width required for the particular item to be installed sufficiently wide to provide ample working room. Trench width to a point no less than 2 feet above the outside top of pipe shall be the pipe outer diameter plus 24 inches.
 2. Excavate trenches to the depth indicated or required. Carry the depth of trenches for piping to establish the indicated flow lines and invert elevations. Beyond the building perimeter, keep bottoms of trenches for which elevations are not given sufficiently below finish grade to avoid freeze-ups.
 3. Trenches for pipes shall not be opened more than the number of linear feet of pipe that can be placed and backfilled in 1 day.
 4. Grub roots and stumps within 6 inches of outside surface of pipe bottom and sides to minimum depth of 6 inches below grade. Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and which are carried

SECTION 312000 - EARTH MOVING: continued

below the bottom of such footings, or which pass under wall footings. Place concrete to the level of the bottom of adjacent footing.

5. Pipe bedding shall be as shown on the Plans.

K. Cold Weather Protection:

1. Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.

3.04 BACKFILL FILL AND COMPACTION:

A. General:

1. The project Inspector or Engineer shall be notified 24 hours in advance of any fill, backfill or compaction operations.
2. Place acceptable material in 8-inch lifts to required subgrade elevations.
3. Fills: Use suitable material (per Section 2.2 of this section) obtained from on-site excavation, except use borrow material when suitable on-site material is not available or when specified by the Engineer or shown on the Plans.
4. Backfilling: Use suitable material (per Section 2.2 of this section) obtained from on-site excavation, except use select backfill where indicated on Plans, backfill to a height of 2 feet above the top of pipe with earth free from stones, rock fragments, dirt clogs or frozen material greater than 2 inches in largest dimension.
5. Do not provide additional off-site borrow material until all acceptable excavated materials on the site have been utilized in the work unless approved by the Engineer.
6. Place the various types of materials in the areas as designated on the Plans.

B. Backfill excavation as promptly as work permits, but not until completion of the following:

1. Inspection, testing, approval and recording locations of underground utilities.
2. Removal of concrete formwork.
3. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.
4. Removal of trash and debris.
5. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

C. Backfilling Prior to Approvals:

1. Should any of the work be so enclosed or covered up before it has been approved, uncover all such work at no additional cost to the Owner.
2. After the work has been completely tested, inspected and approved, make all repairs and replacements necessary to restore the work to the condition in which it was found at the time of uncovering, all at no additional cost to the Owner.

D. Ground Surface Preparation Prior to Filling:

1. Remove all vegetation, debris, topsoil, unsatisfactory soil materials, obstructions and deleterious materials from existing ground surface to a depth of not less than 4 inches and not more than 6 inches prior to placement of fills. Plow, strip or break-up sloped surfaces steeper than 1 vertical to 4 horizontal to a depth of not less than 6 inches so that fill material will bond with existing surface.
2. When existing ground surface has a density less than that specified under "Compaction," for the particular area classification, break up the ground surface, pulverize, moisture condition to the optimum moisture content, and compact to required depth and percentage of maximum density.

SECTION 312000 - EARTH MOVING: continued

- E. Placement and Compaction:
1. Place backfill materials in layers not more than 8 inches in loose depth.
 2. Control soil compaction during construction providing minimum percentage of density specified for each area classification listed below.
 3. Pavement areas are defined, for the purpose of this Section, as extending a minimum of 5 feet beyond the building and/or pavement.
 4. Compact soil to not less than the following percentages of maximum dry density for soils which exhibit a well-defined moisture density relationship determined in accordance with ASTM D1557 and not less than the following percentages of relative density determined in accordance with ASTM D2049, for soils which will not exhibit a well-defined moisture-density relationship.
 - a. Lawn or Unpaved Areas: Compact top 6 inches of subgrade and each layer of backfill or fill material at 90% maximum dry density.
 - b. Walkways: Compact top 6 inches of subgrade and each layer of backfill or full material at 95% maximum dry density or 90% relative dry density.
 - c. Pavement Areas: Compact top 12 inches of subgrade and each layer of backfill or fill material at 95% maximum dry density or 90% relative dry density.
 - d. Base Course Materials: Compact each layer of base course material to 95% of maximum dry density.
 - e. Trench Stabilization Materials: Compact each layer of material to 95% of maximum dry density.
 5. Moisture Control:
 - a. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operations.
 - b. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
 - c. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.
 - d. Moisture condition fills materials to within 3% of the optimum moisture. Fill that is so wet that it is unstable under compaction equipment shall be dried and re-compacted to achieve a stable fill.
 6. Puddling or jetting will not be permitted.
 7. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice, or other unsuitable materials.
 8. Place backfill and fill material evenly adjacent to structures, to be required elevations. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around structure to approximately same elevation in each lift.
 9. Compact backfill to height of 2 feet above top of pipe using approved flat-faced mechanical tampers.

3.05 GRADING:

- A. General:
1. Uniformly grade areas within limits of grading under this Section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

SECTION 312000 - EARTH MOVING: continued

- B. Grading Outside Building Lines:
 - 1. Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes, and as follows:
 - a. Lawn or unpaved areas: Finish area to receive topsoil to within not more than 0.10 feet above or below the required subgrade elevations.
 - b. Walks: Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than 0.10 feet above or below the required subgrade elevation.
 - c. Pavement: Shape surface of areas under pavement line, grade and cross-section, with finish surface not more than 1/2 inch above or below the required subgrade elevation. All topsoil and other unsuitable material shall be removed and replaced with suitable backfill.
- C. Compaction:
 - 1. After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.
- D. Treating after Grading:
 - 1. After grading is completed, permit no further excavating, filling or grading.
 - 2. Use all means necessary to prevent erosion of freshly graded areas during construction and until such time as permanent drainage and erosion control measures have been installed.
- E. Subgrade Preparation:
 - 1. All subgrade preparation shall be performed in accordance with the applicable sections of the Delaware Department of Transportation Standard Specifications except as may be modified by this Specification Section.
 - 2. Subgrades for paving shall be firm and unyielding when proof-rolled in accordance with Section 202 of the Standard Specifications.

3.06 GRADED AGGREGATE BASE COURSE:

- A. General:
 - 1. Base Course consists of placing graded aggregate base course material in layers of specified thickness over subgrade surface to support pavements, pavement patches and structures, as shown on Plans.
 - 2. Provide Base Course in accordance with Section 302 of the Standard Specifications, except as otherwise modified by this Specification Section.
- B. Grade Control:
 - 1. During construction, maintain lines and grades including crown and cross-slope of base course.
- C. Placing:
 - 1. Place base course material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting base course material during placement operations.
 - 2. When a compacted base course is shown to be 8 inches or less, place material in a single layer. When shown to be more than 8 inches thick, place material in equal layers, except no single layer shall be more than 8 inches in thickness when compacted.
 - 3. Spread, shape and compact all base course material deposited on the subgrade during the same day.

SECTION 312000 - EARTH MOVING: continued

3.07 FIELD QUALITY CONTROL:

- A. Quality control testing during construction. Allow testing service to inspect and approve subgrades and fill layers before further construction work is performed.
- B. If subgrade or fills, which have been placed, are below specified density, provide additional compaction and testing at no expense to the Owner. This shall include compaction and testing at areas initially tested and at other locations as directed.

3.08 MAINTENANCE:

- A. Protection of Graded Areas:
 - 1. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
 - 2. Repair and establish grades in settled, eroded and rutted areas to specified tolerances.
- B. Reconditioning Compacted Areas:
 - 1. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape and compact to required density prior to further construction.

3.09 DISPOSAL OF EXCESS AND WASTE MATERIALS:

- A. Remove waste materials, including excess and unacceptable excavated material, trash and debris, and dispose of it off the Owner's property.

3.10 TOPSOILING:

- A. Preparation:
 - 1. Verify that clearing, earthwork, grading and other preceding work affecting ground surface have been completed and that the area to be topsoiled is cleared, shaped, and dressed.
 - 2. Preparation of Topsoil Subsoil:
 - a. Shape and dress area to be topsoiled. This work includes grading to required lines and elevations; removal of all stones, clods, lumps two inches or larger in any dimension; removal of all wires, cables, pieces of concrete, tree roots and debris or other unsuitable material.
 - b. Do not proceed with installation of topsoil until this work has been approved.
- B. Installation:
 - 1. Place in even layers that will produce the minimum compacted thickness as indicated on the Plans.
 - 2. If quantity of topsoil obtained from stripping is insufficient for the project requirements, provide required topsoil from approved sources located outside project limits.
 - 3. Remove stones, lumps, roots and other objects larger than 1 inch in any dimension from graded topsoil surface.
- C. Maintenance:
 - 1. Immediately before establishment of ground cover, re-topsoil and regrade areas which have become eroded or otherwise disturbed.
 - 2. Perform all maintenance work in accordance with the Specifications without additional compensation.
 - 3. Maintenance period to extend until installation of ground cover.

SECTION 312000 - EARTH MOVING: continued

D. Cleaning:

1. Immediately clean spills, soil, and conditioners on paved and finished areas.
2. Haul and dispose of topsoil in excess of the quantity required for the project off site.
3. Dispose of protective barricades and warning signs at termination of maintenance period.

END OF SECTION 312000

SECTION 312319 - DEWATERING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section includes construction dewatering.
- B. Related Sections:
 - 1. DIVISION 01 Section "[Construction Progress Documentation] [Photographic Documentation]" for recording preexisting conditions and dewatering system progress.
 - 2. DIVISION 31 Section "Earth Moving" for excavating, backfilling, site grading, and for site utilities.
 - 3. DIVISION 31 Section "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
 - 4. DIVISION 33 Section "Subdrainage" for permanent foundation wall, underfloor, and footing drainage.

1.03 PERFORMANCE REQUIREMENTS:

- A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
 - 1. Delegated Design: Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - 2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
 - 3. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - 5. Remove dewatering system when no longer required for construction.

1.04 ACTION SUBMITTALS:

- A. Shop Drawings: For dewatering system. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
 - 1. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
 - 2. Include a written plan for dewatering operations including control procedures to be adopted if dewatering problems arise.
- B. Delegated-Design Submittal: For dewatering system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.05 INFORMATIONAL SUBMITTALS:

- A. Qualification Data: For qualified [Installer] [land surveyor] [and] [professional engineer].
- B. Field quality-control reports.

SECTION 312319 - DEWATERING: continued

- C. Other Informational Submittals:
 - 1. [Photographs] [or] [Videotape]: Show existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by dewatering operations.

- 1.06 QUALITY ASSURANCE:
 - A. Installer Qualifications: An experienced installer that has specialized in [design of dewatering systems and]dewatering work.
 - B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with hauling and disposal regulations of authorities having jurisdiction.
 - C. Preinstallation Conference: Conduct conference at [Project site] <Insert location>.
 - 1. Review methods and procedures related to dewatering including, but not limited to, the following:
 - a. Inspection and discussion of condition of site to be dewatered including coordination with temporary erosion control measures and temporary controls and protections.
 - b. Geotechnical report.
 - c. Proposed site clearing and excavations.
 - d. Existing utilities and subsurface conditions.
 - e. Coordination for interruption, shutoff, capping, and continuation of utility services.
 - f. Construction schedule. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - g. Testing and monitoring of dewatering system.
 - h. <Insert agenda items>.

- 1.07 PROJECT CONDITIONS:
 - A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
 - 1. Notify [Architect] [Construction Manager] [Owner] no fewer than [two] <Insert number> days in advance of proposed interruption of utility.
 - 2. Do not proceed with interruption of utility without [Architect's] [Construction Manager's] [Owner's] written permission.
 - B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for dewatering.
 - 2. The geotechnical report is [included] [referenced] elsewhere in the Project Manual.
 - C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
 - 1. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

SECTION 312319 - DEWATERING: continued

PART 2 - PRODUCTS - NOT APPLICABLE.

PART 3 - EXECUTION

3.01 PREPARATION:

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
 - 1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
 - 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Provide temporary grading to facilitate dewatering and control of surface water.
- D. Monitor dewatering systems continuously.
- E. Promptly repair damages to adjacent facilities caused by dewatering.
- F. Protect and maintain temporary erosion and sedimentation controls, which are specified in [DIVISION 01 Section "Temporary Facilities and Controls"] [DIVISION 31 Section "Site Clearing"] during dewatering operations.

3.02 INSTALLATION:

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
 - 1. Space well points or wells at intervals required to provide sufficient dewatering.
 - 2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
- B. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.
- C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
 - 1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
- D. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
 - 1. Maintain piezometric water level a minimum of [24 inches] [60 inches] <Insert depth> below surface of excavation.
- E. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

SECTION 312319 - DEWATERING: continued

- F. Provide standby equipment on site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner.
 - 1. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.
- G. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

3.03 FIELD QUALITY CONTROL:

- A. Observation Wells: Provide, take measurements, and maintain at least the minimum number of observation wells or piezometers indicated; additional observation wells may be required by authorities having jurisdiction.
 - 1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
 - 2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
 - 3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.
- B. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

END OF SECTION 312319

SECTION 312500 - EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. General: Provide temporary soil and sediment control measures in accordance with the Plans and Contract Documents.
- B. Refer to LEED™ REQUIREMENTS in SECTION 018113.13 - SUSTAINABLE DESIGN REQUIREMENTS for LEED requirements and documentation submittals pertaining to Work in this Specification Section.

1.02 QUALITY ASSURANCE:

- A. Standards:
 - 1. Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:
 - a. Delaware Erosion and Sediment Control Handbook (2003).
 - b. Delaware Department of Transportation Standard Specifications for Highways and Bridges, dated August 2001 (hereinafter referred to as the "Standard Specifications").
- B. Design Criteria:
 - 1. The primary objective of this specification is to control soil erosion to the maximum extent practicable and to comply with the approved sediment and stormwater plan for the site construction.
 - 2. The temporary control provisions contained herein shall be coordinated with permanent erosion control features to the extent practical to assure effective and continuous erosion control throughout the construction and post-construction period.
 - 3. The erosion control measures described herein shall be continued until the construction is complete and all disturbed areas are fully stabilized.
 - 4. Wherever construction exposes work, which is subject to erosion, erosion control features or other work to be completed within such areas shall follow as soon after exposure as practicable.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Temporary mulches shall conform to Section 735 of the Delaware Department of Transportation Standard Specifications for Bridges and Highways.
- B. Temporary grass mixtures shall be as shown on the Plans and shall conform to the Section 734 of the Standard Specifications.
- C. Fertilizer and soil conditioners shall be a standard commercial grade.
- D. Temporary structural Erosion Control measures shall conform to the requirements of the Delaware Erosion and Sediment Control Handbook and the Delaware Department of Transportation Standard Specifications.
- E. Erosion control matting and blankets shall conform with the Delaware Erosion and Sediment Control Handbook requirements for soil stabilization matting (SSM) I and II. Matting shall be composed of 100% agricultural straw (minimum 0.5 pounds per square yard) or 100% wood excelsior fiber (0.8 pounds per square yard) with a single or double netting of either photo-degradable or bio-degradable material. SSM-I shall be North American Green S75, American Excelsior Curlex I, or approved equal. SSM-II shall be North American Green S150, American Excelsior Curlex II, or approved equal.

SECTION 312500 - EROSION AND SEDIMENTATION CONTROLS: continued

- F. Riprap: The stones shall be of durable rock, sized and graded so that at least 50% of the pieces are larger than the d50 size shown on the Plans. The diameter of the largest stone shall not exceed 1.5 times the d50 size, nor shall the smallest stone be smaller than one-half the d50 size. All stone shall meet the requirements of Section 712 of the Delaware Department of Transportation Standard Specifications. Filter cloth shall be a non-woven geotextile conforming to ASTM D1777 or ASTM D1682.

PART 3 - EXECUTION

3.01 CONSTRUCTION REQUIREMENTS:

- A. Vegetative stabilization shall be used on graded or cleared areas, which are subject to erosion for a period of 14 days or more.
- B. All temporary erosion control measures shall be installed in accordance with the Delaware Erosion and Sediment Control Handbook.
- C. Erosion control matting shall be installed in accordance with the manufacturer's written instructions, the requirements of the Delaware Erosion and Sediment Control Handbook, and the details on the Plans.
- D. In the event of conflict between these requirements and pollution control laws, rules, or regulations of other federal or state agencies, the more restrictive laws, rules, or regulations shall apply.
- E. The Contractor shall be responsible for maintaining all soil erosion and sediment control measures in an acceptable and functional manner. The Contractor shall remove all temporary measures after all other construction is complete, final restorations installed, and all disturbed areas have been adequately stabilized.

END OF SECTION 312500

SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

- A. Section includes temporary excavation support and protection systems.
- B. Related Sections:
 - 1. DIVISION 01 Section "[Construction Progress Documentation] [Photographic Documentation]" for recording preexisting conditions and excavation support and protection system progress.
 - 2. DIVISION 01 Section "Temporary Facilities and Controls" for temporary utilities and support facilities.
 - 3. DIVISION 31 Section "Dewatering" for dewatering system for excavations.

1.03 PERFORMANCE REQUIREMENTS:

- A. [Design,]furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.
 - 1. Delegated Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - 4. Monitor vibrations, settlements, and movements.

1.04 ACTION SUBMITTALS:

- A. Shop Drawings: For excavation support and protection system.
- B. Delegated-Design Submittal: For excavation support and protection system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.05 INFORMATIONAL SUBMITTALS:

- A. Qualification Data: For qualified [land surveyor] [and] [professional engineer].
- B. Other Informational Submittals:
 - 1. [Photographs] [or] [Videotape]: Show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems. Submit before Work begins.
 - 2. Record Drawings: Identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions.
 - a. Note locations and capping depth of wells and well points.

SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION: continued

1.06 QUALITY ASSURANCE:

- A. Preinstallation Conference: Conduct conference at [Project site] <Insert location>.
 - 1. Review methods and procedures related to excavation support and protection system including, but not limited to, the following:
 - a. Geotechnical report.
 - b. Existing utilities and subsurface conditions.
 - c. Proposed excavations.
 - d. Proposed equipment.
 - e. Monitoring of excavation support and protection system.
 - f. Working area location and stability.
 - g. Coordination with waterproofing.
 - h. Abandonment or removal of excavation support and protection system.
 - i. <Insert agenda items>.

1.07 PROJECT CONDITIONS:

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
 - 1. Notify [Architect] [Construction Manager] [Owner] no fewer than [two] <Insert number> days in advance of proposed interruption of utility.
 - 2. Do not proceed with interruption of utility without [Architect's] [Construction Manager's] [Owner's] written permission.
- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from the data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection.
 - 2. The geotechnical report is [included] [referenced] elsewhere in the Project Manual.
- C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
 - 1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. General: Provide materials that are either new or in serviceable condition.
- B. Structural Steel: ASTM A36, ASTM A690, or ASTM A992.
- C. Steel Sheet Piling: ASTM A328, ASTM A572, or ASTM A690; with continuous interlocks.
 - 1. Corners: [Site-fabricated mechanical interlock] [Roll-formed corner shape with continuous interlock].
- D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of [size and strength required for application] [3 inches] [4 inches] <Insert dimension>.

SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION: continued

- E. Shotcrete: Comply with DIVISION 03 Section "Shotcrete" for shotcrete materials and mixes, reinforcement, and shotcrete application.
- F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.
- G. Reinforcing Bars: ASTM A615, Grade 60, deformed.
- H. Tiebacks: Steel bars, ASTM A722.
- I. Tiebacks: Steel strand, ASTM A416.

PART 3 - EXECUTION

3.01 PREPARATION:

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
 - 1. Shore, support, and protect utilities encountered.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces are not impeded.
- D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.
- E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

3.02 SOLDIER PILES AND LAGGING:

- A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than [2 inches from a horizontal line and not more than 1:120 out of vertical alignment] <Insert tolerances>.
- B. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.
- C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.03 SHEET PILING:

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Accurately place the piling, using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 60 inches. Accurately align exposed faces of sheet piling to vary not more than [2 inches from a horizontal line and not more than 1:120 out of vertical alignment] <Insert tolerances>. Cut tops of sheet piling to uniform elevation at top of excavation.

3.04 TIEBACKS:

- A. Tiebacks: Drill, install, grout, and tension tiebacks. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.

SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION: continued

1. Test loading shall be observed by a qualified professional engineer responsible for design of excavation support and protection system.
 2. Maintain tiebacks in place until permanent construction is able to withstand lateral soil and hydrostatic pressures.
- 3.05 BRACING:
- A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
 1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.
 2. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
 3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.
- 3.06 REMOVAL AND REPAIRS:
- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.
 1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlaying construction and abandon remainder.
 2. Fill voids immediately with approved backfill compacted to density specified in DIVISION 31 Section "Earth Moving."
 3. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.
 - B. Leave excavation support and protection systems permanently in place.

END OF SECTION 315000

DIVISION 32 - EXTERIOR IMPROVEMENTS

SECTION 320523 - CONCRETE SIDEWALKS

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Remove existing concrete sidewalk as shown on the plan, marked in the field, or as directed by the Engineer.
- B. Provide new concrete sidewalk in areas designated on Plans, marked in the field, or as directed by the Engineer.
- C. Place Graded Aggregate Base Course below proposed concrete sidewalks.

1.02 STANDARDS:

- A. The quality and performance of work specified in this Section shall be in accordance with the Delaware Department of Transportation Standard Specifications for Road and Bridge Construction, dated August 2001 (hereinafter referred to as the "Standard Specifications").
 - 1. Section 302 - Graded Aggregate Base Course.
 - 2. Section 705 - Portland Cement Concrete Sidewalk.
 - 3. Section 762 - Saw Cutting.
 - 4. Section 812 - Portland Cement Concrete.

1.03 SUBMITTALS:

- A. Certificates: All deliveries of concrete shall be accompanied by delivery slips.
- B. LEED Submittals:
 - 1. For new concrete sidewalks, submit documentation relative to manufacturer's calculated Solar Reflectance Index (SRI), calculated from emissivity and solar reflectance, for each concrete product in accordance with SS Credit 7.1 of the LEED Reference Guide.
 - 2. Submit concrete mix indicating all mix components, material sourcing locations and percent of each component material, by weight. Submit material cost of concrete for each mix.

1.04 ENVIRONMENTAL REQUIREMENTS:

- A. Allowable Concrete Temperatures:
 - 1. Cold weather: 60°F when discharged from the mixer.
 - 2. Hot weather: Maximum concrete temperature is 80°F.
- B. Do not place concrete during rain, when atmospheric temperature is at or below 36°F, or when conditions are otherwise unfavorable.

1.05 PROTECTION:

- A. Protect concrete from pedestrian and vehicular traffic until concrete has been sufficiently cured.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Concrete:
 - 1. Use concrete developing a compressive strength of 3,000 psi at 28 days.
 - 2. Use air-entrained concrete.

SECTION 320523 - CONCRETE SIDEWALKS: continued

- B. Cement aggregates, water and air-entrainment methods and materials conforming to Section 812 of the Standard Specifications.
- C. Joint filler: Pre-formed expansion joint material, conforming to Section 808.06 of the Standard Specifications.
- D. Curing compound: White pigmented liquid, conforming to AASHTO M148 for Type 2, Class A or B.
- E. Vapor barrier: Where called for on Plans shall be 6 mil polyethylene.
- F. An exposed aggregate surface shall be used for replacement or extension of existing exposed aggregate surfaces. Aggregate size, color, and type, and mixture, shall match existing sidewalk. The contractor shall submit samples of the aggregate for approval.
- G. Solar Reflectance Index: Concrete sidewalk surface shall have a minimum calculated Solar Reflectance Index (SRI) of 29, calculated from emissivity and solar reflectance values in accordance with Credit SSc7.1 of the LEED Reference Guide.

PART 3 - EXECUTION

3.01 REMOVING EXISTING SIDEWALK:

- A. All portions of existing concrete sidewalk to be removed shall be isolated from pavements, curb, or buildings to remain by saw cutting or by the presence of an existing expansion joint. Care shall be exercised by the Contractor to insure that no damage occurs to any elements to remain and any damage to items to remain shall be replaced or repaired by the Contractor at no additional cost to the Owner.
- B. Concrete shall be broken up by an approved power breaking machine. All concrete removed shall be taken off the project site and disposed of lawfully.

3.02 PREPARATION FOR NEW SIDEWALK:

- A. Excavate subgrade and set forms so that finished sidewalk conforms to lines and grades shown on Plans.
- B. Prepare sidewalk subgrade as specified in Section 705 of the Standard Specifications.
- C. Verify that earthwork is completed to correct line and grade.
- D. Verify that forms conform to line, grade and dimensions shown on Plans.
- E. Check that subgrade is smooth, compacted and free of excessive moisture.
- F. Do not commence work until conditions are satisfactory.

3.03 CONSTRUCTION METHODS:

- A. Concrete sidewalks shall be constructed in accordance with the requirements of Section 705 of the Standard Specifications.
- B. The foundation shall be formed at the required grade to accommodate the elevations, dimension, and details shown on the Plans for the bottom of the sidewalk. All soft and yielding or otherwise unsuitable materials shall be removed and replaced with graded aggregate.
- C. Concrete shall be cured for a minimum of five days. The sidewalk shall not be opened to pedestrian and vehicular traffic until the end of the curing period.
- D. Exposed Aggregate Surface (where designated on the Plans):
 - 1. The pre-mixed exposed aggregate concrete shall be placed, screeded, and darried to the proper grade.
 - 2. As soon as the concrete will support weight, the surface shall be hand floated. All aggregates should be completely embedded just beneath the surface, and the grout should completely surround and slightly cover all aggregates, leaving no holes or openings.

SECTION 320523 - CONCRETE SIDEWALKS: continued

3. Shortly following the floating, spray surface retardant in accordance with the surface retardant manufacturer's instructions.
4. As soon as the concrete has set sufficiently to hold the aggregate firmly, expose the aggregate by simultaneously brushing and hosing with water. Slightly more than one-half of the depth of the aggregate should remain embedded.
5. Approximately two to four hours after the aggregate has been exposed, it shall be washed and lightly brushed to remove any cloudy residue.

END OF SECTION 320523

SECTION 321200 - FLEXIBLE PAVING

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Work included: Provide labor, materials, and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Milling existing pavements.
 - 2. Patching pavement, including removal of existing pavement and installation of bituminous concrete base course patch.
 - 3. Surface preparation, and installation of Type B, binder course pavement.
 - 4. Installation of Type C, wearing surface course for proposed pavements, and for overlay of existing bituminous pavement including repaired areas.
 - 5. Installation of bituminous concrete base course.
 - 6. Pavement markings.
 - 7. Traffic control and street signs.

1.02 STANDARDS:

- A. The quality and performance of work specified in this Section shall be in accordance with the Delaware Department of Transportation Standard Specifications for Road and Bridge Construction, dated August 2001 (hereinafter referred to as the "Standard Specifications").
 - 1. Section 401 - Hot-Mix, Hot-Laid Bituminous Concrete Pavement.
 - 2. Section 406 - Hot-Mix Patch.
 - 3. Section 748 - Pavement Markings.
 - 4. Section 760 - Pavement Milling.

1.03 DEFINITIONS:

- A. Subgrade: Surface upon which pavements will be constructed.
- B. Base Course: That portion of the pavement cross section consisting of graded aggregate base course or bituminous concrete deep lift.

1.04 QUALITY ASSURANCE:

- A. Bituminous concrete producer shall be regularly engaged in the production of hot-mix, hot-laid bituminous concrete, and shall be approved by the Delaware Department of Transportation or the Pennsylvania Department of Transportation.

1.05 SUBMITTALS:

- A. Job mix formula.
- B. Provide copies of delivery slips at the end of each working day.
- C. LEED Submittals: Submit each mix indicating all mix components, material sourcing locations and percent of each component material, by weight. Submit material cost of concrete for each mix.

PART 2 - PRODUCTS

2.01 GENERAL:

- A. Materials and mixtures shall comply with the following Sections of Delaware Department of Transportation Standard Specifications.

SECTION 321200 - FLEXIBLE PAVING: continued

2.02 PAVING MATERIALS AND MIXTURES:

- A. Graded Aggregate Base Course:
 - 1. Section 302 - Materials.
- B. Hot Mix, Hot Laid Bituminous Concrete Pavement:
 - 1. Section 401 - Materials.
 - 2. Section 401 - Mixture.
- C. Section 811 - Emulsified Asphalt.
- D. Sections 805, 813 - Course Aggregate.
- E. Tack Coat: CSS-1-h asphalt (diluted with 50% water) meeting the requirements of AASHTO M208.

2.03 JOB MIX FORMULA REQUIREMENTS:

- A. Provide job mix formulas for each required bituminous concrete mixture as specified in Section 401.20 of the Standard Specifications.
- B. Submit for approval prior to beginning paving operations.

2.04 MIX DESIGN AND CONTROL REQUIREMENTS:

- A. The design and control requirements for all paving mixtures shall conform to Section 401 of the Standard Specifications.

2.05 SAMPLES AND TESTING:

- A. Methods and rates of sampling bituminous mixtures shall conform to Section 401 of the Standard Specifications with the following exceptions:
 - 1. Sampling shall be performed by the producer's quality control technician.
 - 2. For small scale projects where it is possible to attain the minimum lot size specified, a total of five (5) samples shall be taken at random for each type of mix specified, per each day's production.
- B. Testing of bituminous concrete mixtures to determine the quantity of bitumen, gradation of aggregate, and conformance to mix design requirements shall be as specified in Section 401 of the Standard Specification.
- C. Submit results of tests on forms signed by producer's quality control technician.

2.06 PREPARATION OF MIXTURES:

- A. The preparation of all bituminous mixtures shall conform to Section 401 of the Standard Specifications.

2.07 PAVEMENT MARKINGS:

- A. All paint shall be of materials approved by the Delaware Department of Transportation per Section 748 of the Standard Specifications.
- B. Paint striping for handicap accessible spaces and aisles shall conform to the requirements of the Americans with Disabilities Act and the Delaware Architectural Accessibility Board standards.
- C. Thermoplastic material, where required, shall meet the requirements of Section 748 of the Standard Specifications.

2.08 TRAFFIC CONTROL SIGNS:

- A. All traffic control signs and posts shall conform with the Delaware Manual of Uniform Traffic Control Devices, the Standard Specifications, and the Americans with Disabilities Act.

SECTION 321200 - FLEXIBLE PAVING: continued

- B. Street signs shall conform with the requirements of the local municipality and DeDOT requirements, and shall be of a consistent style with street signs in the surrounding neighborhood.

PART 3 - EXECUTION

3.01 GENERAL:

- A. The method of construction to including bituminous concrete plant and equipment, bituminous concrete pavers, vehicles for transporting bituminous mixtures, rollers, and all construction methods shall conform to Section 401 of the Standard Specifications except as modified by the Supplemental Requirements below.

3.02 PAVEMENT MILLING:

- A. Construction methods for pavement milling shall conform to Section 760 of the Standard Specifications.

3.03 PAVEMENT PATCHING:

- A. Construction methods for patching pavement shall conform to Sections 401 and 406 of the Standard Specifications. A milling machine may be use for pavement and base course removal.

3.04 PROOF ROLL:

- A. Proof roll subgrade surfaces using heavy, rubber-tired rollers, or loaded dump truck in accordance with Section 202 of the Standard Specifications. Proof roll in the presence of the Owner's Representative.
 - 1. Subgrades shall be firm and unyielding.
 - 2. Compact areas showing deflection and instability.
- B. Notify the Engineer or the Inspector of unsatisfactory conditions.
- C. Do not begin paving work until any such unsatisfactory conditions have been corrected.

3.05 SURFACE PREPARATION:

- A. Earth and Base Course Surface:
 - 1. Remove loose and foreign material from compacted subgrade surface immediately before application as required.
 - 2. Use power broom or blowers and hand brooming as required.
 - 3. Do not displace subgrade material.
- B. Existing Pavement Surfaces:
 - 1. Remove loose and foreign material from existing pavement surfaces immediately before application of paving.
 - 2. Use self-propelled mechanical sweepers. Supplement with hand brooming as required.
 - 3. Pay particular attention to cleaning of gutter lines and outer edges of pavement areas.
 - 4. Remove all weeds, grass or other vegetative matter growing in pavement areas, particularly along joints and curbs.
- C. Minor Patching:
 - 1. Existing pavement surfaces: Fill in depressions, and patch pavement in overlay areas that are not marked out for base repairs.

3.06 TACK COAT:

- A. Apply to cleaned surfaces of all pavements to be overlaid or slurry seal coated.

SECTION 321200 - FLEXIBLE PAVING: continued

- B. Apply to cleaned surfaces of newly constructed base pavement if coated with dust, dirt, foreign materials in sufficient amount to prevent bond with surface course.
- C. Apply to edges of paving where base repairs are to be made.
- D. Apply tack coat material at temperatures, specified in Section 401 of the Standard Specifications.
- E. Apply at rate of 0.02 gallon per square yard immediately prior to placing pavement.
- F. Apply tack coat by brush to contact surfaces of pavement cold joints, curbs, gutters, manholes, and other structures projecting into or abutting asphalt concrete pavement.
- G. Allow surfaces to dry until material is in a condition of tackiness to receive pavement.
- H. Take precautions to insure tack coat is not applied to exposed surfaces of curbs or other exposed surfaces. Tack coat so applied shall be removed by Contractor at no additional cost to Owner.

3.07 GENERAL SURFACE REQUIREMENTS:

- A. Test finished surface of each bituminous concrete course for smoothness using a ten- (10-) foot straightedge.
- B. The straightedge shall have projections on the bottom at each end, either built-in or firmly attached, so that it is supported six (6) inches above the pavement surface at the ends. It shall be free from warp and deflection, and furnished by the Contractor without additional compensation.
- C. Check surfaced areas at intervals and in directions specified.
- D. Check surfaces for pavement smoothness immediately after initial compaction, and correct variations by removing or adding material as may be necessary. Then rolling shall be continued as specified.
- E. Immediately after final rolling and while the pavement is still hot, the smoothness of the course shall be checked again and all projections or depressions exceeding the specified tolerances shall be corrected by removing defective work and replacing it with new surface course as specified. Portions of the surface otherwise unsatisfactory shall be replaced.
- F. Finished surfaces shall be free of all roller marks, ridges and voids.

3.08 FIELD QUALITY CONTROL:

- A. Taking of pavement cores and testing for the determination of conformance to control air voids and pavement thickness shall be performed in accordance with Section 401 of the Standard Specifications.
- B. When required per the General or Special Provisions, the Contractor shall employ and pay for the services of an Independent Testing Laboratory acceptable to the Engineer to perform additional field quality control sampling and testing when initial tests indicate work does not comply with the Contract Documents. All sampling and testing shall be performed as specified in Section 401 of the Standard Specifications.
- C. Areas of pavement removed for field quality control testing shall be replaced by the Contractor as follows:
 - 1. Clean debris from core area. Cut all exposed pavement edges vertical.
 - 2. Apply tack coat to exposed surfaces before installing replacement pavement.
 - 3. Fill core area with surface course mixture for the full depth of the core.
 - 4. Compact and grade mixture; seal repaired area with tack coat; and apply thin layer of sand over tack coat.

3.09 PAVEMENT MARKINGS:

- A. Paint equipment and installation shall conform to Section 748 of the Standard Specifications.

SECTION 321200 - FLEXIBLE PAVING: continued

- B. Application of Thermoplastic materials, where required, shall conform to Sections 748.08 and 748.09 of the Standard Specifications.
- C. All markings shall comply with the Delaware Manual on Uniform Traffic Control Devices, the Americans with Disabilities Act, and the Delaware State Fire Prevention Regulations.

3.10 TRAFFIC CONTROL SIGNS:

- A. Traffic control and street signs shall be installed in accordance with the Delaware Manual of Uniform Traffic Control Devices, and the Standard Specifications.

END OF SECTION 321200

SECTION 321613 - CONCRETE CURB AND GUTTER

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Remove and dispose off site existing concrete or bituminous curb as shown on the Plans, marked in the field, or as directed by the Engineer.
- B. Install new poured Portland cement concrete curb in the locations designated on the Plans, marked in the field, or as directed by the Engineer.

1.02 STANDARDS:

- A. The quality and performance of work specified in this Section shall be in accordance with the Delaware Department of Transportation Standard Specifications for Road and Bridge Construction, dated August 2001 (hereinafter referred to as the "Standard Specifications").
 - 1. Section 701 - Portland Cement Concrete Curb and Integral Curb and Gutter.
 - 2. Section 812 - Portland Cement Concrete.

1.03 SUBMITTALS:

- A. All deliveries of concrete shall be accompanied by delivery slips.
- B. LEED[®] Submittals:
 - 1. For new concrete, submit documentation relative to manufacturer's calculated Solar Reflectance Index (SRI), calculated from emissivity and solar reflectance, for each concrete product in accordance with SS Credit 7.1 of the LEED Reference Guide.
 - 2. Submit concrete mix indicating all mix components, material sourcing locations and percent of each component material, by weight. Submit material cost of concrete for each mix.

1.04 ENVIRONMENTAL REQUIREMENTS:

- A. Allowable Concrete Temperatures:
 - 1. Cold weather: 60°F when discharged from the mixer.
 - 2. Hot weather: Maximum concrete temperature is 80°F.
- B. Do not place concrete during rain, when atmospheric temperature is at or below 36°F, or when conditions are otherwise unfavorable.

1.05 PROTECTION:

- A. Protect new concrete curb from traffic for a minimum of 7 days.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Concrete:
 - 1. Use concrete developing a compressive strength of 3,000 psi at 28 days.
 - 2. Use air-entrained concrete.
- B. Cement, aggregates, water, and air entrainment methods and materials: Section 812 of the Standard Specifications.
- C. Joint Filler: Pre-formed expansion joint material conforming to Section 808.06 of the Standard Specifications.
- D. Curing Compound: White pigmented liquid, conforming to AASHTO M148 for Type 2, Class A or B.
- E. Bituminous Joint Sealant: Conforming to the requirements of Section 808.04(c) of the Standard Specifications.

SECTION 321613 - CONCRETE CURB AND GUTTER: continued

- F. Product Specification: Exterior concrete curbs and gutters shall have a minimum calculated Solar Reflectance Index (SRI) of 29, calculated from emissivity and solar reflectance values in accordance with Credit SSc7.1 of the LEED Reference Guide.

PART 3 - EXECUTION

3.01 PREPARATION:

- A. When encountered, cut existing pavements vertically with a sharp tool on a straight line prior to excavating for curb. Cut shall be made 12-inches to 24-inches beyond the limits of excavation, and maintained straight and neat, or re-cut and dressed as required.
- B. Excavate subgrade and set forms so that finished curb conforms to required lines and grades.
- C. Prepare curb subgrade as specified in Section 701 of the Standard Specifications.
- D. Verify that earthwork is completed to correct line and grade.
- E. Verify that forms conform to proposed line, grade and curb cross section.
- F. Check that subgrade is smooth, compacted and free of frost and excessive moisture.
- G. Do not commence work until conditions are satisfactory.

3.02 PERFORMANCE:

- A. Method of curb construction shall conform to Section 701 of the Standard Specifications.
 - 1. Install 1/2-inch wide expansion joints at equal intervals, not to exceed 40 feet. Install additional expansion joints where curb abuts structures, and install expansion joints or bond breaker where curb abuts sidewalk. Fill expansion joints with joint filler, 1/2-inch thick. Insert joint filler 1/4-inch from the top and face of curb.
 - 2. Construct contraction joints (transverse joints) at 10-foot intervals, except where shorter sections are necessary for closures; but no Section shall be less than 4 feet.
 - 3. Finish concrete surfaces of curb to match existing adjacent curbs. Curb cross section shall be as shown on the Plans.

END OF SECTION 321613

SECTION 321723 - PAVEMENT MARKING

PART 1 - GENERAL

1.01 SUMMARY:

- A. This Section includes pavement marking and remarking for paved areas, including but not limited to, taxiways and apron areas.
- B. For pavement replacement, markings shall be restored to the type, width, and color of those destroyed unless indicated otherwise.

1.02 REFERENCES:

- A. Criteria and standard requirements for pavement markings are provided in the following publication:
 - 1. Applicable Standards:
 - a. Federal Specifications (FS):
 - (1) TT-P-1952 - Paint, Traffic and Airfield Marking, Water Emulsion Base.

1.03 SUBMITTALS:

- A. Submit as specified in DIVISION 01.
- B. Includes, but not limited to, the following:
 - 1. Manufacturer's Catalog Data:
 - a. Reflective Media.
 - b. Paint and Color Charts.
 - c. Thermoplastic Compounds and Primer.

1.04 DELIVERY AND STORAGE:

- A. Deliver paint and paint materials in original sealed containers that plainly show the designated name, specification number, batch number, color, date of manufacturer, manufacturer's directions, and name of manufacturer.
- B. Provide storage facilities at the Site for maintaining materials at temperatures and conditions recommended by the manufacturer.

1.05 WEATHER LIMITATIONS:

- A. Apply paint to clean, dry surfaces, and unless otherwise approved, only when temperatures are ascending, air and pavement temperatures are, above 45°F for oil-based materials, above 50°F for water-based materials, and less than 95°F for both oil and water based materials.
- B. Maintain paint temperature within these same limits.

PART 2 - PRODUCTS

2.01 MARKING PAINT:

- A. Paint for pavement marking shall conform to FS TT-P-1952 and as specified in this Section. Color shall match demolished markings unless otherwise indicated.

2.02 EQUIPMENT:

- A. Machines, tools, and equipment used in the performance of the Work shall be approved by Engineer and maintained in satisfactory operating condition.
- B. Paint Applicator:
 - 1. Provide hand-operated, push-type applicator machine of a type commonly used for application of paint to pavement surfaces.
 - 2. Paint applicator machine shall be acceptable for marking small street and parking areas.

SECTION 321723 - PAVEMENT MARKING: continued

3. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage rate specified.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION:

- A. Allow pavement surfaces to cure for a period of not less than 7 days before application of marking materials.
- B. Thoroughly clean surfaces to be marked before application of the paint.
- C. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of methods required to provide acceptable bonding.
- D. Remove rubber deposits, existing paint markings, residual curing compounds, and other coatings adhering to the pavement by waterblasting or sandblasting.
- E. Scrub affected areas, where oil or grease is present on old pavements to be marked, with several applications of trisodium phosphate solution or other approved detergent or degreaser and rinse thoroughly after each application.
- F. After cleaning oil-soaked areas, seal with shellac or primer recommended by the manufacturer to prevent bleeding through the new paint.
- G. Do not commence painting in any area until pavement surfaces are dry and clean, wind conditions are less than 5 miles per hour, and surfaces have been inspected and approved by Owner's representative.

3.02 APPLICATION:

- A. Rate of Application:
 1. Nonreflective Markings: Apply paint evenly to the pavement surface to be coated at a rate of 100 to 110 square feet per gallon (The number of coats shall be determined by manufacturer's recommendations).
 2. Painting:
 - a. Apply paint pneumatically with approved equipment at coverage rate specified.
 - b. Provide guidelines and templates as necessary to control paint application.
 - c. A maximum drying time of 75 minutes for paint will be strictly enforced to prevent undue softening of bitumen and pickup, displacement, or discoloration by tires of traffic.
 - d. Discontinue painting operations if there is a deficiency in drying of the markings until cause of the slow drying is determined and corrected.

3.03 PROTECTION AND REPAIR:

- A. Place warning signs near the beginning of the Work Site and well ahead of the Work Site for alerting approaching traffic from both directions.
- B. Place small markers along newly painted lines to control traffic and prevent damage to newly painted surfaces. Mark painting equipment with large warning signs indicating slow-moving painting equipment in operation.
- C. Promptly repair all thin or damaged areas to conform with these Specifications.

END OF SECTION 321723

SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Provide lime, fertilizer and permanent seed mixture in the areas shown on the plans for:
 - 1. Restoration of existing grass areas disturbed by Contractor's operations.
 - 2. Stabilization of unpaved areas.
- B. Furnish, place, and anchor mulch over seeded areas, on slopes, and on others areas as indicated on the Plans.
- C. Provide watering for grass prior to seeding and during lawn establishment.

1.02 STANDARDS:

- A. The quality and performance of work specified in this section shall be in accordance with the Delaware Department of Transportation Standard Specifications for Road and Bridge Construction, dated August 2001 (hereinafter referred to as the "Standard Specifications").
 - 1. Section 733 - Topsoiling.
 - 2. Section 734 - Seeding.
 - 3. Section 735 - Mulching.
 - 4. Section 803 - Water.

1.03 SUBMITTALS:

- A. Certificates:
 - 1. Seed producer's certified analysis of composition, purity, and germination of seed mixture, dated within nine (9) months of sowing.
 - 2. Manufacturer's certified chemical and physical composition analysis for ground limestone.
 - 3. Provide certificates, signed by the material supplier or producer, stating that mulch and binder material when specified, complies with specification requirements.
- B. Delivery Slips:
 - 1. Accompany each delivery of seed, ground limestone, and fertilizer with delivery slip showing the product weight.
- C. Test Reports:
 - 1. Submit results of test report for pH analysis of soil, and when ground limestone is required, the total amount of magnesium and calcium oxides required.
- D. Manufacturer's Literature and Recommendations:
 - 1. Submit manufacturer's descriptive and printed application instructions for synthetic emulsion, fiber mulch and liquid binders.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver all materials in accordance with supplier's printed instructions, and in such manner as to protect from moisture.
- B. Store and handle material in accordance with supplier's printed instructions, and in such manner as to protect from moisture.
- C. Deliver all erosion control binder materials in manufacturer's original packaging with all tags and labels intact and legible.

1.05 JOB CONDITIONS:

- A. Existing Conditions: Perform seeding only after preceding work affecting ground surface is completed.

SECTION 329200 - TURF AND GRASSES: continued

- B. Environmental Requirements:
 - 1. Plant seed on unfrozen soil. Soil shall be in friable condition at time of seeding.
 - 2. Do not perform seeding when wind exceeds 15 mph.
 - 3. Do not seed between October 15th and March 1st.
- C. Protection: Restrict pedestrian and vehicular traffic from seeded and mulched areas after planting to the end of the establishment period.

PART 2 - PRODUCTS

2.01 SEED MIXTURE:

- A. Use temporary and permanent seed mixtures as shown on the Plans. If seed mixtures are not shown on the Plans, the seed mixture shall be as specified in Delaware Department of Transportation Standard Specification Section 734.03(e): Permanent Seeding - Suburban Developments.
- B. Use clean, dry, new crop seed. Use certified seed when available.

2.02 TOPSOIL:

- A. Topsoil shall conform to Section 733 of the Standard Specifications and SECTION 312000 of these Specifications.

2.03 GROUND LIMESTONE:

- A. Limestone shall be ground agricultural limestone conforming to Section 734.02 of the Standard Specifications.

2.04 FERTILIZER:

- A. Fertilizer shall conform to Section 734.02 of the Standard Specifications for Suburban Development.

2.05 MULCH:

- A. Mulch shall conform to Section 735 of the Standard Specifications.

2.06 LIQUID MULCH BINDER MATERIALS:

- A. Asphalt and emulsified asphalt binders will not be permitted.
- B. Chemical binders shall conform to Section 735 of the Standard Specifications.

2.07 EROSION CONTROL MATTING:

- A. Erosion control matting shall be furnished and installed per SECTION 312500 of these Specifications.

2.08 WATER:

- A. Water shall be potable and free from oil, acid, injurious alkali, or toxic materials.

PART 3 - EXECUTION

3.01 PREPARATION:

- A. Check that clearing, soil preparation and preceding work affecting ground surface is completed.
- B. Verify that soil is unfrozen and within allowable moisture content.
- C. Do not start until conditions are satisfactory.

SECTION 329200 - TURF AND GRASSES: continued

- D. When soil to be seeded has a pH value of less than 5.8, evenly spread ground limestone, which is dry and free flowing, over area to be seeded at rate that will change soil pH value to 6.5. Thoroughly mix limestone into upper 3 to 4 inches of soil by discing, harrowing, or other approved method.
- E. Within limits set forth under materials, select fertilizer for use on the project. Use one selection throughout project. Apply fertilizer in quantity necessary to yield 60 pounds of nitrogen per acre. Thoroughly mix fertilizer into upper 3 to 4 inches of soil by discing, harrowing, or other approved method.
- F. Water dry soil at least 24 hours prior to seeding to obtain a loose friable seed bed.
- G. Before applying seed, remove all stones, rocks, lumps, roots, wires, clods, and other objects measuring 1/2 inch or larger in any dimension.

3.02 APPLICATION:

- A. Broadcast half of seed with mechanical seeder.
- B. Broadcast remaining half of seed at right angles to first seeding pattern, using same broadcast method.
- C. Apply seed at the rate specified in the Standard Specifications.
- D. Cover seed to depth of 1/8 inch by raking or other approved method.
- E. Roll seeded area with roller weighing maximum of 150 pounds per foot of width.
- F. Water seeded area until water penetrates to a depth of 3 to 4 inches.

3.03 PROTECTION:

- A. Erect temporary signs and barriers to protect seeded areas from pedestrian and vehicular traffic.

3.04 MULCH INSTALLATION:

- A. General:
 - 1. Apply straw or cellulose mulch to seeded areas within 7 days of seed application.
 - 2. Secure straw mulch immediately after placing. Use chemical binder or mulch netting or secure by crimping or tilling.
 - 3. Install erosion control matting immediately after seed application, where designated on the plans.
 - 4. Leave all mulch in place and allow to disintegrate, except remove excessive amounts of straw mulch as directed.
- B. Straw Mulch:
 - 1. Quantity of straw mulch shall conform with Section 735 of the Standard Specifications.
- C. Binder Straw Mulch:
 - 1. Evenly distribute binder over mulch.
 - 2. Quantity of mulch binder shall conform with Section 735 of the Standard Specifications and the Delaware Erosion and Sediment Control Handbook.
- D. Mulch Anchoring:
 - 1. Mulch crimping or tilling shall be accomplished in accordance with the standards established in Section 735 of the Standard Specifications.
 - 2. Mulch netting shall be lightweight biodegradable paper, plastic, or cotton, and shall be securely stapled in accordance with the manufacturer's written instructions.
- E. Erosion control matting shall be installed in accordance with the manufacturer's written instructions and per SECTION 312500 of these Specifications.
- F. The quantity of wood cellulose mulch shall be in accordance to Section 735 of the Standard Specifications.

SECTION 329200 - TURF AND GRASSES: continued

3.05 LAWN ESTABLISHMENT:

- A. Watering:
 - 1. Keep soil moist during seed germination period.
 - 2. Method of watering shall provide equal distribution and coverage to all areas seeded.
 - 3. Continue watering during establishment period to promote healthy grass stand.
- B. Re-lime, re-fertilize and reseed, all seeded areas which become eroded or otherwise disturbed; or which require mowing of weedy areas in order to establish acceptable turf.
- C. Re-lime, re-fertilize and reseed, spots larger than one square foot not having uniform stand of grass practically weed free, and not containing plants in reasonable proportion to the various kinds of seed in the grass seed mixture.
- D. Perform all lawn establishment work in accordance with the specifications without additional compensation.
- E. Establishment period to extend three months after acceptance of the project.

3.06 MULCH MAINTENANCE:

- A. Re-mulch all areas requiring reseeded. Re-lime, re-fertilize, reseed and re-mulch all areas where straw mulch is displaced.
- B. In areas where an erosion control matting becomes loose, torn, undermined, or displaced, or where staples have become loosened or raised; make repairs as required. This shall include re-liming, re-fertilizing and reseeded.
- C. Perform all mulch maintenance work in accordance with the specifications without additional compensation.
- D. Mulch maintenance period to extend until acceptance of project.

3.07 CLEANING:

- A. Immediately clean spills on paved and finished surface areas.
- B. Remove debris and excess materials from project site.
- C. Dispose of protective barricades and warning signs at termination of lawn establishment period.

3.08 FIELD QUALITY CONTROL:

- A. Seed Mixture:
 - 1. Contractor shall pay for testing and related costs when materials are found not to be in compliance with this specification.
 - 2. Sampling and testing shall be conducted in accordance with Delaware Code and with the rules and regulations for testing seed adopted by the Association of Official Seed Analysis.

END OF SECTION 329200

DIVISION 33 - UTILITIES

SECTION 331100 - WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Furnish and install ductile iron water pipe, fittings, and appurtenances as shown on the Plans and described herein.
- B. Furnish and install PVC water pipe, fittings, and appurtenances as shown on the Plans and described herein.
- C. All water mains, fittings, taps, valves, and fire hydrants shall be supplied, installed, disinfected, and tested in accordance with the requirements of the Sussex Shores Water Company, and the Delaware Department of Health.
- D. Furnish and install copper water tubing for service connections under three-inches in diameter.
- E. Coordinate with the Sussex Shores Water Company for service connections and to determine the scope of services to be performed by the Sussex Shores Water Company.
- F. Related work specified elsewhere includes:
 - 1. SECTION 312000 - EARTH MOVING.

1.02 STANDARDS:

- A. Sussex Shores Water Company Standards and Specifications.
- B. American Water Works Association:
 - 1. AWWA C900.
 - 2. AWWA C151.
 - 3. AWWA C104.
 - 4. AWWA C110.
 - 5. AWWA C111.

1.03 SUBMITTALS:

- A. All pipe and fittings shall be inspected and tested at place of manufacture as required by the AWWA standards referenced in the Specification. Provide the Engineer with two copies of certifications from each manufacturer stating the product was inspected as required, and that the test results comply with AWWA standards.
- B. Submit manufacturers' product data for pipe, fittings, and gaskets.
- C. All manufacturers shall validate other than by certification, the ductility of each length of pipe by an Underwriters Laboratory approved method. All PVC pipe is to have Underwriters Laboratory approval.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Polyvinyl Chloride Pipe:
 - 1. Water mains shall conform to AWWA C900, Class 150.
 - 2. PVC services shall conform to ASTM 2241 for SDR 21, unless otherwise approved by the Water Company or Engineer.
- B. Joints for PVC Pipe: Integral-bell push-on joints except where mechanical joints are necessary to change pipe material.

SECTION 331100 - WATER UTILITY DISTRIBUTION PIPING: continued

- C. Pipe Fittings:
 - 1. Shall be ductile iron fittings conforming to AWWA C110, with minimum pressure rating of 250 psi.
 - 2. Fittings shall be cement-lined, 1/8-inch thick, in accordance with AWWA C104 and seal-coated inside.
 - 3. Fittings shall have mechanical joints.
- D. All water valves, valve boxes, and fire hydrants shall meet the requirements of City of Wilmington Department of Public Works and SECTION 311200 of these Specifications.
- E. Ductile Iron Pipe:
 - 1. Shall conform to AWWA C-151, Class 350, and shall be manufactured in eighteen or twenty foot nominal lengths.
 - 2. All ductile iron pipe for water mains shall be cement-lined, 1/8-inch thick, in accordance with AWWA C104 and seal coated inside.
 - 3. Use Push-on joints, conforming to AWWA C151 and AWWA C111, except where mechanical joints are indicated on the Plans.
- F. Seamless copper tubing shall be type "K" in conformance with ASTM B88 and ANSI/NSF 61. Valves and fittings shall be in conformance with AWWA C800.
- G. High density polyethylene tubing shall be copper tube size in accordance with ASTM D2737 and AWWA C901 for a working pressure of 200 psi.

PART 3 - EXECUTION

3.01 INSPECTION AND QUALITY OF PIPE:

- A. Before being lowered into the trench, each pipe shall be carefully inspected, and those not meeting the specifications shall be rejected and either destroyed or removed from the work within 10 hours. No pipe shall be laid except in the presence of the Owner's designated representative. The Owner's designated representative may order the removal and relaying of any pipe not so laid.
- B. The Contractor shall carefully examine all pipe and special castings before placing the same in the trench. Any pieces which are broken or show evidence of cracks or fractures shall be rejected by the Contractor. Such inspection shall carry with it the responsibility on the part of the Contractor for the removal at the Contractor's own expense of all pipe, special castings, and appurtenances, incorporated in the work, and which under test are found to be cracked or otherwise defective.

3.02 INSTALLATION:

- A. Excavation and backfill for pipes shall conform to Specification SECTION 312000 - EARTH MOVING and shall be as shown on the Plans.
- B. All piping shall be installed in a neat and workmanlike manner. All piping shall be installed to accurate lines and grades and shall be supported as shown, specified, or necessary. Where temporary supports are used, they shall be sufficiently rigid to prevent shifting or distortion of the pipe. Suitable provision shall be made for expansion where necessary.
- C. No defective pipe or fitting shall be laid or placed in the piping, and any piece discovered to be defective after having been laid shall be removed and replaced by a sound and satisfactory piece by the Contractor at the Contractor's own expense.
- D. Every pipe and fitting shall be cleared of all dirt and other debris before being installed and shall be kept clean until accepted in the completed work.
- E. No pipes shall be laid in fill or other unsuitable material, in a wet trench, or in same trench with another pipe or other utility unless so noted on the drawings. A minimum 18-inch

SECTION 331100 - WATER UTILITY DISTRIBUTION PIPING: continued

clearance shall be maintained between the outside surface of pipe and outside surface of other existing pipes and structures. When this clearance cannot be maintained, contact the Engineer for instructions prior to proceeding with the pipe installation.

- F. No direct contact between pipes and structures at crossings will be permitted. Pipes in place shall not be worked over or walked on until covered by backfill well tamped in place to a depth of 12 inches over the pipe.
- G. Minimum cover over water mains shall be as shown on the Plans.
- H. The interior of all pipes shall be thoroughly cleaned of all foreign material before being lowered into trench. Pipes shall be kept clean during laying operations by means of plugs or other approved methods.
- I. Gas, storm sewer, and sanitary sewer lines shall have right-of-way and water mains shall be installed to avoid the same.
- J. If conflicts occur between proposed water lines and other utilities, the water lines shall be dropped below the conflicting utility to attain the proper clearance.
- K. Brace all plugs and fittings as required to prevent leakage or blowout during testing.
- L. All newly placed pipes shall be pressure tested, disinfected, and cleaned in accordance with City of Wilmington Department of Public Works, the Delaware Department of Health, and NFPA Standards and Specifications.

3.03 PIPING SUPPORTS:

- A. The Contractor shall furnish and install all supports necessary to hold the piping and appurtenances in a firm, substantial manner at the lines and grades indicated on the drawings or specified. Bends, tees, and other fittings buried in the ground shall be backed up with concrete placed against undisturbed earth where firm support can be obtained. If the soil does not provide firm support, then suitable bridle rods, clamps, and accessories to brace the fitting properly shall be provided. Such bridle rods, etc., shall be coated thoroughly with an approved bituminous paint after assembly, or, if necessary, before assembly. This work shall include bracing plugs to prevent leakage or blowout during testing.

3.04 HANDLING AND CUTTING PIPE:

- A. Handle and lay pipe and fittings to avoid damage to the pipe, scratching or marring machined surfaces, and abrasion of the coating or lining. Pipe cuts shall be made using an abrasive wheel, rotary wheel cutter, guillotine pipe saw, milling wheel saw, or other method approved by the Engineer. Grind cut ends and rough edges smooth. For push-on connections, bevel cut all ends.

3.05 ASSEMBLING PIPE:

- A. Clean ring groove and bell socket prior to inserting rubber gasket seal. Properly seat gasket; make sure it faces proper direction.
- B. Clean bell and spigot ends of pipe. Lubricate spigot end of pipe and rubber gasket.
- C. Hold pipe securely and in proper alignment when joining.
- D. Join pipe so that reference mark on spigot end, if provided by manufacturer, is flush with end of bell.
- E. Join pipe in strict accordance with manufacturer's printed installation procedures.
- F. General Procedure for Joining PVC Pipe:
 - 1. Join pipe up to twenty-four inches in diameter when installed on non-granular and firm bedding, by means of a bar and wood block or use mechanical pipe pullers.
 - 2. Do not use excavating equipment to force pipe sections together.
 - 3. Hold pipe securely and in proper alignment when joining.

SECTION 331100 - WATER UTILITY DISTRIBUTION PIPING: continued

4. Do not disturb previously made joints. Check completed piping to assure joints are intact. Insure backfilling is accomplished without disturbing pipe.
5. Do not allow earth, stones, or other debris to enter pipe or end section.

3.06 PROTECTION:

- A. Protect all finished work. Joints once made and disturbed shall be subjected to immediate rejection. It shall therefore be the duty of the Contractor to avoid the slightest movement in completed work, while in the act of laying the pipe, in backfilling, or in the passage of workmen up and down the trench. At all times during which pipe is not being laid, the end of the pipe shall be sealed with a tight fitting plug. In no case will the drainage of trench water through a completed pipe be permitted.
- B. All curves, bends, tees, hydrants and ends of pipe shall be securely blocked with socket clamps or yokes to prevent movement. At the end of a line or turn, where provision has been made for future extension or connections, fittings shall be furnished with lugs and anchored by means of socket clamps or yokes.

3.07 ADAPTORS:

- A. When it is necessary to join pipes of different types the Contractor shall furnish and install the necessary adaptors. Adaptors shall have ends conforming to the above Specifications for the appropriate type of joint to receive the adjoining pipe. When adaptors join two classes of pipe, the adaptors may be the lighter class.

3.08 CLEANING AND TESTING:

- A. All waterlines shall be fully cleaned, disinfected, and tested in accordance with City of Wilmington Department of Public Works and the Delaware Department of Health standards and requirements, or the NFPA standards in the case of fire system lines, before being accepted by the Owner.

END OF SECTION 331100

SECTION 331200 - WATER UTILITY DISTRIBUTION EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Provide valves and fire hydrants for water lines as shown on the Plans or as directed by the Engineer.
- B. Comply with the requirements of the Sussex Shores Water Company.

1.02 SUBMITTALS:

- A. Submit a complete list of all materials and equipment proposed to be furnished and installed under this portion of the work giving manufacturer's name, catalog number, and catalog cut sheet for each item.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. General: All work under this item shall be in accordance with the latest standards of the AWWA and in accordance with Sussex Shores Water Company specifications.
- B. Gate valves: Gate valves shall be installed where shown on the Plans and shall be resilient seat type, open right, mechanical joint, with accessories per AWWA C-500. Valves shall be Ken-Seal Resilient Wedge Valves, as manufactured by Kennedy Valve Co., or approved equal.
- C. Each buried valve shall be provided with a cast iron two-piece, slide type valve box. Valve boxes shall be 5-1/4-inch shaft with a round base, and be as manufactured by Bingham & Taylor, Tyler Company, or approved equal.
- D. Corporation Stop: "Mueller" 3/4 to 2-inch corporation stop with quarter bend coupling, or approved equal.
- E. Curb Stop: "Mueller" 3/4 to 2-inch curb stop with check, or approved equal. Contractor to supply valve box to comply with accepted curb stop in accordance with Sussex Shores Water Company specifications.
- F. Fire Hydrants shall conform to AWWA C502, and be "Guardian" as manufactured by Kennedy Valve Company, "Super Centurion" as manufactured by Mueller Company, or approved equal acceptable to the City of Wilmington.
- G. Tapping sleeves and valves shall meet the requirements of the Sussex Shores Water Company, and shall be as manufactured by Mueller Company, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Prior to installation, inspect valves for direction of opening, freedom of operation, tightness of pressure-containing bolting, cleanliness of valve ports and especially seating surfaces, handling damage and cracks. Do not install dirty or defective valves.
- B. Valves shall be set and joined to the pipe in the manner specified in SECTION 331100 of these Specifications.
- C. No valve shall be set under roads, pavements or walks, except where so noted. All valves shall be provided with cast iron extension boxes and covers at grade marked "WATER". Two (2) "T" handle socket wrenches of 5/8-inch round stock and long enough to extend two feet (2') above top of deepest valve box shall be provided for each size of valve furnished. The valve box shall not transmit shock or stress to the valve, with the valve box cover flush with the surface of the finished area.

SECTION 331200 - WATER UTILITY DISTRIBUTION EQUIPMENT: continued

- D. All valves, hydrants, tapping sleeves, and appurtenances shall be installed, tested, and disinfected in accordance with the requirements of the Sussex Shores Water Company, the Delaware Department of Health, and the NFPA standards and specifications.

END OF SECTION 331200

SECTION 333100 - SANITARY UTILITY SEWERAGE PIPING

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Furnish and install polyvinyl chloride (PVC) gravity sewer pipe and appurtenances as shown on the Plans and described herein.
- B. Furnish and install ductile iron gravity sewer pipe and appurtenance as shown on the Plans and described herein.
- C. Coordinate with the Sussex County to determine the scope of services and required inspections formed by Sussex County.

1.02 STANDARDS:

- A. American Society for Testing and Materials (ASTM).
 - 1. ASTM D2241 - Polyvinyl Chloride (PVC) Pressure-Rated Pipe.
 - 2. ASTM D3212 - Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
 - 3. ASTM 1785 - Schedule 40 Polyvinyl Chloride (PVC) pipe.
- B. Sussex County.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Storage and Materials:
 - 1. Store materials to prevent physical damage.
 - 2. Store pipe and fittings off of the ground to prevent dirt and debris from entering.
 - 3. Store flexible gasket materials and joint primer or adhesive compounds in cool dry place. Keep rubber gaskets clean, away from oil, grease, excessive heat, and out of direct sunlight.
- B. Handling of Materials:
 - 1. Protect materials during transportation and installation to avoid physical damage.
 - 2. Do not install out-of-round pipe.
 - 3. Unload pipe to prevent abrasion.
 - 4. Do not drag or push pipe while handling or distributing on project site.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. PVC Pipe and Fittings:
 - 1. ASTM D3034; SDR 26.
 - 2. ASTM 1785, Schedule 40.
 - 3. Joint material: Elastomeric ring rubber gasket, ASTM D3212.
 - 4. Joint material Primer/Adhesive: As provided or specified by pipe manufacturer.
- B. Ductile Iron Pipe and Fittings:
 - 1. Shall conform to AWWA C-151, and shall be manufactured in 18 or 20-foot nominal lengths.
 - 2. Use push-on joints, conforming to AWWA C-151 and AWWA C-111, except where mechanical joints are indicated on the plans.

SECTION 333100 - SANITARY UTILITY SEWERAGE PIPING: continued

PART 3 - EXECUTION

3.01 MATERIAL INSPECTION:

- A. The following information shall be clearly marked on each pipe section of PVC pipe:
 - 1. Pipe type and SDR number.
 - 2. Nominal pipe size.
 - 3. The PVC cell classification.
 - 4. Name or trademark of manufacturer.
 - 5. The ASTM Specification designation.
- B. PVC Fittings shall have the following markings:
 - 1. The ASTM Specification designation.
 - 2. Manufacturer's name or trademark.
 - 3. Nominal size.
 - 4. The material designation.
- C. Inspect pipe for defects prior to placement in trench. The pipe and fittings shall be free from visible cracks, holes, foreign inclusions or other injurious defects.
- D. Assure that all materials are of the type specified and are not defective. Unmarked pipe or pipe and materials not meeting Specifications requirements shall be removed from the site as directed by the Engineer.

3.02 INSTALLATION:

- A. Fine grade trench bottom so that pipe is supported for its full length.
- B. Install piping beginning at the low point of the system, true to grades and alignment indicated on the Plans. Place the bell ends of the pipe facing upstream.
- C. Do not lay pipe on unsuitable material, in wet trench, or in same trench with another pipe or utility.
- D. General Procedure for Joining Pipe:
 - 1. Do not use excavating equipment to force pipe sections together.
 - 2. Hold pipe securely and in proper alignment when joining.
 - 3. Do not disturb previously made joints. Check completed piping to assure joints are intact. Insure placement of backfill over pipe is accomplished without disturbing pipe position.
 - 4. Do not allow earth, stones, or other debris to enter pipe or fittings.
 - 5. Method of installing joint materials and joining piping shall be in strict accordance with manufacturer's printed instructions.

3.03 BACKFILL AND COMPACTION:

- A. Bedding and Initial Backfill:
 - 1. Bedding and initial backfill shall be as shown on the Plans, or be in accordance with the manufacturer's written instruction, or in absence of said instructions, in accordance with the details on the Plan, or with SECTION 312000 of the Specifications.
 - 2. Install initial backfill material as shown on the Plan details for the type of pipe being used.
 - 3. When required, material shall be placed under the pipe haunch to provide adequate side support. Material shall be installed for entire trench width and shall be tamped and rodded to insure full contact with pipe at haunch up to the spring line.
 - 4. Little or no tamping of the initial backfill directly over the pipe shall be done.
- B. Final Backfill:
 - 1. Final backfill shall be in accordance with SECTION 312000 of these Specifications.

SECTION 333100 - SANITARY UTILITY SEWERAGE PIPING: continued

3.04 TESTING:

A. Deflection Testing - PVC Sanitary Sewer Pipe:

1. Pipe deflection testing shall be in accordance with the requirements of the Sussex County.
2. For pipe conforming to the requirements of ASTM D3034, the maximum allowable pipe deflection (reduction in vertical inside diameter) shall be 72%.
3. For pipe conforming to the requirements of ASTM D2241, the maximum allowable pipe deflection (reduction in vertical inside diameter) shall be 5%.
4. Deflection tests shall be successfully performed on the complete installation by means of one of the following methods prior to the acceptance of construction.
 - a. "Go-No-Go" mandrel properly sized.
 - b. Calibrated television.

B. Lamping:

1. Lamping shall be in accordance with the requirements of the Sussex County.
2. Sewer lines shall meet the following standards to pass the lamping inspection.
 - a. Barrel of pipe shall have no vertical deflection (not to be confused with the deflection test), and at least 75% of barrel shall be visible in the horizontal direction.
 - b. Pipe not meeting this Specification shall be re-laid and re-lamped until compliance is achieved at no additional cost to the Owner.

C. Low Pressure Air Test:

1. All gravity sanitary sewer lines shall be air tested in accordance with the requirements of the Sussex County.
2. The drop in pressure during the prescribed test time shall not exceed 0.5 psi, from 3.5 to 3.0 psi testing pressure. A drop in pressure below 3.0 psi shall indicate a failure in the test.

END OF SECTION 333100

SECTION 333900 - SANITARY UTILITY SEWERAGE STRUCTURES

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Furnish and sanitary manholes, connect existing pipes to manholes, and connect proposed pipes to existing manholes where shown on the Plans or as directed by the Engineer.
- B. Adjust manhole tops as shown on the Plans.

1.02 STANDARDS:

- A. Sussex County.
- B. The quality and performance of work specified in this Section shall be in accordance with the Delaware Department of Transportation Standard Specifications for Road and Bridge Construction, dated August 2001 (hereinafter referred to as the "Standard Specifications"):
 - 1. Section 708 - Drainage Inlets and Manholes.
 - 2. Section 710 - Adjusting and Repairing Drainage Inlets and Manholes.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Storage and Materials:
 - 1. Store materials to prevent physical damage.
 - 2. Store pipe and fittings off of the ground to prevent dirt and debris from entering.
 - 3. Store flexible gasket materials and joint primer or adhesive compounds in cool dry place. Keep rubber gaskets clean, away from oil, grease, excessive heat, and out of direct sunlight.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. All manholes shall be precast or cast-in-place Portland cement concrete (p.c.c.) and shall conform to Section 708 of the Standard Specifications, and the Sussex County Specifications. Precast manholes shall conform with ASTM C478, except where noted on the Plan. All concrete shall be 4,000 psi.
- B. Integrally-cast rubber gaskets shall be used where pipes join manholes. Gaskets shall be as manufactured by A-Lok, or approved equal, and shall be acceptable to the Sussex County.
- C. The flow channel in the manhole shall be brick on edge or precast concrete.
- D. Manhole steps shall be as required by the Sussex County.

PART 3 - EXECUTION

3.01 MATERIAL INSPECTION:

- A. Inspect manholes for defects prior to placement. Precast manholes shall be free from visible cracks, holes, foreign inclusions or other injurious defects.
- B. Assure that all materials are of the type specified and meet the dimensions shown on the Plans.

3.02 INSTALLATION:

- A. Manholes shall be installed in accordance with Section 708 of the Standard Specifications and the Sussex County Specifications.
- B. Installation of rubber gaskets for precast manholes shall be in accordance with the manufacturer's recommendations.

SECTION 333900 - SANITARY UTILITY SEWERAGE STRUCTURES: continued

- C. Frames shall be well bedded in mortar, making a watertight joint. Cover and frame shall have a shop coat of asphaltic pitch and shall have a field coat of similar paint after the frame is set in final position.

END OF SECTION 333900

SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Furnish and install polyvinyl chloride (PVC) storm pipe and appurtenances as shown on the Plans and described herein.
- B. Furnish and install high density polyethylene (PE) gravity storm sewer pipe and appurtenances as shown on the Plans and described herein.
- C. Furnish and install reinforced concrete storm sewer pipe and appurtenances as shown on the Plans and described herein.
- D. Furnish and install ductile iron storm sewer pipe and appurtenance as shown on the Plans and described herein.

1.02 STANDARDS:

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM D-3034 - Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.
 - 2. ASTM D-3212 - Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
 - 3. ASTM 1785 - Schedule 40 Polyvinyl Chloride (PVC) pipe.
 - 4. ASTM C-76 - Reinforced Concrete Culvert Storm Drain and Sewer Pipe.
 - 5. ASTM C-270 - Mortar for Unit Masonry.
 - 6. ASTM C-443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
- B. The quality and performance of work specified in this Section shall be in accordance with the Delaware Department of Transportation Standard Specifications for Road and Bridge Construction, dated August 2001 (hereinafter referred to as the "Standard Specifications"):
 - 1. Section 612 - Reinforced Concrete Pipe.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Storage and Materials:
 - 1. Store materials to prevent physical damage.
 - 2. Store pipe and fittings off of the ground to prevent dirt and debris from entering.
 - 3. Store flexible gasket materials and joint primer or adhesive compounds in cool dry place. Keep rubber gaskets clean, away from oil, grease, excessive heat, and out of direct sunlight.
- B. Handling of Materials:
 - 1. Protect materials during transportation and installation to avoid physical damage.
 - 2. Do not install out-of-round pipe.
 - 3. Unload pipe to prevent abrasion.
 - 4. Do not drag or push pipe while handling or distributing on project site.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. PVC Pipe and Fittings:
 - 1. ASTM D3034 - SDR 35.
 - 2. ASTM D2241 - Polyvinyl Chloride (PVC) Pressure-Rated Pipe.
 - 3. ASTM 1785, Schedule 40.
 - 4. Joint material - Elastomeric ring rubber gasket, ASTM D3212.
 - 5. Joint material Primer/Adhesive - As provided or specified by pipe manufacturer.

SECTION 334100 - STORM UTILITY DRAINAGE PIPING: continued

- B. High Density Polyethylene Pipe and Fittings:
 - 1. All polyethylene pipe shall have a corrugated outer wall and an integrally formed smooth interior, and shall meet AASHTO M294 and DelDOT Specifications for Type "S" high density polyethylene pipe.
 - 2. Pipes, couplings, and fittings shall be meet the requirements of AASHTO M294, modified as follows: Minimum pipe stiffness shall be 35 psi at 5% deflection and 30 psi at 10% deflection, when tested in accordance with ASTM D2412.
 - 3. Pipe shall have an integral built-in bell and factory-installed gasket. Joints for all polyethylene pipe greater than 12 inches in diameter shall be watertight in accordance with ASTM 1417.
- C. Reinforced Concrete Pipe:
 - 1. Reinforced Concrete Pipe shall conform to the requirements of Section 612 of the Standard Specifications. All Reinforced Concrete Pipe shall conform to ASTM C76, Class III or IV.
 - 2. Joint design for round reinforced concrete pipe and fittings shall conform to AASHTO C443. Conic surface of spigot or tongue shall be designed to properly contain and seat the gasket, or gasket shall be designed so that it is properly contained and seated on conic surface of spigot or tongue.
 - 3. Joint Material shall be flexible rubber gaskets, meeting the criteria of ASTM C443. Joint material primer or adhesive shall be as provided or specified by pipe manufacturer.
- D. Ductile Iron Pipe and Fittings:
 - 1. Shall conform to AWWA C-151, and shall be manufactured in 18 or 20-foot nominal lengths.
 - 2. Use push-on joints, conforming to AWWA C-151 and AWWA C-111, except where mechanical joints are indicated on the plans.

PART 3 - EXECUTION

3.01 MATERIAL INSPECTION:

- A. The following information shall be clearly marked on each pipe section of PVC pipe:
 - 1. Pipe type and SDR number.
 - 2. Nominal pipe size.
 - 3. The PVC cell classification.
 - 4. Name or trademark of manufacturer.
 - 5. The ASTM Specification designation.
- B. PVC Fittings shall have the following markings:
 - 1. The ASTM Specification designation.
 - 2. Manufacturer's name or trademark.
 - 3. Nominal size.
 - 4. The material designation.
- C. Polyethylene pipe shall be marked with the pipe class, date of manufacture, and the name or trademark of the manufacturer.
- D. The following information shall be clearly marked on each section of reinforced concrete pipe:
 - 1. Specification designation (ASTM).
 - 2. Pipe class or strength designation.
 - 3. Date of manufacture.
 - 4. Name or trademark of manufacturer.
 - 5. For reinforced pipe with elliptical or quadrant reinforcement the letter E or Q, respectively.

SECTION 334100 - STORM UTILITY DRAINAGE PIPING: continued

- E. Inspect pipe for defects prior to placement in trench. The pipe and fittings shall be free from visible cracks, holes, foreign inclusions or other injurious defects.
- F. Assure that all materials are of the type specified and are not defective. Unmarked pipe or pipe and materials not meeting Specifications requirements shall be removed from the site as directed by the Engineer.

3.02 INSTALLATION:

- A. Concrete pipe shall be installed in accordance with Section 612 of the Standard Specifications.
- B. Fine grade trench bottom so that pipe is supported for its full length.
- C. Install piping beginning at the low point of the system, true to grades and alignment indicated on the Plans. Place the bell ends of the pipe facing upstream.
- D. Do not lay pipe on unsuitable material, in wet trench, or in same trench with another pipe or utility.
- E. General Procedure for Joining Pipe:
 - 1. Do not use excavating equipment to force pipe sections together.
 - 2. Hold pipe securely and in proper alignment when joining.
 - 3. Do not disturb previously made joints. Check completed piping to assure joints are intact. Insure placement of backfill over pipe is accomplished without disturbing pipe position.
 - 4. Do not allow earth, stones, or other debris to enter pipe or fittings.
 - 5. Method of installing joint materials and joining piping shall be in strict accordance with manufacturer's printed instructions.
- F. Polyethylene pipe shall be installed in accordance with the manufacturer's written instructions or as directed by the Engineer. Joints for all polyethylene pipe greater than 12 inches in diameter shall be watertight in accordance with ASTM 1417.

3.03 BACKFILL AND COMPACTION:

- A. Bedding and Initial Backfill:
 - 1. Bedding and initial backfill shall be as shown on the Plans or in accordance with the manufacturer's written instruction, or in absence of said instructions, in accordance with SECTION 312000 of these Specifications.
 - 2. Install initial backfill material as shown on the Plan details for the type of pipe being used.
 - 3. When required, material shall be placed under the pipe haunch to provide adequate side support. Material shall be installed for entire trench width and shall be tamped and rodded to insure full contact with pipe at haunch up to the spring line.
 - 4. Little or no tamping of the initial backfill directly over the pipe shall be done.
- B. Final Backfill:
 - 1. Final backfill shall be in accordance with SECTION 312000 of these Specifications.

END OF SECTION 334100

SECTION 334900 - STORM DRAINAGE STRUCTURES

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Furnish and install catch basins and manholes, and connect existing pipes to manholes or catch basins, and connect proposed pipes to existing manholes or catch basins where shown on the Plans or as directed by the Engineer.
- B. Adjust manhole and catch basin tops as shown on the Plans.

1.02 STANDARDS:

- A. The quality and performance of work specified in this Section shall be in accordance with the Delaware Department of Transportation Standard Specifications for Road and Bridge Construction, dated August 2001 (hereinafter referred to as the "Standard Specifications"):
 - 1. Section 612 - Reinforced Concrete Pipe.
 - 2. Section 708 - Drainage Inlets and Manholes.
 - 3. Section 710 - Adjusting and Repairing Drainage Inlets and Manholes.
 - 4. Section 812 - Portland Cement Concrete.

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Storage and Materials:
 - 1. Store materials to prevent physical damage.
 - 2. Store pipe and fittings off of the ground to prevent dirt and debris from entering.
 - 3. Store flexible gasket materials and joint primer or adhesive compounds in cool dry place. Keep rubber gaskets clean, away from oil, grease, excessive heat, and out of direct sunlight.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. All catch basins and manholes shall be precast or cast-in-place Portland cement concrete (p.c.c.) and shall conform to Section 708 of the Standard Specifications. Precast manholes shall conform with ASTM C478, except where noted on the Plan.

PART 3 - EXECUTION

3.01 MATERIAL INSPECTION:

- A. Inspect catch basins and manholes for defects prior to placement. Precast catch basins and manholes shall be free from visible cracks, holes, foreign inclusions or other injurious defects.
- B. Assure that all materials are of the type specified and meet the dimensions shown on the Plans.

3.02 CATCH BASINS AND MANHOLES:

- A. Catch basins and manholes shall be installed in accordance with Section 708 of the Standard Specifications.
- B. Installation of rubber gaskets for precast catch basins and manholes shall be in accordance with the manufacturer's recommendations.
- C. Frames shall be well bedded in mortar, making a watertight joint. Cover and frame shall have a shop coat of asphaltic pitch and shall have a field coat of similar paint after the frame is set in final position.

END OF SECTION 334900